THE SHEEP AND CATTLE INDUSTRIES OF THE FALKLAND ISLANDS

A REPORT

BY

T H DAVIES I A DICKSON C T McCREA

H MEAD AND W W WILLIAMS

Foreign and Commonwealth Office
OVERSEAS DEVELOPMENT ADMINISTRATION
Eland House
Stag Place
LONDON SW1

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CONTENTS

His Excellency the Governor
Port Stanley
FALKLAND ISLANDS

Your Excellency

We were appointed by the Ministry of Overseas Development in June 1969 as a study team to visit the Falkland Islands. Our terms of reference were as follows:-

"The team will be required to study all aspects of sheep and cattle health and production in the Falkland Islands and

a. make recommendations on how the Falkland Islands farmers can best improve the productivity of the sheep industry;

b. advise on future production of beef cattle.

In doing so they should liaise closely with the Development Committee of the Falkland Islands Legislative Council. The survey will include studies and recommendations on the following matters in particular:-

a. Nutritional deficiency problems

b. Helminthiasis

c. Extent and cause of loss by disease and remedial measures that could be taken

d. Grassland improvement

e. Sheep husbandry

f. Cattle husbandry

g. Farm management."

The period of study covered the whole of the season 1969/70.

We have the honour of presenting our report and trust it will be of value not only to you and your Government but also to the owners and managers of farms in the Colony.

T H Davies
I A Dickson
C T McCrea
H Mead
W W Williams

ACKNOWLEDGEMENTS

The Team wishes to express its sincere thanks to everyone in the Falkland Islands who helped during its visit. His Excellency the Governor, Sir Cosmo Haskard KCMG MBE provided invaluable assistance in many practical ways and above all gave us great encouragement through his enthusiasm. His Excellency and Lady Haskard also provided kind hospitality on many occasions.

Members of Executive Council, Legislative Council and its Development Committee showed keen interest in our work and were always helpful both collectively and as individuals.

The Colonial Secretary and Government employees at all levels did everything in their power to further our work and to ensure our comfort and welfare especially with secretarial help and transport. A member of staff, Mr Peter McGill, was put at our disposal as driver and he also assisted in our experimental and investigational work.

We especially wish to record our thanks to all Managers and their wives. They generously provided the hospitality of their homes; they readily gave access to their farm records; they showed us over their farms and patiently answered questions about their farming practice. We were greatly encouraged by the enthusiastic welcome with which we were received everywhere. Members of farm staffs gave us every assistance and on farms where we conducted experiments we relied heavily on the help readily given by shepherds and navvies.

We are indebted to those members of the staffs of the National Agricultural Advisory Service and the Veterinary Investigation Service of the Ministry of Agriculture, Fisheries and Food, the Hill Farming Research Organisation and Food and Agriculture Organisation who supported our work so effectively by the examination and analysis of specimens and samples and by supplying information.

Finally we wish to record our thanks to the residents of Stanley for helping to make our stay in the Colony so enjoyable through their friendliness and hospitality.

CHAPTER 1 - INTRODUCTION

The fluctuating fortunes of the sheep farming industry in the Falkland Islands since its beginnings midway through the nineteenth century are described in several sources. It is not proposed to repeat the story in detail in this report. A brief historical review might be of value, however, in providing a background to the Team's presence in the Colony and explaining its objectives.

Serious development and expansion of the sheep industry started in the 1860's, and by 1898 the Colony carried 807,000 sheep. From this time numbers declined gradually to 647,085 in 1923. This was clearly cause for concern, and in 1924 the New Zealander, Mr H Munro, was commissioned to investigate the sheep farming industry of the Falkland Islands. His report made many practical down-to-earth recommendations, most of them still applicable today, including the setting up of an experimental farm. Thus the Anson "Model" Farm near Green Patch had a brief existence before being closed down in 1928, so history tells us, "In the interests of public economy". Actually wool prices were improving so that there was presumably an easing of economic pressure on the industry.

The next period of crisis appears to have come in the early 1930's, for in 1937 Mr William Davies, Senior Grassland Investigator of the Welsh Plant Breeding Station, Aberystwyth, arrived in the Islands to carry out a survey of the grasslands. For four months in the summer of 1937/38 Davies, covering great distances on horseback and by sea, visited all the major settlements in the Colony. His report entitled "The Grasslands of the Falkland Islands" contained many recommendations and suggestions as well as describing and making an agricultural assessment of the natural and sown pastures. By 1938/39, however, the price of wool had gradually increased, and in any case the outbreak of World War II occurred soon after Davies' visit.

Throughout the War a New Zealander, Dr Gibbs, was Agricultural Officer to the Colony. As well as helping the War effort by growing vegetables and forage crops on Stanley Common, Gibbs carried out much experimental work on grassland improvement. Presumably due to wartime travel restrictions most of this was done in the close vicinity of Stanley. He produced a report describing his work and making recommendations, but very few copies appear to have been circulated. At all events, the War was followed by a period of unprecedently high wool prices, reaching a peak in the early 1950's, so that once again pressure was relieved.

However, wool prices again dropped and the industry had to face further threat from the increasing development and production of artificial fibres. In 1960/61, by arrangement with the Department of Technical Co-operation, Mr A R Wannop, at that time Director of the Hill Farming Research Organisation, spent two and a half months in the Colony. He visited the majority of the farms and wrote a report which laid particular stress on the value of fencing and sub-division. He also recommended that a young trained investigator should spend three to five years in the Colony carrying out trial work on commercial farms.

In due course Mr C D Young was appointed in this capacity and he served in the Islands from 1965 to 1968. Almost all his work consisted of reseeding trials using a wide range of species and varieties of legumes and grasses. In his report of October 1968 Young concludes that carrying out critical experimental work on commercial farms was so difficult as to be virtually impossible and he suggested that the next step should be the setting up of an experimental farm.

While Young was still working in the Colony, His Excellency the Governor appointed Mr C W Guillebaud of St John's College, Cambridge, to conduct an economic survey of the Falkland Islands. Guillebaud made a visit in March and April 1967 and his report deals not only with the farming industry but also with the wider economic problems of the Islands.

At about the same time, in 1967, preliminary arrangements were being made for a Land System Analysis to be made of the Islands by a team from the Land Resources Division of the Directorate of Overseas Surveys. The field work was undertaken by Dr C M Clapperton of Aberdeen University and C D Young. Advice and help was provided by the Macaulay Institute and the North of Scotland College of Agriculture. It was not possible for any member of Land Resources Division to visit the Falkland Islands for the purpose of the survey. Nevertheless a report was published in 1969 in which it was stressed that the survey had, of necessity, severe limitations and would be mainly useful as a source of information for subsequent research workers.

In the summer of 1969 the present Study Team was recruited by the then Ministry of Overseas Development. It will have been noted that previous visitors were either Grassland Specialists or Livestock Specialists or Economists. Grassland and livestock are inter-related and completely inter-dependent and clearly are best looked at together. The Team consisted of two Grassland Specialists and two Livestock Specialists supported by a Laboratory Technician/Field Assistant. A Pasture Specialist, T H Davies who was also the leader, and an Agronomist, H Mead made up the grassland section, and the livestock section consisted of a Veterinary Surgeon, C T McCrea and a Sheep Husbandry Specialist, I A Dickson. For the first time therefore it was possible for the whole of the grassland/livestock complex to be studied. W W Williams was the technician. There were two other major differences between the Team and previous visitors. Members were not selected primarily for eminence in their various fields of study but to a large degree on the grounds of long practical experience of farm advisory work on subjects and in conditions relevant to the Falkland Islands. In the second place it differed from predecessors in that it was able to take out to the Islands sufficient equipment to set up a laboratory and conduct experimental work.

Arrangements were made for the Team's arrival to coincide with lambing and for it to stay in the Islands for the whole of one sheep farming season. It arrived on 20 September 1969 and left on 16 April 1970 - a period of seven months. During this time every settlement in the Colony was visited by one or more of the Team - some several times. To cover the ground as efficiently as possible, visits were made in pairs by one Grassland and one Livestock Specialist. In addition to collecting information, experiments were laid down and individual problems dealt with. Unlike Davies in 1937 who records travelling 1,100 miles on horseback, over 1,000 miles by sea and only 40 miles by car, the Team did nearly all its travelling between settlements by air, was driven hundreds of miles over the camp in Landrovers and faced the ordeals of the Falkland Islands "trot" only occasionally.

Immediately on arrival the Team attended a formal meeting with the Colony's Development Committee and throughout the visit close liaison was maintained with its chairman and members. On the second of March 1970 the Team appeared before a joint meeting of the Executive and Legislative Committees. A review of work and conclusions to date was presented. During the visit Team members acted from time to time as advisers to His Excellency the Governor on agricultural matters.

Several broadcasts were made over the Falkland Island Broadcasting Service by the whole Team and individual members. A conference for Mangers was organised in Port Stanley during "Sports Week 1970" and was attended by all Managers in Stanley at the time - about two-thirds of the total number. One member of the Team gave a public showing of colour slides of the Islands to the residents of Stanley.

CHAPTER 2 - THE PROBLEM

The basic problem of the Falkland Islands economy is the future of wool in world markets. The prospect is far from happy. In a report commissioned by the Economic Development Committee for the Wool Textile Industry (UK) it is suggested that:-

> The industry should plan to increase its output of converted tops (ie man-made fibre tops), worsted yarns, semi-worsted yarns and non-woven fabrics, but decrease its output of combed tops (ie wool tops) and woollen woven fabrics. The industry should also diversify into the production of knitted fabrics.
>
> From a graph illustrating the trends in prices over the last 10 years of a selection of raw materials including polyester white top, acrylic staple, 64's Merino and 50's crossbred, the two features which are most marked are the longterm decline in the price of 50's quality and the marked decline in man-made fibre prices compared to wool prices.
>
> Wool consumption in 1975 will be 16 per cent below the level of 1967: 9½ per cent less wool will be consumed in the worsted sector and 22 per cent less in the woollen sector. On the other hand consumption of man-made fibres will increase by 62 per cent.
>
> To meet the new level of production in the 1970's the industry should plan for its purchases of raw wool and hair to fall from 352 million lb. clean to about 310 million lb. and for its purchases of man-made fibres to rise from 127 million lb to about 204 million lb.
>
> There should be a significant reduction in the amount of stocks and work in progress held in the industry. (Use of capital.)

In a commentary on the report, the General Manager of the British Wool Marketing Board states "A further analysis suggests that on the Report's suggestions, total wool consumption in 1975 would be 23 per cent below that of 1968, and cross-bred wool consumption would be probably 26 per cent lower. When the implications of the Report are studied more deeply, the situation facing growers and distributors of raw wool is serious".

Since Falkland Islands' wools are "cross-bred" the prospects are particularly bleak for them.

All suggestions for aid to the Islands whether for the improvement of agriculture or of services must therefore be viewed against a background of the comparatively low financial cost of evacuating the Islands. This cost of compensation and transport could be of the order of £7 million. It is not likely that the UK would find any difficulty in absorbing the 2,000 inhabitants of whom virtually all are of UK origin. The cost in human terms is less acceptable.

For the remainder of the report it is assumed that farming will continue in the Islands.

The internal problem of the sheep industry of the Falkland Islands is one of static output in the face of rising costs. The picture regarding output emerges clearly from Table 1. It is based on the Government's Annual Stock Returns and is an extension of the table presented as Appendix II in the Guillebaud report.

TABLE 1

SHEEP NUMBERS AND WOOL OUTPUT 1963/64 TO 1968/69

Season	Total Sheep	Sheep Shorn	Wool Clip in 1,000 lb	Average London Price in Pence per lb	Gross Sale Proceeds	Approximate net value ie Gross less 7d per lb
					£	£
1963-1964	626,863	573,897	4,840	57.06	1,150,873	1,010,000
1964-1965	626,608	560,443	4,839	48.05	968,161	827,000
1965-1966	638,165	566,568	4,847	49.21	993,837	852,466
1966-1967	627,367	567,959	4,604	40.83	783,256	648,972
1967-1968	620,932	559,802	4,515	43.20	812,700	681,013
1968-1969	635,236	565,807	4,650	45.26	876,913	741,288

It may be thought unnecessary by many to present evidence of rising costs as everyone is aware of this trend. However Table 2 shows the rise over the same period of years and taking the 1963 as 100 per cent underlines the point. It should be emphasised that the figures are averages of a sample of Falkland Islands farms and no claim is made that they are representative of the Colony as a whole.

TABLE 2

COST OF WOOL PRODUCTION

Year	Relative cost of wool production per cent
1963	100.0
1964	107.4
1965	102.3
1966	111.2
1967	112.5
1968	121.5

The problem is not peculiar to the Falkland Islands. As far as can be judged most pastoral countries of the world are experiencing exactly the same difficulties. During the Team's tour of Argentinian and Chilean Patagonia it was apparent that the same state of affairs existed. While no financial data were collected on the tour the problem of increased costs was illustrated clearly when we were told that in the hey-day of sheep farming in Patagonia, skins, hides and meat for canning paid all the farm expenses and receipts for wool were profit. Nowadays the total wool output is required to pay farm costs and the only profits come from skins, hides and meat. On the Coast they are attempting to overcome their difficulties by increasing their ewe flocks relative to total sheep numbers and sending virtually all wether lambs for slaughter. They are also going over to cattle on the better land. Both these changes are possible because of the existence of an adequate number of frigorificos to deal with the extra meat produced.

As far as the Falkland Islands are concerned the challenge of costs rising to meet output can be met in three ways, by increasing output without proportionate increases in costs, by reducing costs while maintaining output or by diversification - or a combination of two or all three methods. Another solution would be a dramatic increase in the world price of wool but at the moment this seems improbable.

The term 'output' is used in the sense of total cash output from the farm. Cash output under the present system of farming is, for the most part, the product of the number of sheep shorn, the weight of fleece per sheep and the cash value of each pound of wool produced. Output can be increased by improving one or all of these factors. All are dependent on the quantity, seasonality and quality of feed produced on the farm and on sheep management in both husbandry and veterinary aspects. A great deal of the content of the following chapters of the report will deal with technical aspects of increasing output.

The second method of improving profitability is by reducing costs while at the same time maintaining output. The major item contributing to costs on all farms is labour. In many cases it accounts for 50 per cent of total costs. The other major items are "Materials" and wool handling charges which include freight, insurances, brokerage and commissions. Both of these may be up to 15 per cent of total costs. They are costs which are largely outside the control of Managers. Any visitor to the Colony is however certain to question whether it is absolutely essential for all supplies and materials to be brought 7,000 miles from the United Kingdom. It is traditional and goods from anywhere are bound to be relatively expensive due to the geographical situation of the islands. Nevertheless it would appear realistic for other possible sources to be explored. The Falkland Islands Company has recently made efforts to integrate vertically the marketing of some part of the Colony's wool by acquiring a 50 per cent holding in a company which scours and sorts wool for further sale. The aim is to reduce wool handling costs.

The term labour cost is used here to cover wages of farm staffs, salaries of managers, passages to and from the United Kingdom and Stanley, pension and other social funds. It is by far the greatest cost and moreover is one which is directly under the Managers' sphere of control. The Team realizes that there are labour difficulties. Contract men recruited in the United Kingdom are often inexperienced in the special crafts of the sheep industry. Good, experienced men are difficult to find and Managers are naturally concerned to keep such men. Nevertheless we recommend that the labour costs on every farm are looked at critically. Is every man fully employed all the year round for instance? Is the labour force being maintained at a certain level all the year round merely to have an adequate gang available for shearing? Is the efficiency of the shearing gang what it should be? Has the possibility of itinerant shearing gangs been looked at seriously from the aspect of sheer economics? We do not consider ourselves competent to answer these questions in detail but we suggest that a considerable amount of heart searching is required on these and similar questions. In times of economic pressure productivity per man is particularly vital in a situation where labour cost is such a high proportion of total costs.

The third way of overcoming the present economic difficulties could be through diversification. This could have implications on output and costs. The Colony as a whole is very interested and involved in the possibilities of diversification in non-agricultural fields. From the farming standpoint the main possibility seems to be meat production. This could be in the form of beef or sheep meat either for human consumption or as pet food. Any developments in this direction would involve considerable problems in terms of processing facilities, with attendant heavy capital expenditure, and marketing. This question is dealt with in the livestock section. One aspect which was raised at the meeting of Executive Council attended by the Team was the possible export of store cattle to the Coast for fattening. While we were in Chile we saw ample evidence that the pastures in the Punta Arenas and Puerto Natales areas are capable of finishing beef cattle. We also received the impression that although the Chileans were building up their breeding stocks of cattle as rapidly as possible they were still very short of suitable beasts to fatten off. Nothing is known of the prices they might be prepared to pay for store cattle but it would appear to be a point worth investigating.

The Team has considered one further aspect of the question of solving the basic problem of the Falkland Islands sheep industry and that is farm structure. It is a commonly held view amongst some sections of the community in the Colony that the farms are too large. They contend that much smaller units in which many more people have a direct stake would be more efficient and profitable. There is certainly some point in the argument that personal interest and involvement is important in any farming enterprise and particularly so with livestock. However we feel that the nature of the soil and environment of the Falkland Islands imposes an extensive system of farming. Extensive systems require large areas of land. There is world-wide acceptance of the principle that poor soil and conditions go hand in hand with extensive systems on large farms. Only good soils and conditions allow intensive systems on small farms. We do not therefore support the idea of wholesale splitting up of farms into small units. There is also the point that a great amount of capital investment would be required in buildings and fencing and we do not believe that individuals or Government have the resources available for such a development at this stage.

The opposite point of view was also put to us namely that larger units have greater possibilities of cutting costs through economy of scale and therefore of improving profitability. In this connection it was pointed out that at the present moment it was the larger and more extensively farmed stations that were making the best profits. What these farms are doing in effect is maintaining output at the same level as previously with many fewer men. This is one of the principles leading to increased profitability discussed earlier in this chapter. Much of course depends on the ability to maintain output with a reduced labour force. If cost cutting in labour is overdone essential work on the farm such as maintenance of fences suffers. Output may then also suffer and margins begin to decline once more. Delay in the replacement of capital items may also give farms the illusion of maintaining profits but a day of reckoning is unavoidable.

What then is the answer to the basic problem? There is no one answer. Of the possibilities listed at the start of this chapter some will adopt one answer, some another and many will combine more than one method. It is clear that if the trend of costs catching up with output is to be halted everyone will have to do something or go out of business.

It seems likely that the larger farms will continue to attempt to improve productivity by reducing costs. This could indeed be the most satisfactory solution for individual stations. If all the farms adopted this answer however it is unlikely that the present population of the islands could be supported, particularly the residents of Stanley of whom few are involved in the generation of new income for the islands. It would also have repercussions on the maintenance of communications.

Increased output is likely to be a more attractive solution than cutting costs for most of the medium and smaller farms. It provides better opportunities for maintaining present standards of living. Larger farms should also consider this alternative. Each manager and each company will have to decide which of the possible solutions is best for their particular circumstances. Whatever their choice, technical considerations will be involved and most of the remainder of the report deals with these.

CHAPTER 3 - THE GRASSLAND COMMUNITIES

The climate of the Falkland Islands is cool and maritime. It is governed by the persistent westerly winds, the proximity of South America and the cool seas in between. January and July mean temperatures differ only by 7°C. Frost and snow have been recorded in every month. The summers are comparable with those experienced in north-west Scotland and Orkneys and Shetland but the winters are much milder. Accumulation of snow is rare. Ground frost rarely penetrates to any depth and the 4 inch soil temperature in July averaged 1.9°C over the period 1948-64, while in January the 4 inch soil temperature averaged 9.9°C over the same period.

The islands are very windy, sunshine levels are low and total cloud cover frequent. Rainfall is moderate but evaporation due to wind frequency and speed is high. Evaporation figures from an open tank for September to December 1969 at Port Stanley show a loss of 268.1 mm while the rainfall for this period was 156.2 mm. The average wind speeds over these four months was 18.6, 21.1, 17.8 and 19.1 knots respectively.

It is not surprising therefore to read Skottsberg's (1913) original description of the flora as being "oceanic heath". The vegetation is notable for its monotony and total absence of natural tree growth. Many of the common species found have a wide degree of adaptability and associations merge into each other imperceptibly. From the agriculturalists point of view the main communities are:

The coastal fringe of Poa flabellata (Tussac)
Oceanic heath
Mountain associations
March formations
Sandgrass associations
Bush associations
Valley flush associations or "greens"
Coastal "greens"

There are other formations of interest to botanists and these are described in detail elsewhere (Skottsberg 1913 Moore 1968).

THE TUSSAC FRINGE. The association at the moment is confined to minor coastal areas on the larger islands and to the smaller islands. It never extends inland more than about 100 yards. According to the literature the association is not as extensive as it was before the introduction of grazing stock which found it highly palatable compared with other local plants. As a result it has been grazed out except where it has been fenced against stock and alternatively grazed and rested. A fuller description of this potentially important association is detailed elsewhere.

OCEANIC HEATH. This is by far the most common of the formations found and can be classified into two main divisions, the one dominated by Cortaderia pilosa (whitegrass) and the other by dwarf shrubs. However both these communities intermingle quite freely to form a most complex system of communities on occasion.

The whitegrass association is most frequent on poorly drained areas where there is not a swamp situation. It is widespread on flat or undulating areas in the lowlands. Associated plants of grazing value are Deschampsia flexuosa (wavy hair grass), Festuca ovina (sheep's fescue) and other fine leaved grasses. Gunnera magellanica (pig vine) is also very common in this situation although it appears to have no grazing value. This association, particularly where it grades into the valley flushes or "greens", often assumes a very open habit where the individual tussocks of whitegrass become prominent and 18" or more apart. Between the whitegrass tussocks a valuable grazing area of Poa pratensis (smooth stalked meadow grass), Agrostis spp (bent), Poa annua (annual meadow grass) and Juncus scheuzerioides (small jointed rush) is found. This type of whitegrass community is the most valuable for the grazier both from the nutritional and shelter points of view and is known locally as 'bog' whitegrass. In wet areas whitegrass shares dominance with the apparently ungrazed and coarse cushion plant Oreobolus obtusangulus (oreob). As the land becomes wetter and more poorly drained whitegrass grades into a Rostkovia magellanica (short brown rush) association and from this to the marsh formation.

The soil developed under the whitegrass is a coarse dark brown fibrous peat which may vary from a few inches to several yards in depth overlying the rock or clay of the sub-soil. It grades into a sodden sapric peat in very wet situations.

The prevalence of whitegrass is the cause of the characteristic dun colouring of the landscape changing to a creamy white in the distance interrupted by the dark slashes of the dwarf shrub and the silvery rocks and stoneruns.

The dwarf shrub association is mainly confined to the better drained areas where the subsoil is more broken and shaly. This allows free water percolation from the overlying hard peat which has a coarse sandy texture. The most common shrub is Empetrum rubrum (diddle-dee) with Baccharis magellanica (Christmas bush) and Pernettya pumila (mountain berry) occasionally assuming dominance or codominance. In addition there are two species of fern, Blechnum penna-marina (small fern) and Blechnum tabulare (tall fern) which often assume codominance and these together with large cushions of Bolax gummifera (balsam bog) also form characteristic facies of the drier heath and rock strewn well drained heath.

Sheep do not normally graze the major shrubs of the heath although occasional observations of sheep eating the berries and younger shoots of diddle-dee have been recorded. It is alleged that areas, particularly in the west island and off-shore islands which are now dominated by vast tracts of diddle-dee and very little else, have been overgrazed to such an extent in the past that most of the gramineous components have been eaten out. Whether there ever were agriculturally important grasses in these areas is open to conjecture but now they have an extremely low agricultural potential in their native state.

Large scale burning of diddle-dee has been common in the past in an attempt to encourage grass growth. Unfortunately the species is very inflammable and the fires were so intensely hot that the peat soil often ignited. Large tracts of burned diddle-dee heath are now dominated by Christmas bush, mountain berry and the ferns with few edible components. The resulting pasture is virtually useless. However, these dry, well drained dwarf shrub associations are often suitable for improvement by reseeding. Over 15,000 acres have been ploughed or rotavated and sown out with varying degrees of success to imported species, mainly Holcus lanatus (Yorkshire fog) which has raised their agricultural value considerably. The process of reseeding is being actively pursued on many farms and one farm along has reached 7,000 acres out of a total farm area of 74,000 acres. Other farms are approaching this figure.

Exceptionally the dwarf shrub association is seen on the top of deep, peat banks in association with Astelia and short brown rush. Rain run off from these peat banks which have been isolated by soil slip is high.

MOUNTAIN ASSOCIATIONS. The more mountainous parts of the heathland are characterised by outcrops of rock, extensive areas of boulder strewn terrain and stoneruns or stone rivers. The vegetation is mainly whitegrass, oreob, Christmas bush with a small amount of Poa alopecurus (mountain blue grass) and Festuca erecta (land tussac). At the highest elevations (2,300 feet maximum) the flora is mainly made up of lichens and the cushion plants such as balsam bog, Azorella, Colobanthus and Abrotanella and the soil under these is often in a loose unstable condition.

The mountain associations provide a fair diet for dry sheep in summer. Due to the rough terrain however and the consequent difficulties and high costs of gathering sheep from mountain enclosures many farms are now questioning the economics of using them.

MARSH FORMATIONS. Where drainage is at its poorest and the water table is high several associations occur. Sphagnum spp (sphagnum moss) associations with short brown rush are dominant in the wettest areas grading out as the water table falls slightly to the short brown rush - whitegrass - oreob association. These areas appear dark brown in colour from the dominant short brown rush. On many farms benefit has followed surface drainage carried out using a swamp plough. Floral change is slow but sheep have been observed grazing surface drained areas where they have not been seen to graze before.

The Astelia pumila (Astelia) association which is always found over very deep peat can best be described as a carpet. The leaves of the plant are short (10-23 mm), very stiff, dagger shaped and with a sharp hard point. The old leaves do not fall and a water retaining habit results which further impedes the already poor drainage. These associations form the least valuable grazing areas in the islands but unfortunately they occupy very large tracts particularly in the northern part of East Falkland. One Astelia dominated bank was measured on a vehicle speedometer. It was over three miles long and varied in breadth from 200 to 300 yards.

SANDGRASS ASSOCIATIONS. Both Ammophila arenaria (marram grass) and Elymus arenarius (lyme grass) have been introduced in attempts to stabilise sandy lyme grass areas which suffer from wind erosion both inland and on the coast. Marram grass has been the more successful and where it has been planted it has established easily. In the sheltered valleys behind the stabilised dunes turf formation is being initiated by such useful grazing species as small jointed rush and meadow grasses. Sheep and cattle also find the marram grass quite palatable and it is grazed freely.

Inland blow-away sandy areas such as are found adjacent to the east coast ridge of West Falkland and extensively in the southern part of the same island have been well stabilised in many localities and planting continues.

BUSH ASSOCIATIONS. Under conditions where soil water is not static but moving towards a stream, Chiliotrichum diffisum (fachine) occurs both in the whitegrass and dwarf shrub heath but more commonly in the valley flush situations. The bush is readily eaten by stock and the plant must have been far more common in the past than now. It often appears in profusion after whitegrass enclosures have been rested particularly over a long period. It can, in sheltered well watered situations, grow to heights of seven to eight feet as at Roy Cove in a very wide valley flush.

In Patagonia and Tierra del Fuego fachine also grows in profusion but never to this height. It is interesting to note that the species is not grazed in South America and is valued only for its shelter. Large scale reclamation programmes aimed at replacing fachine with improved grassland are in being.

The only other bush occurring naturally is Hebe elliptica (native box). Sheep and cattle it is understood are fond of eating the bark of this plant which is then rapidly killed. Native box was probably a major component of the dwarf shrub heath before the introduction of grazing stock. It still grows vigorously in situations inaccessible to stock where the dwarf shrub heath terminates in steep cliffs overlooking the sea.

VALLEY FLUSH SITUATIONS OR "GREENS". These ribbon areas are situated on the damp, more or less level banks of streams and rivers and around spring holes. In contrast to the surrounding land they are bright green in colour. This is due partly to hard grazing from sheep and geese partly due to the higher mineral fraction of the flush soils. From the air it always appears that the sheep are concentrated on the greens which are composed mainly of small jointed rush, annual and smooth stalked meadow grasses, bents, Aira spp, Acaena lucida (native yarrow) and various species of Carex (sedges). All blend to form a damp closely knit turf. The "greens" together with 'bob' whitegrass constitute the most valuable grazings on the islands.

The situation of "greens" is a mixed blessing to the grazier. Very often streams associated with them have been enlarged below ground by the high volumes of water which flow after winter rains. Their surface openings are often narrow. Sheep, particularly lambs and hoggets, fall into the deep cavities and are lost. Some managers put their hogget losses due to this cause as high as 20 per cent in some years.

COASTAL "GREENS". The effect that gentoo penguins have on the coastal flora is impressive. The birds come ashore to nest and colonies arrive at approximately the same part of the coast each year. They change their nesting places however quite haphazardly each season. The herbage growing in the nesting area is very quickly destroyed, whether it be robust diddle-dee, whitegrass or balsam bog. Everything is trampled down by the birds in their journeys to and from the sea and eventually the ground is totally denuded of vegetation. This mechanical effect coupled with the heavy deposit of droppings encourages colonisation of old nesting grounds after a few years by annual meadow grass. Penguin grounds do not seem to revert to the oceanic heath flora but due to intense grazing by sheep and geese remain as a short well knit turf which makes a valuable contribution to the keep in the enclosure.

CHAPTER 4 - PRESENT FARMING PRACTICE

At the outset it was thought advisable to try to see the farming of the islands as a dynamic system by carrying out a survey. This was divided into five parts.

Part A - Numbers of stock of each class in each camp at dipping 1969.

Part B - Changes in ewe numbers by camp during the stock year 1967-68;

Changes in the numbers of their offspring from birth in 1967 until the females were shorn in 1969 before entering the ewe flocks as replacements;

Losses of wethers between dipping and shearing in the seasons 1968-69 and 1969-70.

Part C - The acreage of each camp on the farm together with the Manager's assessment of the proportion of different plant associations to be found in each camp.

Part D - Aspects of the organisation and management of the sheep especially their breeding, grazing, lamb-marking and dipping.

Part E - The organisation of milk and beef production.

Parts B, D and E are separate entities but parts A and C are considered together to see whether there exists a superficial link between stock carrying capacity and one or more of the plant associations found.

NUMBERS OF FARMS

It was not possible to obtain the necessary information from all farms. Either the team members had insufficient time during their visit to the station, or the Manager was unable to answer all the questions. In all 23 units were recorded to a greater or lesser extent. These consisted of 10 mainland and 2 island stations in East Falkland and 7 mainland and 4 island units in West Falkland. They are therefore highly representative of the total situation. It is necessary, however, to sound a cautionary note on the stock figures. In most cases these represent only one year's results and so may not be typical. Nevertheless they are an attempt to quantify some of the stock problems which have been recognised for many years.

I. THE VEGETATIVE COMPOSITION OF THE ENCLOSURES

This part of the survey was completed by asking Managers to estimate the percentage of each vegetative type which occurred on their farms, enclosure by enclosure. It was realised that this is a very subjective means of bulk botanical analysis but it was considered that apart from conducting an accurate camp by camp survey which would have been a very time consuming and laborious procedure it was the next best alternative. The percentage distribution of the sizes of the enclosures occurring on the farms surveyed is shown in Table 3.

TABLE 3

PERCENTAGE DISTRIBUTION OF THE SIZES OF CAMPS SURVEYED

CAMP SIZE	EAST FALKLAND	WEST FALKLAND	ISLANDS
Under 1000 acres	10	8	44
1000-4999 acres	35	43	48
5000-8999 acres	24	30	8
9000-12999 acres	16	14	-
13000-16999 acres	8	1	-
17000-20999 acres	5	2	-
21000-24999 acres	1	1	-
25000 and over	1	1	-
ACTUAL NO OF CAMPS	121	187	84

The major botanical divisions and their distribution are detailed in Table 4. The divisions were selected after examination of the flora and coincide broadly with those of Davies (1939). He obtained his distribution figures after roughly marking out the areas of the communities on a map and then estimating the total area using squared paper. Davies' map approximates to the contour maps of the islands and it is not considered that the vegetative types are as sensitive to altitude as Davies seemed to believe. Both methods are open to criticism on the grounds of subjectivity but at least the method adopted in this report is based on the opinion of Managers who know each enclosure intimately through gathering sheep in it over a number of years.

The most common of the communities is the whitegras dominant association. This is to be found on moderately well drained land and when this area is considered with the whitegrass/diddle-dee co-dominant area it is obvious that investigations of improvement of this type of camp should be pursued.

It is surprising to note that the area of greens and associated "bog" whitegrass is so high in East Falkland compared with West Falkland. This is possibly due to two causes: a. the poorer subsoil drainage pattern of the East Falkland leading to a more dense surface drainage pattern (streams) with its accompanying wash down of nutrients and b. The high proportion of "bog" type whitegrass in Lafonia and its association with streams and greens. The "greens" are largely made up of a small jointed rush, the useful native grasses and sorrel. Their stocking capacity is of a high order and they are always grazed hard by sheep and geese. All sheep tracks in the camp appear to lead from one green to another. Together with the "penguin" grounds on the coast they form valuable natural grazings.

The area of whitegrass/oreob which reaches nearly 18 per cent in East Falkland as compared with just over 13 per cent in West Falkland is another reminder of the different drainage pattern. Compared with whitegrass dominant areas this community is found on land which is softer underfoot and does not carry the flora which is associated with good sheep grazing. Davies (1939) demonstrated this in his detailed botanical analyses.

TABLE 4

TYPES AND PERCENTAGE DISTRIBUTION OF VEGETATION

TYPE OF VEGETATION	WEST FALKLAND %	EAST FALKLAND %	ISLANDS %
Reseeded Land	1.79	0.66	0.53
Whitegrass dominant	39.33	27.04	13.40
Whitegrass/oreob	13.26	17.60	0.00
Whitegrass in "bog" formation and greens	4.76	15.71	25.40
Whitegrass/diddle-dee equal dominance	7.54	2.80	1.81
Diddle-dee dominant	13.49	6.36	17.16
Diddle-dee/tall fern	1.42	0.54	19.02
Tall fern	0.10	0.44	4.71
Diddle-dee over deep wet peat	0.00	0.64	0.00
Astelia/short brown rush	0.76	13.90	0.00
Mountain berry/Christmas bush/ small fern/balsam bog	2.26	0.02	0.98
Marsh - Sphagnum Associations	0.00	3.68	0.00
Mountain Associations	7.85	0.53	0.09
Sand Grass Association - Marram and lyme grass	1.23	0.17	3.08
Cinnamon grass dominant	0.00	1.59	1.71
Tussac	0.07	0.09	2.37
Goose grass Associations	0.00	0.00	5.16
Other Associations	2.08	0.00	0.37
Stoneruns, Rocks, Eroded and Waste Ground, Ponds etc	4.06	8.23	4.21
	100%	100%	100%

Land is roughly classified locally as "hard" camp or "soft" camp, the two terms meaning the relative support which the land gives underfoot when walking or riding. Thus diddle-dee ground which is usually on well drained ground is "hard" camp. The division into hard and soft camp appears to be based on geology and drainage pattern rather than on rainfall as many areas of low rainfall have soft camp and vice versa. From Table 3 it can be seen that West Falkland and the islands have a much higher proportion of "hard" to "soft" camp than East Falkland. From the viewpoint of availability of land for reseeding the West Falkland would therefore appear to have more potential than the East Falkland as diddle-dee ground has to date been more amenable to reseeding techniques than whitegrass dominant land. Hard camp dominated by mountain berry, Christmas bush, small fern and balsam bog also responds well to reseeding techniques.

The areas of mountain associations are composed mainly of whitegrass, mountain blue grass and Festuca magellanica (native fine leaved fescue). They occur mainly on boulder strewn terrain in the mountains and proportionately are not as large in this survey as in Davies (1939). Many Managers tend to disregard the mountains and other inaccessible areas as hardly worthy of attention. Thus they are more likely to have classified these as rocky areas and waste land. One farmer chose to regard most of his land over 600-700' as being "waste" ground.

The large area of Astelia/short brown rush association (nearly 14 per cent) which is to be found in East Falkland is virtually useless for the grazier and does not appear to be of any use to the Colony except as a source of fuel from the underlying deep peat.

II. STOCK CARRYING CAPACITY OF THE ENCLOSURES

The relating of the stock carried on each camp to its vegetative composition was difficult because different botanical components occur in different proportions in each camp. Nevertheless a computer was able to allocate to some of these components a value in terms of stock carrying capacity express in ewe-equivalents.

The method of calculation employed by the computer automatically discarded any farm which had a smaller number of camps than botanical types. Unfortunately this ruled out the analysis of any but the larger farms. These were Darwin and Walker Creek, San Carlos, Douglas and Fitzroy on East Falkland and Fox Bay East, Fox Bay West, Chartres and Roy Cove on West Falkland. Farms where a large amount of rotational grazing is practised had to be excluded as this would have confused the results.

On the first submission of data to the computer all vegetative types recorded in the survey were entered whether they occurred in each camp or not. On this basis the computer could not find any significance between ewe carrying capacity and any of the vegetative types. The data were resubmitted including only the types which occurred in each camp. Thus, if there were no diddle-dee in the camp the acreage was not recorded as "0 acres" but was ignored altogether. On this basis significance between stocking and vegetation was found on some farms. These were few in number and, while valid, were not helpful.

As a further exercise, all the camps were submitted as though for one farm. A very high degree of 70.8 per cent of correlation was obtained. This means that the computer could make sense of the relationship between vegetative type and stock carrying capacity on 70.8 per cent of the area involved. A summary of the statistical analysis of the exercise is in the appendix. The relationships found, on a basis of all camps analysed, are given in Table 5.

TABLE 5

VEGETATIVE TYPES AND EWE EQUIVALENTS/ACRE

VEGETATIVE TYPES	ACRES TO ONE EWE EQUIVALENT
Whitegrass	4.7
Whitegrass/oreob	5.2
"Greens"	3.0
Whitegrass/diddle-dee 50/50	4.4
Diddle-dee	5.4
Mountain Association	Negative - a liability
Reseeded Land	2.2

If the figures submitted related to one big farm then the carrying capacity of any enclosure could be calculated by multiplying the area of each vegetative type by the carrying capacity factor given above. It is obvious that differences between farms do occur which would make the universality of these figures suspect. These differences could not be detected in the first two analyses.

III. LOSSES OF SHEEP

1. Ewes

Marking is recognised as an incomplete gathering because the distances involved make it advisable not to gather the very youngest lambs. For this reason it was impossible to obtain a meaningful measure of the losses to marking. The combined winter and lambing losses were therefore measured by the dipping to shearing loss. In the winter and spring of 1967 there was a loss of 16,070 ewes (9.8 per cent) out of a total of 164,107 stud and camp ewes recorded on 20 farms. The average losses on individual farms varied up to 15.8 per cent.

TABLE 6

DISTRIBUTION OF EWE LOSSES BY FARMS

ewe loss %	0-4.9	5.0-9.9	10.0-14.9	15.0-& over
number of farms	2	12	5	1

An examination of the returns from individual camps showed a wider spread. After removing the figures for stud ewes, and those for three farms which could not give the information, the distribution of losses in 77 individual camps containing 134,341 ewes is given in the next table.

TABLE 7

DISTRIBUTION OF EWE LOSSES BY CAMPS

Ewe loss %	0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0 & over	Total
Number of camps	11	29	24	10	3	77
% of ewes	12.3	41.1	34.6	9.9	2.1	100.0

From this it can be seen that in 1967 losses in 69 per cent of the camps and representing 76 per cent of the ewes lay between 5 and 15 per cent.

2. Young Sheep

Lambs Marked

Reference has already been made to the inaccuracy of ewe counts at marking. The lamb marking figure given by the Falkland Island farmer is usually the sum of the pen tallies of lambs marked plus the number of lambs marked at the next gathering (shearing). In a very small number of instances in the survey, the pen tallies only were obtained. Grouping of whole-farm averages in November 1967 showed the following distribution of lambs marked as a percentage of ewes dipped.

TABLE 8

DISTRIBUTION OF LAMB MARKING PERCENTAGE BY FARMS

marking %	40.0-49.9	50.0-59.9	60.0-69.9	70.0-79.9	80.0-89.9	90.0-99.9
number of farms	2	3	9	3	0	1

Thus half the farms' averages lay between 60.0 and 69.9 per cent. The range was much wider when the figures for individual camps, excluding studs and whole farm data, were examined.

TABLE 9

DISTRIBUTION OF LAMB MARKING PERCENTAGE BY CAMPS

marking %	20.0-29.9	30.0-39.9	40.0-49.9	50.0-59.9	60.0-69.9	70.0-79.9	80.0-89.9	90.0-99.9	Total
number of camps	3	5	11	16	28	14	4	2	83
% of ewes	2	4	12	25	33	20	2	2	100

Some 53 per cent of the camps representing 57 per cent of the ewes yielded marking percentages in the range 50-70 per cent. The number of ewes in the 83 camps was 143,436. The ewe figure is larger than the total in the ewe loss section by the number of ewes on a farm unable to give ewe loss data.

The overall figures for marking, which includes studs and whole farm data show that 165,187 ewes on 20 farms yielded 102,534 marked lambs - 62.1 per cent. The discrepancy between the ewe figure here and in the section on ewe losses is due to a camp of 1,080 ewes for which marking but not ewe loss figures were available. The islands marked 76 per cent compared with 61 per cent and 60 per cent on East Falkland and West Falkland respectively.

Lambs Weaned

Of the farms surveyed very few recorded the numbers of lambs weaned. Whereas marking was recorded on 18 farms (83 camps), weaning was only available on 6 farms (28 camps). Half of those camps yielded weaning figures in the range 50-70 per cent (of the ewes dipped). The totals show an average of 52 per cent of the 41,695 ewes on the 6 farms.

TABLE 10

DISTRIBUTION OF LAMB WEANING PERCENTAGE BY CAMPS

weaning %	20.0-29.9	30.0-39.9	40.0-49.9	50.0-59.9	60.0-69.9	70.0-79.9	80.0-89.9	90.0-99.9	Total
number of camps	3	2	3	7	7	4	1	1	28
% of ewes	7	12	13	22	30	7	3	6	100

The totals show a global average of 61.4 per cent lambs weaned on the 6 farms.

Lambs Dipped

From weaning the lambs are run together and so only farm totals and averages were available. The following was the distribution of lamb dipping numbers expressed as a percentage of ewes dipped in the previous autumn.

TABLE 11

DISTRIBUTION OF LAMB DIPPING PERCENTAGE BY FARMS

lamb dipping %	below 50	50.0-59.9	60.0-69.9	70.0-79.9	80.0 & over	Total
% of ewes	19.6	56.5	20.8	2.8	0.3	100.0
number of farms	4	8	5	2	1	20

On two farms the total for lambs dipped was suspect and was estimated by interpolation, made easier by the fact that both had supplied weaning data. The global average for the farms sampled was 53.9 per cent of the ewes dipped 12 months earlier. The advantage of the small islands was still evident at 65.8 per cent compared with 52.9 per cent for East Falkland and 51.9 per cent for the West Falkland. Dipping is the time when the very poorest lambs may be killed so the loss between weaning and dipping may be slightly exaggerated. However in practice these are the least viable lambs and would probably not have survived the winter anyway.

Hoggets Shorn

By the age of 14-15 months the numbers of hoggets has diminished further. This is the age at which the wethers are transferred to the wether flocks on many farms and so represents the last opportunity for recording the sexes jointly. By this stage most of the expected losses have occurred.

The following was the distribution of farm averages for hoggets shorn in 1968, expressed as a percentage of the ewes dipped some 20 months earlier.

TABLE 12

DISTRIBUTION OF HOGGET SHEARING PERCENTAGE BY FARMS

hogget shearing %	40.0	40.0-49.9	50.0-59.9	60.0-69.9	70.0-79.9	80.0 & over	Total
% of ewes exposed	13.0	15.0	67.6	4.1	0	0.3	100.0
number of farms	3	3	10	3	0	1	20

Again the small islands maintained their differential, recording 58.7 per cent compared with East Falkland (50.1 per cent) and West Falkland (48.6 per cent). The global average was 50.2 per cent which means that for every two ewes exposed to the ram, one hogget born from those ewes was shorn.

Progressive Loss of Young Sheep

The results from the young sheep born in 1967 can be shown graphically to demonstrate how the numbers diminished with time (Graph 1). The number of ewes dipped in March 1967, that is exposed to the ram in May 1967, was once again used as the common denominator.

(the missing material will appear in the printed version)

As an alternative to using the number of ewes dipped as a base-line, it is possible to use the number of lambs marked. The number weaned would be preferable but was not generally available.

The whole-farm loss of lambs from marking to dipping averaged 10.5 per cent with a range of 1½-20½ per cent. Figures for half of the farms lay between 10 and 15 per cent and the small islands showed no advantage. During the following winter and spring, dipping to shearing, farm losses averaged 8.6 per cent with a range of 3-16 per cent of the lambs marked. Half of the farm averages were between 5 and 10 per cent. Again the small islands had no advantage.

When the two losses are put together so that the total losses from marking to first shearing are measured it transpires that the global average is 19.1 per cent with a range of 4-29 per cent. Of every five lambs marked only four survive to be shorn 12 months later. Eleven of the 20 farms showed losses of 20 per cent or more. The small islands were at a disadvantage in 1967 if the differences are real for they lost 23 per cent compared with 18 per cent for East Falkland and 19 per cent for West Falkland. However, it will be recalled that they marked a higher percentage, and this advantage persisted to the hogget shearing stage in terms of ewes dipped.

Losses of Ewe Lambs from Marking

Marking is the first opportunity for differentiating between the sexes, so for an examination of the progressive loss of young female breeding stock the two base-lines used were ewes exposed to the ram (dipped) and lambs marked. Farms unable to provide virtually all the required information have been excluded so that the totals differ from those in previous paragraphs. Thirteen farms provided the information but two qualifications are needed. Figures from West Falkland did not provide separate counts of male and female lambs at marking, so for each the number of ewe lambs was estimated as 52 per cent of the total marked. This was the average proportion on farms where the figures for each sex were known. Secondly, it was necessary to interpolate in three cases where tallies were missing, and to extrapolate to the last stage in one instance. Despite these weaknesses it is believed that the figures are representative of the real situation in the years concerned.

TABLE 13

SURVIVAL OF YOUNG FEMALES UNTIL ENTERING EWE FLOCKS

	Age (months)	as % of ewes dipped 1967		as % of ewe lambs marked 1967	
		Average	Range	Average	Range
Marked 1967	½-2	31.4	26.0-46.3	100.0	0
Dipped 1968	5	28.6	21.8-40.3	90.9	83.8-94.8
Shorn 1968	14	26.1	20.0-40.0	83.2	70.6-88.7
Dipped 1969	17	24.9	18.8-35.8	79.3	67.7-86.8
Shorn 1969	26	23.1	16.9-31.9	73.4	63.4-78.9

The average situation may be summarised verbally as:-

It is necessary to mate four ewes to obtain one mature replacement for them.

Three out of four ewe lambs dipped will be available for use as flock replacements two years later.

In fairness it should be pointed out that a certain amount of culling goes on during the growth of young sheep but this is usually confined to those showing the most serious defects of wool type or body conformation.

3. Wethers

The first count taken after dipping is normally at shearing, therefore the losses are more clearly a reflection of winter stress although they do include a proportion lost due to casting in spring. In most instances it has been possible to exclude any mutton sheep but a small number of returns may exaggerate losses because the muttons may have been included. The distribution of the average farm losses in 1967 and 1968 was

TABLE 14

DISTRIBUTION OF WETHER LOSSES BY FARMS

wether loss %	0-4.9	5.0-9.9	10.0-14.9	15.0 & over	Total
1967	5	10	3	0	18
1968	7	7	4	0	18

The average loss for the 141,053 wethers dipped in 1967 was 6.3 per cent and for 142,615 in 1968 it was 6.9 per cent.

IV. ASPECTS OF SHEEP MANAGEMENT

1. The Rams

Breeds and Crosses

Where stud ewe flocks are kept it is normal practice to use imported rams (or the best progeny of the first stud ewes) on the first stud ewes to obtain a limited number of rams of the best quality. The resultant first generation rams are used in a second stud ewe flock whose function is to provide rams to serve the camp ewes. Of the 16 farms in the survey which had stud flocks 3 were using Polwarth rams, 1 was using Romney only, 4 were using both Romney and Corriedale (or Corriedale type) and 8 Corriedale (or Corriedale type) only. The only rams registered with Breed Societies are the imported rams. No females are registered. No station other than Port Howard (Corriedale) has followed a consistent "pure-breeding" policy down to the camp ewe level although a small number have done so at first stud level. The general picture is that of imported registered rams being put to cross-bred ewes to provide cross-bred rams in the second generation for use in the camp flocks.

Rams in the Breeding Season

Only 2 farm Managers out of 23 acknowledged selecting ewes for particular rams. These were in stud flocks. In one case it was done to avoid inbreeding; in the other finer wooled rams were put to slightly coarse-wooled ewes and vice-versa in order to bring more uniformity of wool type into the flock rams.

Dates given for the joining of the rams with the ewes varied in the range 19 April to 18 May. Some 50 per cent of the farms put the rams in on a date between 27 April and 4 May. Studs and camp flocks did not differ appreciably in this respect. When asked the reasons for their choice of dates the answers given tended to be vague initially, although two factors were later stated to be involved. The first was a husbandry problem - the need to delay lambing sufficiently to avoid lambing in the bad weather experienced at the equinox and therefore to have lambing as near to the advent of spring growth as possible. The second was a labour problem - the need to start lambing early in order to allow an early start to shearing.

The rams joined expressed as a percentage of the ewes was in the range $2\frac{1}{2}$-$3\frac{1}{2}$ per cent for camp ewes in 19 out of 23 farms. There was greater diversity in study flocks but 9 out of 16 were in the range 2-3 per cent. On one farm where small paddocks are used at tupping, only 1 per cent of rams was employed.

Once the rams were put in with the ewes they remained with them on all farms in the survey. On one farm, however, it was the practice to put in the better quality half of the rams for the first three weeks and then turn in the other half. Rams ran with the ewes for 6-8 weeks but on three farms they were often left with them all winter until lamb marking.

Replacement of Rams

There was considerable divergence of though among the managers of the 21 farms from which estimates of the rate of ram replacment were obtained. The range was 9-50 per cent. However, on 10 farms the estimate was in the range 25-28 per cent, with a further 3 saying 33 per cent.

Rams are usually culled at shearing time. The estimates of the proportion of rams cast for age fell into two distinct groups, 25-50 per cent (8 farms) and 67-100 per cent (12 farms). The latter would appear to be those who are content to abide by their judgement of their rams at first shearing.

While all mentioned wool quality as a reason for culling (other than for age), only one specifically mentioned wool weight. Body conformation, mentioned by 10 farms out of 18 (56 per cent), came second with wool colour faults third (44 per cent) and wool blindness fourth (28 per cent). Examination for Epididymitis was carried out on 3 of the 18 farms. Also named were the presence of horns, and soundness of teeth and feet.

2. Sheep Grazing Management

At Mating

Neither stud nor flock ewes were flushed before mating in the United Kingdom sense. Improved grazing after dipping was obtained in 9 of the 23 farms surveyed by having the ewe camps or paddocks vacant or lightly stocked from shearing to dipping. On one island ewes were given access to tussac from the time the rams were put in. There was little enthusiasm for twins from camp ewes for only 6 of 22 found them acceptable. In the stud flocks they seemed to be more welcome for 8 out of 17 expressed no bias against twinning.

Winter Grazing

Set-stocking was the system adopted by 14 out of 16 farms for stud flocks and 15 out of 23 farms for camp ewes. The remainder used some form of rotational or alternate grazing with a view to improving the ewe's nutrition. In one instance the alternation was 6 weeks on one area then 8 weeks on another (due to area differences) but most Managers favoured longer stays with a shift being made on the eve of lambing. Four out of 23 farms recorded some movement of wethers during the winter.

Supplementary feeding was practised on some of the islands by allowing access to tussac, and hay and silage were provided for the stud sheep at Port Howard.

Summer Grazing

Half of the 16 stud flocks were set-stocked in summer with a further one farm putting the ewes to the mountains from shearing to dipping. Those adopting some form of alternation or rotation were 7 in number. The position with the camp ewes was very similar with 10 out of 23 farms employing set-stocking and a further 4 farms putting their ewes to the mountain or poorest camps after shearing. Regulated movement of camp ewes occurred on the remaining 9 farms. However in the case of wethers only 4 farms employed alternation or rotation, 16 being set-stocked and 3 going to the mountains after shearing.

Camp Quality and Class of Stock

Questions were included from which it was intended to find out why any camp was chosen for the particular class of sheep occupying it. This objective was not attained but this may not be surprising since 12 out of 23 said they never changed this relationship, a further 3 saying they only rarely did so. Nevertheless the remaining 8 had changed or were prepared to change. This was particularly true where an improved lamb marking percentage was being sought. The change might be either permanent or temporary. From general discussion with the Managers it become obvious that the priority list for the best camps is

ewes
hoggets
shearling ewes
wethers.

3. Lambing

Shepherd's Chores

There was general agreement that righting cast sheep, and skinning dead sheep took up the largest part of the shepherd's time at lambing, although the Managers laid equal stress on the need to help a ewe to lamb if she was seen to be in difficulties. Other points raised in discussion were mothering-up separated ewes and lambs, moving ewes to keep them active, moving ewes off poor feed, and minimum disturbance by either humans or dogs. Some of these aims are contradictory.

No attempt was made to move lambed ewes into a different enclosure after lambing.

Incidence of Twinning

It has already been noted that twins are not wanted in the camp flocks. There was unanimous agreement that if a ewe had twins in either stud or camp flocks, nothing would be done to prevent her from rearing them.

There was considerable diversity of opinion about the proportion of twins born. Estimates for stud flocks varied between 1 and 10 per cent (12 out of 15) but was held to be not more than 3 per cent in camp flocks by 15 out of 21 Managers.

4. Marking

Marking by using special pliers, and tailing by means of the knife were universal. Rubber rings were used for castration by 17 farms, cord-crushing pliers by 5 while both methods were in use on one farm.

5. <u>Weaning</u>

Weaning imposes a considerable stress on the lamb and since travel imposes an added strain at that time, information on such travel was sought. Inevitably there was considerable variation according to the size of the station and/or the proximity of the ewe camp to that allocated to the weaned lambs. In 13 out of 19 instances the journey to the weaning point took 1 or 2 days, and in one instance longer. The stay in the vicinity of the weaning point was a day or less in 12 cases out of 16 where an estimate was made. The outward journey was a day or less on 16 out of 20 farms. In addition to these there was the exceptional case of Packe Bros where a segmented holding resulted in a delay of up to 5 weeks between the initial gathering and arrival in the wintering ground. Rest is obviously possible in such an arrangement.

6. <u>Dipping</u>

Of the 22 farms which gave information, 5 are exempted from the statutory dipping. Of the balance 12 used a BHC type and 4 an organo-phosphorus type of dip. The position was somewhat different in off-shear spraying or showering practised by 12 farms. On one of these, both dieldrin and organo-phosphorus types had been used in 1969/70 for off-shear spraying. Dieldrin was used by 3, BHC by 1 and organo-phosphorus types by 7 farms.

V. MILK AND BEEF PRODUCTION

1. <u>The Functions of Cattle</u>

All 23 Managers consulted agreed that the production of milk and butter for the human population is the primary reason for keeping cattle in the Falkland Islands. Only one Manager would disagree with that statement if applied to his own farm. At Port Howard a relatively high ratio of cattle to sheep is kept to act as grazing machines for the improvement of camp pasture. Three others mentioned grazing control as a function of the cattle but as third in order of importance. All regarded beef as a useful and essential by-product of the cows, and noted this function second. Only two Managers recognised a clear-cut division between milk and beef cow herds.

2. <u>Breeds and Crosses</u>

Herds consisted of an agglomeration of breeds in which the influence of the Welsh Black, Hereford, Red Poll, Ayrshire and Friesian breeds could be seen and was described. There was visual evidence of the Shorthorn and Highland breeds having played their part too. The only near-pure cattle were at Port Howard (Ayrshires) and Douglas (Welsh Black).

The stated breeding objective was for a dual-purpose type, the aim of 14 out of 19 who were willing to nominate a type.

3. <u>Calving Dates</u>

Calving dates were planned on 11 out of 23 stations with an "average" arrangement of 70 per cent of the calvings wanted in spring and 20 per cent in autumn to ensure a supply of milk during the winter. Autumn calvers required supplementary feed which was usually supplied as oat hay or tussac (cut or grazed) but on some farms Yorkshire fog hay was supplied. Rape, kale, swedes and silage were also named on individual farms, but the quantities involved were not great.

Such special crops were also available on farms where calving was acknowledged to be at random. Here, too, the predominance of spring calving was agreed. On 2 farms it was stated that cows only calved in alternate years. On 5 farms out of 23 supplementary feed was not provided.

4. Castration of Calves

This operation was performed at any age up to 10 months but there was a marked tendency to castrate with a rubber ring at ages up to 6 weeks (9 out of 16) or with the knife at 5 months or more. A cord crusher was used on one farm. On a further 5 farms the age of castration was given as the range 1-4, 1-6 or 1-7 months. On these 3 used the knife only and 2 used rings on the younger and the knife on the older calves.

5. The Grazing of Cattle

There was no pattern of distribution of stock in the camps except the obvious one that the milk cows were kept close to the settlement or outside-shepherd's house. The answers of those who expressed their views on the allocation of cattle to camps were approximately these:-

Into one or more groups of cattle to clear roughage by mob-stocking.

Completely at random.

Into age-groups.

According to class - dry cows or steers or dairy replacements.

Two of the 23 Managers moved the cattle around camps according to a plan; the remainder employed set-stocking.

6. Bringing in Calving Cows

The question on withdrawal of cows and heifers from the camps around calving was intended to find out how easy or difficult it was to inspect the dry cows at frequent intervals. The answers showed that the question was not sufficiently explicit. Five Managers said that the cows were close to the settlement so that no special inspection was necessary. A further 5 made inspections regularly or irregularly at intervals of 2-6 weeks. There were 13 farms where a fairly definite statement was made about the time of withdrawal from the camp.

TABLE 15

STAGE OF TRANSFER OF COWS TO THE MILKING HERD

	Before calving	At calving	After calving
Cows	2	6	5
Heifers	5*	3	5

In 2 instances where heifers were withdrawn from distant camps before calving (*) this was in order to run them with the bull.

The cows are hand-milked while the calf suckles other quarters. Normal practice is for a household to be allocated certain cows which the women then tend and milk. It is unusual for a settlement herd to be tended by one person and the milk distributed to households.

7. Sales of Beef

It has been stated that cattle for beef are recognised as a by-product of milk production. Of the 23 farms only 11 sold cattle for beef and sales from 4 were at irregular intervals. Three of the remaining 7 were Falkland Island Company farms selling at least half of their annual production of suitable animals. However, it should be noted that the question on the proportion sold is ambiguous.

On 3 farms the cattle were 2½-3½ years of age when sold and on 7 they were 4-5 years. April to August appeared to be the season for beef, although one island with a regular order supplied beef all year.

CHAPTER 5 - GRASSLAND IMPROVEMENT TO DATE

Over the past 20 years or so most farms have made efforts of one sort and another to improve grassland. During the Team's visit most of this work was inspected. The reasons for success or failure of the improvement on the farm as a whole were discussed. This chapter reviews the main methods adopted and attempts to assess their value in the economy of the farms.

I. RESEEDING PRACTICE

Various methods of reseeding have been attempted. Most farms have followed the convential system of destroying the existing sward by ploughing or rotavating before seeding out. Others have drilled seed direct into swards with sod-seeding drills or oversown without cultivation. The method adopted on any particular farm has been determined largely by the type of soil and herbage cover present. For practical purposes the methods used can be discussed under the two broad heads of diddle-dee camp and whitegrass camp.

1. Diddle-dee Camp

Most of the conventional reseeding carried out has been on camp either at present growing diddle-dee of various heights and densities or on hard dry ridges. These may have grown diddle-dee at one time but are now sparsely covered by dwarf Christmas bush and fine leaved grasses. The reasons for the choice of this type of land for reseeding appear quite logical. First, in their original state they offer very little grazing. Diddle-dee is hardly ever grazed though from the "sculptured" appearance of some of the "bogs" stock obviously nibble new young shoots keeping them pruned. Christmas bush seems never to be grazed. The "finer grasses" on this type of soil are dry, hard and unpalatable. A main one, Aira praecox (goose grass), is an annual and dies off completely during dry spells. Second, the soil under most diddle-dee is a peaty loam and reasonably dry. It is therefore more amenable to cultivation than the pure peats found elsewhere in the Falklands.

The first problem in reseeding diddle-dee ground is the destruction of the top-hamper of existing scrub. In the Falkland Islands this can be considerable. Diddle-dee frequently grows to a height of two to three feet with woodybranches ½ inch to ¾ inch in diameter. This has been tackled in a number of ways. The most popular because of speed and cheapness has been burning. Burning of diddle-dee has been condemned in previous reports. The pros and cons of burning are discussed elsewhere in the report but at this point it is necessary to refer briefly to the distinction between haphazard or accidental burning which is left to recover naturally and burning with a purpose. Burning of diddle-dee as a planned operation within an overall programme of reseeding has proved a perfectly efficient and acceptable method of destroying top growth which would otherwise impede cultivations. In one respect it is superior to other methods. On the soil surface at the centre of every diddle-dee "bog" is an accumulation of dry, dead, undecomposed leaves very similar in appearance to tea leaves. Seeds establish very poorly in this material. Several Managers believe that it contains some substance which prevents seed germination. It seems more likely that the loose, dry nature of the material resists wetting and consolidation so that conditions suitable for germination are not attained. Burning helps to destroy this material.

Other means used to destroy diddle-dee top growth prior to reseeding are heavy rolling, smashing down with towed girders and other improvised heavy harrows and mowers of the "slasher" type. All have proved satisfactory but rolling, smashing and slashing with machines of the type with cutters that revolve in the horizontal plane still leave quite long branches of diddle-dee which are difficult to plough in or which interfere with rotary cultivation. The Team imported a flail mower the slashing cutters of which revolve in a vertical plane. This reduced diddle-dee leaves and twigs to dust and even the stronger woody branches were chopped into lengths of four to five inches.

Pretreatment of scrub is followed by ploughing or rotavating. Managers tend to favour one method or the other. The ploughing enthusiasts were liable to take us to see areas where they had tried rotavating and found it inferior. Similarly keen supporters of rotavation had ploughed areas which were not as successful as their favourite method. Despite this we felt that either method was perfectly acceptable and are happy to leave the choice to individual tastes and equipment available. In the past vast areas have been reseeded in single blocks and as cultivation tends to level out the land rather open shelterless stretches of country have resulted. More recently there has been a move to reseed in strips leaving bands 10 to 12 yards wide of the original diddle-dee to act as miniature shelter belts. This is excellent practice.

Where there is little scrub to be dealt with ploughing or rotavating has been done without pretreatment. In one case land of this sort was merely disced before seeding. It was very successful. Rather more of the original plants re-established themselves than with other methods but as reseeds tend to be rather thin under Falkland Islands soil conditions the presence of indigenous plants to complete the ground cover is not altogether a bad thing.

The light loamy soils under diddle-dee are very liable to blow away when they dry out following ploughing or rotavating. It is common practice therefore to seed out as soon as possible after the ground is broken. Though this has much to commend it, consolidation difficulties often arise. These are discussed in Chapter 9.

The drilling of seeds is virtually universal. Bearing in mind the light dry nature of the seed bed and the dangers from blowing this is good practice. Two types of drill are in common use. One is a modified corn drill. It is modified only in the sense that it is thoroughly strengthened in all parts to withstand rough use in camp. The other, known as the "Brillion", is a drill composed of two Cambridge-type rolls which delivers the seed between the rolls. Both are quite effective though the "Brillion" does not bury the seed very deeply and this could lead to difficulties if seed brairded and was then subjected to prolonged drought.

Timing of operations seems to be geared more to the availability of farm staff than to a serious attempt to sow at the best time for establishment. In actuality the best time for seeding is not known as no-one has worked on the problem systematically over a series of years. There seems to be a growing body of opinion, however, that late summer to early autumn is safest. The soil is moist and warm after mid-summer rains. There are exceptions of course. The autumn of 1969 was dry and many areas had to be resown in the spring later the same year. On many farms work on ploughing and preparing ground for reseeding can only be undertaken in winter time when work on sheep is minimal. Such farms are committed to spring seeding.

Seeding is usually followed by rolling yet the value of rolling light, dry peaty soil is suspect. As soon as the roll passes the soil normally springs up to its previous level. Cases were seen where small areas were rolled up to 20 times without seemingly achieving anything. Best establishment is always in the tractor wheel marks.

Yorkshire fog is normally the only grass sown. Experience has shown that it is the most dependable species to establish itself in the poor acid soils of the Colony. Seed rates are 8 to 12 lbs husked seed to the acre. In spite of this ability to establish under the conditions Yorkshire fog has considerable deficiences as a herbage plant for all the year round feeding of sheep and the Team believes should be supplemented with other species. This point will be dealt with later in the report.

Since areas to be reseeded in any year may be large and often situated at considerable distances from Settlements the usual procedure is for one, two or more men of the farm staff to undertake reseeding during winter on a contract basis. They are provided with a caravan sited conveniently near the work and supplied with tractors, equipment and stores. They are thus able to make the best use of daylight hours to do as much field work as possible. The usual arrangement is for them to receive normal wages plus an agreed acreage payment for completed work. The present rate of payment is 10s 0d to 20s 0d per acre.

In estimating the cost of reseeding it is usual in the Falklands to take account of labour costs including contract payments, fuel and seeds but to omit depreciation charges on machinery. Overall costs as low as £2 14s 0d per acre have been quoted for reseeding using a rotavator and (Guillebaud 1967) quotes £5 7s 1d per acre for a small acreage reseeded using the plough. At present value of money a figure of around £5 per acre would probably be realistic and this would be increased if a depreciation charge on machinery were included. Depreciation must be relatively high bearing in mind the rough conditions under which the machines operate.

Establishment of the new pastures is very slow by United Kingdom standards. At least a full year is required to obtain even a modest ground cover in most cases. The Yorkshire fog is usually allowed to seed itself in an attempt to make it thicken up. A satisfactory take may not be obtained until the third year after reseeding.

2. <u>Whitegrass Camp</u>

Very little conventional reseeding has been carried out on whitegrass camp which is mainly found on the wetter more peaty soils. Whitegrass is a particularly tough plant with a tussocky habit of growth. It has strong thick roots. Ploughing is slow and laborious as the 'bogs' are difficult to detach and bury. Rotavators make heavy going of whitegrass and often detach pieces which do not become incorporated with the "soil" beneath. A reasonable seed bed is therefore difficult to make and consolidate.

Reseeding of whitegrass has been accomplished in some instances however. One of the most successful methods has been to burn after rotavating. This virtually removes the whole of the surface remains of the whitegrass "bog" and root exposing a fresh, firm surface of peaty soil covered with fire ash. This can be reseeded with a minimum of further cultivation. In spite of the success of this technique however it is a distinctly hazardous practice. The fire is very difficult to control and extinguish. It may well burn into the peat much deeper than anticipated. Managers who have tried it, while pleased with the results achieved, are unlikely to take this risk. It is described here however for the sake of completeness. A similar effect could probably be obtained by rotavating in autumn and leaving the area over winter, or longer, to try to get rid of the spongy surface vegetation by weathering.

Most of the work on introducing grass seeds into whitegrass camp has been done by various methods of oversowing and sod-seeding. At their Darwin farm the Falkland Islands Company carried out an extensive programme of sod-seeding over the years 1956 to 1960. A large heavy machine was used to drill seed of Yorkshire fog direct into whitegrass camp. Judging by the remnants visible today the initial take of seeds must have been good. The drawback to the machine was that it carried only three reseeding tines and these were very widely spaced at intervals of 2 ft 3 ins to 2 ft 6 ins. It was for the most part used in the tall, dense whitegrass typical of Lafonia. Probably as a result of shading and competition from this type of whitegrass very little lateral spread of the Fog by self-seeding seems to have taken place.

During the last year or two a different type of sod-seeder has been tried, again on a Falkland Island Company farm at Port Stephens, and in a different sort of whitegrass sward. The machine is a Rotaseeder. This works more on the principle of the rotavator with vertically revolving tines cutting out and completely removing narrow channels of turf. Seeds are dropped into the soil exposed in the bottoms of the channels. The rows of seedlings are approximately 7 ins apart so that a much more complete ground cover is achieved from the start. Where sod-seeding with this machine has been carried out the herbage is short, straggling whitegrass in association with Oreob. It is too early to make a final assessment of the success of this work as much of it has been carried out only in the last year. At present however it looks most promising. Cross drilling with the machine in an attempt to obtain an even greater ground cover has not been successful as it tears the ground too severely.

Examples of surface oversowing of Yorkshire fog seed on soft and hard camp can be seen on many stations. At various times in the past certain Managers have encouraged shepherds to carry bags of Yorkshire fog seed with them on their horseback journeys into the camp. The seeds trickled from holes made in the bags and trails of plants resulting from this practice can often be followed for miles across the camp. More organised broadcasting of seed has also been carried out often with remarkable success.

One of the difficulties in oversowing seed into the open camp is that the germinating seedlings suffer considerably by competition from the existing herbage. Davies (1939) recommended oversowing soft camp following burning to remove the accumulation of dead herbage.

II. OTHER METHODS OF IMPROVEMENT PRACTISED

White reseeding is the most spectacular method of grassland improvement it is neither the only one nor necessarily the best one for all situations. Various other methods have been adopted by Managers over the years. The principal ones are discussed below.

1. Sub-division of Camps

The Team found evidence on most stations of some progress towards sub-division. Indeed most Managers had pressed on with this work as quickly as they had been allowed by their Directors. Many had plans in mind for further sub-division. In several cases approval in principle had been given for expenditure on extra fencing over the next few years. The Team gave advice where it could on the siting of these new fences.

It would be wrong to give the impression however that camps were being sub-divided into many small units. The name sub-division itself may even create the wrong impression and internal fencing might be a better description. It is true that many of the very large camps have been and still are being reduced in size but the object in most cases has been to facilitate sheep management rather than to improve pastures. Many of the larger camps were difficult and expensive to gather. Smaller camps can be gathered with fewer men and clean gathering is important in sheep management and disease control, particularly Ked control. On farms where sheep have to be driven long distances to and from the settlement sub-division of camps has been carried out in order to provide conveniently placed holding and resting paddocks. This clearly helps sheep management problems. A table showing the distribution of camps according to size in East Falkland, West Falkland and the islands is given in the appendix. The majority are between 1,000 and 8,000 acres on the main islands and below 4,000 acres on the smaller islands.

A minority of farms have however deliberately sub-divided camps to improve the grassland or to make better use of areas of superior quality grass within a camp. Fitzroy has for instance divided some of its ewe camps into three parts, one large area of poorer herbage and two smaller areas of better grass. The ewes are confined to one or other of the better areas during lambing. Improved nutrition at this critical time is provided and the shepherd can see all his ewes every day. This is a very important concept and is dealt with in greater detail elsewhere. Many of the smaller islands and even farms on the main islands that still have Poa flabellata (tussac) have erected considerable lengths of internal fencing to ensure proper utilization of this valuable grass. In a similar way islands and farms with sand erosion problems have fenced off areas planted with or colonized by marram grass so that it can be protected from grazing at appropriate times. On many farms badly eroded areas and clay patches have also been fenced to give them protection in hope that natural regeneration will occur.

An interesting experiment in sub-division has been carried out over the past 10 to 12 years at Port San Carlos in order to provide what have been christened "Concentration Grounds". The practice has been to fence off relatively small areas of large camps. All the sheep normally in these camps are confined in the "Concentration Grounds" during late summer - from shearing to dipping. The object has been to rest the main part of the camp to improve it sufficiently to carry the flock in better condition over winter.

All the farms that have reseeded areas of camp are now alive to the necessity of fencing off these improved portions in order to make fullest use of them. In some cases sub-division in this sense has already taken place though obviously it is not always convenient or economical to run the new fence exactly along the edge of the reseeded area. It is sufficient to enclose an area which is mostly reseeded land.

2. <u>Rotational Grazing</u>

Probably the only farm to sub-divide camps into areas of approximately equal size with the intention of improving the grassland by rotational grazing with stock including large numbers of cattle is Port Howard. Four quite separate groups of five to seven paddocks each around 2,000 acres each have been produced by sub-division of existing camps. One hundred and sixteen miles of fencing was used.

The Team inspected the group of paddocks know as 'Six Hills' and some of the paddocks in the 'White Rock East' group. The grass in the former group was very green when seen in late summer (February) but it was not possible to tell whether this was due to the rotational grazing or the Manager's burning policy. All the grasses present were native species and again it was not possible to tell on the basis of a single visit whether there had been any great change in the vegetation. We were assured however that changes had occurred, in particular 'Front Six Hills' paddock which had once been a 'black ridge' composed of small fern, Christmas bush and dwarf diddle-dee was now dominated by whitegrass.

3. Burning

Burning of camp is a very emotive subject in the Falkland Islands. Managers, indeed all farm staffs and Stanley townsfolk, are either strongly in favour or violently against it! The main argument against burning is that the dominant species present, diddle-dee or whitegrass as the case might be, is unpalatable and of low feeding value. It is of use only in so far as it shelters and protects the better quality "finer grasses" growing amongst it. If it is burned it is claimed that the heat generated will be sufficiently great to kill off the finer grasses. On the other hand those in favour of burning argue that under a heavy top growth of whitegrass or continuous diddle-dee the finer grasses are smothered and not able to contribute as they should towards feeding the sheep. If the top hamper is burned off light and air is able to enter and cause the finer grasses to tiller out and contribute more nutritious green herbage. As to the point about the fierce heat burning the better species it is claimed that the first burn can be done carefully when conditions are right so that it merely singes off the unwanted material. If then it is burned again before too much dead material accumulates a great heat is not generated and the finer grasses are unharmed. Certainly the regrowth after burning whitegrass is fresh and green and more likely to be grazed by the sheep. It should not be thought that the anti-burners take a purely negative view. Most firmly believe that many camps have been too severely burned in the past and by refraining from further burning they are improving the quantity and quality of finer grasses.

Practically all managers are prepared to burn wet soft camp as there is little risk of the fire burning in. Burning is almost always confined to the very early spring before the soil dries out too much. In the past shepherds were often issued with "camp" matches and allowed to burn almost where and when they wished. Nowadays, even on stations where burning is allowed, Managers exercise strict control over firing of the camp.

Until recently there was little alternative to burning but with the advent of flail-type mowers it is possible to remove top-hamper and leave the better grasses below untouched. The Turbomower imported by the Team dealt successfully with diddle-dee and all whitegrass except that formed into large bogs. It is clearly an alternative to burning though slower and more expensive. Many may consider its safety more than out-weighs its cost.

4. Spelling

Most farms make some effort to rest or spell camps from grazing from time to time. The object in doing so is twofold. First by resting it is anticipated that a fund of herbage is built up for grazing off later. Second, an opportunity is provided for grasses to reseed themselves. Spelling is achieved usually by turning sheep on to "summer camps" often on the higher ground on the farm; sometimes by special concentration grounds; occasionally where overall stocking of a farm is low by alternating grazing on different parts of the farm at different seasons.

The Team has doubts about the value of spelling as at present carried out. In the first case it seemed to us that while spelling may result in bulk of herbage being built up usually it is well past the green, leafy nutritious state before the sheep are turned back in. Second, we saw little evidence of new seedlings establishing after spelling. We may have been unlucky as Davies (1939) states "After the rainy spell in January, 1938, large numbers of fresh seedlings of native grasses and herbs were found everywhere". In this statement he is referring specifically to hard camp but spelling also takes place on whitegrass camp.

5. Drainage

The Colony, especially the south, does not have a very high rainfall. Furthermore the continuous strong winds cause considerable evaporation. Nevertheless, very large areas of ground are extremely wet due to the peaty nature of most of the soils. Where there is continuous water-logging only the poorest of grasses and other plants are able to grow. Several years ago a Government scheme existed for making camp tracks. The equipment acquired for this venture included two Cuthbertson ditching ploughs drawn by Buffalo tractors one for each of the main islands. In addition to their track making work these ploughs did a certain amount of ditching on farms. Some farms used them extensively in two ways. First, localised wet patches were drained by special ditches. Second, in camps which were generally wet, regular ditches were drawn in an attempt to dry out the whole camp. Very many miles of ditches were drawn in this way. The Team was told that as a result camps were now being grazed which were impossibly wet before but no convincing data were presented to show an overall farm advantage in terms of extra stock carried. Visually it seemed that in some cases there was an improvement in the grassland for about a yard on the side of the ditch where the spoil furrow was thrown - in fact the yard of ground between the ditch and the furrow. Even here it was not clear whether the improvement was due to the drainage itself or the fact that sheep, possibly using the furrow for shelter, had grazed more closely and deposited more dung and urine in this area.

The most important aspect of drainage is concerned with the opening up and/or straightening of natural ditches and streams which cause considerable losses of sheep, particularly hoggets, from drowning. This is not a new problem in the Falkland Islands. Creeks, ditches and holes were put forward as a major cause of sheep mortality to Munro in 1924. It is remarkable that this state of affairs has been tolerated for so long. The peculiarities of the ditches are described elsewhere in the report. The best way to minimize these hazards without using a considerable amount of hand labour seems to be to cut, with machines, new channels adjacent to the present ones using the spoil to fill in dangerous places. The machine must be capable of working near the edges of the ditches and streams without becoming bogged. While a small rear mounted hydraulically driven scoop may be suitable, it is also possible that a drag-line type machine working from a distance may be necessary. If large machines are found to be essential government financial assistance might be required before they can become available to all farms. This aspect is discussed in Chapter 23. The need to cut down the appalling loss of young sheep from this source is so vital to the Colony that it is recommended that government assistance be considered whatever type of machine is found to be necessary.

There is one danger in the wholesale re-cutting of ditches that must be mentioned. The offending ditches and streams run though green valleys and greens which provide excellent grazing. They are able to do so because of a continuous high water table and high fertility due to valley flushes. If new drainage channels draw off too much water too quickly the green valleys and greens may dry out and fail to provide sufficient grass for the heavy concentrations of sheep which habitually graze on them. The surrounding peat might be dried out also. On the other hand these dangers have to be set against present losses. The Team believes that a great amoung of valuable reshaping of ditches is possible without excessive drying of greens and green valleys. Clearly, however, the shape, size and line of each new ditch must be carefully thought out before work commences.

III. ASSESSMENT OF RESULTS OF IMPROVEMENTS TO DATE ON FARM ENTERPRISES AND ON THE COLONY'S OUTPUT

In the preceding sections an attempt has been made to describe improvements already carried out on many Falkland Islands farms and to give credit for these efforts. It is therefore disappointing to have to point out now that these improvements have not resulted in an increased number of sheep being carried by the Colony, 620,932 in 1967-68 compared with 626,863 in 1963-64, nor increased output of wool, 4,691,000 lb in 1969 compared with 4,840,000 lb in 1964. Neither have any great changes been apparent on individual farms with one or two notable exceptions. It is important to try to understand the reasons for this state of affairs.

It is an unfortunate aspect of most of the improvements that have been carried out so far that they have not increased the amount of winter grass available. Since winter stock carrying capacity is the bottleneck on all extensive sheep farms it follows that mere improvement of summer grass production does not permit an overall increase in stock numbers.

The problem is further complicated in that improving summer grass production without an appropriate overall increase in stock numbers only aggravates the difficulties of properly utilizing summer grass. Much of it is liable to be wasted. Ultimately the whole effort of improvement may be largely wasted. Reseeding with Yorkshire fog seems particularly liable to this hazard. While flying over the islands during the summer areas of Yorkshire fog could be seen to change colour from green to pink as seed heads were put up, then to brown in January as the seed heads became mature and set seed. It is difficult to understand why this potentially productive and relatively nutritious grass should be allowed to reach a stage of maturity where its feeding value is almost nil.

One reason often put forward is that fog is allowed to set seed in order that the sward can "fill up" that is, achieve a better ground cover. There does not seem to be much evidence that this occurs. Many very old stands are cearly still in the rows in which they were sown. However it is conceded that there may be a case for allowing fog to seed itself one year or in occasional years. There does not seem to be a case for allowing all the fog on any one farm to seed in the same year as appeared to the Team to happen in 1969-70. From discussion the impression was gained that nearly all Yorkshire fog seeds every year.

The problem of Yorkshire fog becoming too mature is further aggravated by the use of summer camps. This practice has something to commend it from the point of view of spelling native camps. The feeding value of the herbage on the summer camps, often mountain camps, is not high but, provided it can be corrected before winter, a period of poor nutrition for some classes of sheep between shearing and dipping need not be disastrous. The use of summer camps can be good if it allows areas which include 'greens' and 'Bog' whitegrass to be spelled so that they produce green herbage which can be saved until autumn. But, when Yorkshire fog is rested at this time it produces little more than a fibrous seed head which carries two or three leaves up with it.

The Team may have received a wrong impression when it arrived in the Colony in September 1969. The preceding winter had been an unusually severe one we were told and the spring was certainly cold and rough. However, at that time all the Yorkshire fog was completely white right down to ground level and as lambing had commenced it could not possibly have contributed much to the nutrition of the ewes at this critical stage. Nevertheless it has been stated that Yorkshire fog puts up a slight amount of growth even through the winter (Miller 1966).

The object of this section of the report is not to be critical of what has happened in the past. Rather it is to draw attention to the point that grassland improvement undertaken without proper attention being given to how the better pastures can be utilized in the context of the farm as a whole may well result in less than the anticipated impact on output and hence on profitability. Recommendations for better utilization of improved areas in future appear later.

CHAPTER 6 - WHITE CLOVER AND OTHER LEGUMES

The role of legumes in the economy of grassland farming is well known. They have two outstanding qualities. First, they provide a palatable herbage which is of high feeding value being especially rich in protein and minerals. Second, through the agency of nodule-forming bacteria on their roots they are able, unlike grasses, to make use of atmospheric nitrogen. Nitrogen is an essential element for plant growth. These two factors are capable of starting a whole chain of desirable changes in any sward containing legumes. Surplus nitrogen is taken up by the associated grasses which grow better and are more nutritious. Stock are attracted to the area to graze the palatable legumes and they return fertility to the soil in their dung and urine. The activity of soil fauna and flora increases and this helps to discourage the formation of an undesirable "mat" of partly decayed vegetation.

It is therefore not surprising that previous visiting and resident agriculturalists have laid great stress on the desirability of introducing legumes into the pastures of the Falkland Islands. For example, William Davies wrote in 1939; "Wild white clover may be regarded as the fundamental plant in any scheme of grassland improvement contemplated in the Falklands. Indeed it has been shown to play this role over a very wide area of world grassland in temperate regions". The Team was obviously very conscious of the advantages which might follow the successful establishment of legumes in the pastures of the Colony. The grassland specialists, therefore, devoted part of their time to a study of the factors involved and consideration of the overall significance of the part legumes might play in the economy of the farming system carried out in the Islands.

There is no record of any native legume in the Falkland Islands. Gorse and a few other members of the family have been introduced in the past. Several of our predecessors attempted to introduce legumes into natural and sown swards in the Falkland Islands with varying degrees of success. The legumes which have succeeded in establishing themselves are Trifolium repens (white clover), T. subterraneum (subterranean clover) and T. dubium (yellow suckling clover). The two latter plants are annual, self-fertilising species. While a place can be recognised for yellow suckling clover since it is suited to temperate zone grasslands, it is more difficult to reconcile subterranean clover with Falkland Island conditions as it is a species adapted to Mediterranean regions.

The productivity of yellow suckling clover by temperate zone standards is low, consequently the species has received scant attention from plant breeders. It is also a rather difficult plant to harvest for seed production and as a result its availability on the seed market is erratic. In the Falklands the species is quite common on the heavily grazed paddocks near settlements and occasional plants are to be seen in the camp in areas where stock congregate and keep the native herbage short. Under the natural canopy conditions of camp flora, however, no yellow suckling clover has been seen.

White clover in the form of wild white clover is quite common in settlement paddocks but rarely found in camp even where it has been introduced. It is also common in and about Port Stanley where it often grows vigorously. In these situations, however, it is usually associated with lime products such as concrete. Thus, the best clover is often seen near road verges and the walls of buildings.

Various attempts were made by Davies, Gibbs and Young, to establish white clover under camp conditions and many sites established by these workers were visited by the Team. Results to date are not encouraging - at some of the old experiment sites none at all was found and in others the clover, where it had persisted, was small, unthrifty and of low productivity. For white clover to thrive, it needs a moderate to low acidity level and a supply of phosphate. The importance of white clover in United Kingdom swards was only recognised at the start of this century and its widespread adoption was possible because cheap phosphate fertilisers were readily available. The extensive use of white clover in New Zealand is also coupled with the introduction of phosphates. Another factor necessary for the satisfactory growth of white clover is a moderately damp soil. It does not thrive under dry surface conditions as it is a comparatively shallow-rooting plant.

These conditions are not found in the camp in the Falklands. Acidity is generally high with pH values of around 4.5. Available phosphates are in short supply and for parts of the year at least the surface layers of soil can become very dry. In addition white clover, because it is not indigenous to the Falkland Islands, needs to be inoculated with bacteria which are necessary for its growth. In the face of all these factors it is not surprising that white clover has not established itself and become widespread under camp conditions.

The Team could not embark on complicated trials on any subject during its short stay in the Colony. Nevertheless the question of establishing clover is such a vital one that part of the time given over to experiments was devoted to work on clover. After reviewing previous results it was decided to concentrate on two aspects. The first covered lime and phosphate requirements. These fertilisers are normally imported to the Falkland Islands from the United Kingdom and the cost is naturally very high - prohibitively so. It is possible that cheaper sources may be available if attempts were made to locate them but at best they would be relatively expensive owing to the remote and isolated position of the Falklands. Further, the cash output of sheep farming for wool is so low per unit of land that very little, if any, expenditure on fertilisers can be justified. It was felt, therefore, that an attempt should be made to establish the minimum dressing of lime or phosphate or both which would be necessary to enable white clover to "take" and maintain itself.

The second aspect concerned the inoculation of clover seed with suitable bacteria for nodulation. Davies (1939) reported successful nodulation on clover grown in pots where the soil was inoculated with a sprinkling of soil from an area where clover was known to thrive. Partial success with the same method under field conditions was also achieved. Later experiments by other workers using cultures of bacteria, a more conventional method, have been less successful in inducing nodulation. Since they often had to pass through the tropics on their long journeys from New Zealand, Australia or the United Kingdom, there was some doubt as to whether or not they had retained their viability. The Team was fortunate in having the laboratory so that it was able to prepare its own fresh cultures from local plants for each experiment. The method of Dr Parker of the C.S.I.R.O. of Australia was used. Doubts about this aspect were, therefore eliminated. A simple experiment concerned with rates of lime, rates of phosphate and inoculated versus uninoculated seed was devised and laid down. Details are given in the appendix. The final results of these experiments will not be available at least until March 1971. The present indications are that phosphate is extremely important while lime may be less so.

We are conscious, however, that our experiments were limited both in the factors covered and geographical spread. There is evidence from many sources that trace elements such as copper, sulphur and molybdenum can help in establishing clover on peat soils and moreover enable dressings of basic fertilisers to be reduced. New and more effective commercial bacterial cultures are becoming available. We learned when we were in Patagonia, for instance, that promising results were being obtained by using a new "Universal" culture under conditions where old cultures were ineffective.

There is clearly a need for a considerable amount of experimental work to be undertaken before it can be decided whether white clover can and ought to be propagated generally over the Falklands. The Team is of the opinion, however, that it is unlikely that widespread sowings of clover in the open camp will be justified in the foreseeable future. On the other hand there are areas such as greens and green valleys where moisture levels are fairly constant and fertility conditions relatively high. With adequate phosphate fertilisation in the year before sowing and the use of properly inoculated seed, preferably drilled into the soil, conditions should favour rapid establishment of white clover.

Other perennial legumes which have been considered for use in the Colony and sown in experiments by some workers are Medicago sativa (lucerne) and Onobrychis viciaefolia (sainfoin). Both are unfortunately more sensitive to soil acidity than white clover and they can be considered even less likely to be of any economic importance.

An annual legume, Serradella, was tried by Young with discouraging results. There does not seem to be a place for annual and short-lived perennial legumes under Falkland Island conditions. Costs of establishment are high in proportion to returns. Any resources made available for investigational work with legumes should therefore be confined to the establishment of a long-lived species such as wild white clover. This would at best be a long-term project, however. If facts are faced squarely there is little prospect of a rapid spread of clover over the whole of the Islands in the next few years - yet economic difficulties have to be faced now. We believe, therefore, that clover comes into the "Pie-in-the Sky" category and that farms would be better advised at this stage to concentrate on other measures.

CHAPTER 7 - TUSSAC (POA FLABELLATA (LAM.) HOOK.)

Tussac is a most unusual and interesting grass. Normally it is found growing in huge "bogs" consisting of a stool or trunk 6 feet or so high with a large spreading mop of leaves 2-3 feet long on the top. The stool consists of the undecayed leaf bases and roots of countless previous tillers showing that the "bogs" are frequently of a very great age. The leaves are succulent and very nutritious. Tussac differs from other native grasses found in the Falkland Islands in its ability to resist desiccating winds and remain green. Moreover it carries this summer-produced green stuff into the winter without it drying off. Such is the canopy produced by "bogs" of tussac that even after extended periods of dry weather with high winds the ground underneath remains wet. Coastal plantations are frequented by Magellan penguins and seals which undoubtedly raise soil fertility considerably.

Falkland Islands literature of the nineteenth century describes a fringe of tussac along the entire coastline. This, it is understood, was frequently burned by sealers in pursuit of their trade. Eroded areas following such burning are still in evidence on many of the islands today. The present position of tussac has changed but little since 1924 when Munro, in his report, stated "the extent to which the large Tussock has been destroyed, particularly on the western island, and the total absence of any serious effort to replace the old bogs appears to me to be very regrettable. In view of the fact that this can probably be classed as one of the most nutritious grasses in the world it is quite remarkable to see it so much neglected in a country where nutritious vegetation of any kind is all too scarce". Nowadays tussac is present in sufficient quantities to be of significance to the sheep-farming industry only on some of the smaller islands - in particular, Sedge, Carcass, West Point, New and Sea Lion Islands.

The plant is used for sheep-grazing on these islands mainly during winter. On some farms it has been replanted and its area even extended on to land of a type on which it does not seem to have grown before with every sign of success. It has been observed growing well in places inaccessible to sheep up to three miles inland under conditions which would not by any means be considered ideal. Farm records show that tussac can carry 14 sheep per acre for the winter months of May, June, July and August and in some cases has done so for the last 70 to 80 years without any noticeable deterioration of the stand. Such areas have, of course, been rested for the remainder of the year. These figures demonstrate winter forage production of a high order in any context and as will be seen elsewhere in this report under circumstances where winter grazing of any sort is at a premium. The potential of tussac as a winter fodder producer, therefore, cannot be ignored. Traditionally it has been cut for winter feed for cattle and horses. Under this management where the leaves are cut once in the year and the plant is allowed to recover for the remainder of the year tussac persists extremely well.

Controlled summer stocking is also possible if the plant is rested at other periods. It is essential for fencing to be arranged so that stock have access to the tussac for a limited period of time only. It was once thought that summer grazing would kill tussac. Today, however, several of the small islands graze the grass throughout the summer and, provided it is adequately rested on the basis of six months on and six months off, it does not seem to come to harm. Whether cut or grazed, therefore, tussac must be given a period to recover before it is utilised again.

Tussac is of especial value to the sheep economy of the smaller islands where high stocking rates are essential to provide adequate cash output. It must, of course, be fenced off from non-tussac grassland. Recent experience on the small islands has shown that ewes can safely be left to lamb in tussac areas. This obviously has much to recommend it. Considerable shelter is provided both from the weather and predatory birds. Moreover, the ewe has available a diet of very high quality at a period when she needs it most. A few of the islands carry out the practice of grazing ewes in tussac until shortly before lambing and then turning them out on to exposed pastures, which are frequently bare at this time, for actual lambing. This is a practice which should be discontinued. The ideal seems to be a compromise of keeping the ewes in tussac until lambing is finished then opening the gates so that the ewes, when their lambs are strong enough, can find their way out on to the other pastures at a time when these have started to grow.

It is generally considered that tussac does not have a place in the sheep farming of the large main island farms. Certainly the position will never be reached where sufficient tussac is available to assist the nutrition of the entire flock on the farm. The Team wonders, however, whether this is sufficient reason for having no tussac at all and doing nothing about attempting to propagate it. Sheep are run in distinct flocks and already ewe flocks are allocated the best camps. These are frequently on rincons. Stud flocks, too, are frequently kept in good rincon camps. When the low marking figures common on many farms and the importance this has on selection and age of the flock as a whole are considered the case for making a serious attempt to improve the nutrition of the ewes cannot be contested. If an area of tussac could be provided this would be invaluable to the ewes at those times of the year when their nutritional needs are highest. A good example of this type of development can be seen in the Cape Dolphin camp of Port San Carlos. The extreme tip of this camp has been fenced off for some four or five years and already the tussac is recolonizing the area. The camp carries a stud flock and ewe flocks. Clearly this area of tussac will in future be invaluable in helping to improve the nutrition of these flocks. We recommend that suitable areas of rincons on other farms should be fenced off and planted to tussac.

From an examination of areas of tussac which have recently been planted it is most encouraging to note the undoubted success of these plantations when allowed to grow ungrazed from the original tiller planting until the tussac is three or four years old. This prompts us to suggest another use to which tussac could be put on the large farms. At present many of these grow an area of oats, kale, or hay crop for winter feed for the milking cows of the settlement. Such crops are very costly to grow and harvest. We are of the opinion that most of the larger farms should plant out tussac in settlement enclosures on a system of squares so that tractors could be used to keep the plantations clear of weeds and other plants during their first few years. A planting distance of three to four feet in parallel rows is suggested and an application of a complete fertiliser of the 20 : 10 : 10 (nitrogen : phosphate : potash) type of 3 cwt per acre should be applied before planting to assist rapid development. An investigation of a 5 acre block of this nature at each major settlement could be attempted at very little cost.

The value of tussac for fattening beef animals is acknowledged freely. Unfortunately the quality of the beef from animals grazed over long periods on tussac is not of the best. The fat is yellow and soft, even oily in texture. The meat would be more acceptable if the beasts were merely finished on tussac rather than allowed unlimited access to it for several years. However, the high costs of working boats carrying cattle to and from islands is already causing a reduction in this practice and this, coupled with the low price obtained for the beef, renders such operations very suspect economically.

For many years some areas of tussac have been afflicted by what is called "the disease". This is presumed to be the result of depredations of larvae of beetles or moths which attack the roots of the plant and cause it to become chlorotic and eventually die. Samples of larvae and adult insects have been submitted to entomologists for identification over a period of years but no positive identification has yet been forthcoming. Some insects were collected by the Team on Sedge Island which depends very largely on tussac for maintaining its high stocking rate of sheep. One of these was identified by the British Museum as a weevil called Malvinius compressiventris (End). The Museum authorities state that this insect is very common and endemic to the Falklands but as far as this particular locality was concerned it is a new record. While there is no direct evidence that this weevil is responsible for tussac disease members of the group have grubs which feed on the roots of plants while living in the soil and litter around the base of these plants. The adults also do some damage by biting the aerial parts of the plants. It is possible, therefore, that this weevil may be partly responsible for the trouble.

Tussac disease is so important that a programme of work should be started to identify the pests concerned and then to control them using insecticides of a systemic nature. The suggestion has been made that the trouble is due to an increase of beetles following a decrease in numbers of small ground nesting birds caused in turn by an increase in rat population. However, until comparative population figures for these three groups on affected and not-affected sites are studied the matter remains conjectural.

CHAPTER 8 - THE UPLAND GOOSE (*Chloeophaga picta picta*)

This large handsome bird is a familiar sight in all parts of the Falkland Islands. The population is high though no accurate figures of distribution or numbers are available. According to some sheep farmers the goose population exceeds the sheep population. The species competes with sheep for grass and there is no doubt that during winter at least competition for this scarce commodity is serious.

The Team was not able to study the habits of the Upland Goose in detail but on one occasion an enclosed settlement paddock to which no farm stock had access was kept under observation. The birds stopped feeding for only relatively short periods of the day so that the grass was never allowed to grow beyond the stage normally seen on a well mown lawn. It was quite impossible to keep a record of the number of geese on this particular area as the population was constantly changing.

In Camp too, the number of Upland Geese feeding on the more valuable areas such as valley and coastal "greens" is often observed to be greater than the number of sheep. This concentration of geese on areas of higher nutritional value is obviously to the disadvantage of the sheep. It is doubtful if greens do in fact get any rest from grazing at all - even in camps being rested as part of a system of rotational grazing. It is only the sheep which can be excluded while geese continue to graze the greens throughout.

The depredations of geese are considerable on newly reseeded areas and arable fields in the settlements. The results of their very hard grazing on newly germinated grass, oat or brassica seedlings is very disheartening and frustrating to farmers who have invested heavily in this very necessary work.

It is, therefore, considered that the Upland Goose must be looked upon as a major pest in the Falkland Islands and that increased efforts should be made to control it. On many farms a bounty is paid to employees for every goose killed - on a basis of payment for beaks produced. This does not seem to have had much effect on the overall population of geese. Not all farms have adopted the practice and consequently even if geese are reduced on one farm more can fly in from neighbouring land. Further, the level of payment does not seem to provide sufficient incentive to employees to kill geese. The Team does not, of course, wish to see this magnificent bird eradicated especially since the Falkland Islands race of Upland Goose appears to be distinct from the kind occurring in Patagonia and Tierra del Fuego. It believes, however, that numbers can be drastically reduced to advantage without endangering the survival of the species.

The problem is not an easy one. The geese are not only numerous but they are spread over large farms in a country with a very low human population. The Team does not consider itself competent to give specific advice on this problem. In the long run it believes that a Pest Control-cum-Conservation Specialist must visit the colony to study and advise on the problem.

CHAPTER 9 - GRASSLAND IMPROVEMENT

Although most of the soils of the Falklands are of a peaty nature, there are quite large variations in the types of peat present and in their response to cultivations and treatment. In all soil analysis reports (Davies 1939, Gibbs 1946, King et al 1969) the salient features are the high levels of acidity and low levels of phosphate. The analysis of our own soil samples confirms this picture (see Appendix).

There are four main types of peat. An important type found over large areas is deep upland peat. This may be several yards in depth and is always poorly drained. It is characterised by a flora composed of short brown rush, Astelia and whitegrass. Water retention is high due to impermeable subsoils which may be sandstone, quartzite or clay. This type of peat falls into the local classification of soft camp.

Peat of a moderate depth overlying a more porous subsoil is characterised by such plants as whitegrass, pig vine and a little oreob. Large areas of Lafonia fall into this category known locally as good soft camp.

Shallow to medium peat often has a high sand content and is well drained because it overlies coarse sandstone or an open clay subsoil mixed with degraded sandstone. Typically it carries a flora dominated by dwarf shrub heath such as diddle-dee, Christmas bush and small fern. Quite often too it has large quantities of the better grasses such as the meadow grasses, bent and small jointed rush between the diddle-dee bushes. It is known as hard camp. Often associated with it in minor quantities are balsam bog, Valeriana sedifolia (valerian) and Christmas bush.

Valley flush peats which may be deep are associated with wash-down mineral particles. They are consequently more open and fertile than the surrounding heath. Fertility of these areas is further increased by the intensive grazing to which they are subjected. The flora consists of small jointed rush, the meadow grasses and bent.

Most of the Falklands are covered by one or other of these peat types which like the floral divisions merge into each other gradually. Methods of improvement must be related to the type of peat which is encountered. In the context of improvement, the nutrient status of the soil is also important. Samples for analysis taken by the Team show that all soils are acid, the pH varying from 3.9 to 5.4 with an average of pH 4.5. Phosphate indices are low to very low and an appraisal of the economics of the use of lime and phosphate must be made. The position is not encouraging. There is no source of lime on the islands which would be large enough for economic exploitation. The only sources which occur are small deposits of sea shell on some parts of the coast. There are no local sources of phosphate.

Importation of lime and phosphate is possible but the prices of these after shipping and distribution costs have been added become prohibitive. Prices in the region of £50 per ton for superphosphate and £30 to £40 per ton for lime have been currently quoted. There is an average of only 0.25 sheep per acre over the whole of the islands and the yield of wool may be 8 lb per sheep. This leaves a gross return of 2 lb wool per acre. The net return on this at current prices is in the region of one shilling per acre. At this level of return the benefit of fertilisers is very questionable even if they increased grass yields considerably. The lime requirement alone is several tons per acre and the phosphate requirement is at least 60 to 80 units per acre. Nothing is known of the extent to which the native flora would respond to these elements.

Prices obtained from a phosphate supplier in Uruguay were quoted at £16 to £20 per ton for ground mineral phosphate in Montevideo. In addition there would be shipping costs for the 1,000 mile journey to Port Stanley and further trans-shipment charges from there to the farms. Unfortunately the farm settlements are so situated that shipping direct by a large vessel would necessitate the use of scows and hand labour.

I. DWARF SHRUB DOMINANT CAMP

The soil types which show most promise for grassland improvement are associated with the dwarf shrub heath. These are mainly situated on the west island but there are also several areas on the east island. They correspond to areas classified in the Land Resources Division Report (King et al 1969) as LFr(dk). Very often, however, such areas are associated with rocky ridges and stony outcrops, but these are well known to farm staff and can be avoided when improvement by cultivation is considered.

On some of the dwarf shrub heath individual shrubs are quite distinct and the ground between is occupied by a sward of relatively high value. This is composed of the meadow grasses, small jointed rush, bent and goose grasses. It would be unwise to attempt to improve this land by any method which reduced the present very useful flora or eliminated all the shelter. It is sufficient to destroy the shrubs in strips by mechanical means such as a flail or slasher type mower. On the fringes of such useful grazings where the flora rapidly deteriorates it is advisable to oversow with a seeds mixture in addition to flail mowing. The stock will then consolidate such work. They graze the new seedlings early causing them to stool out at the base and not run to seed head.

Where diddle-dee is dominant and grows to a height of several feet and there is no worthwhile sward below it the only method of improvement is by reseeding. One of the difficulties of such land is the mechanical one of disposal of the large woody bushes before cultivation commences and there is no doubt that the flail mower has made excellent work of diddle-dee. Heavy girders dragged behind tractors have also been efficient but do not reduce the thick but brittle stems of the shrub to such small pieces as the flail mower. On the deeper more uniform soils either ploughing or rotavating can follow bush disposal. On the shallower soils rotavating is preferable because ploughing would lead to inversion of large quantities of clay subsoil.

A vital consideration is consolidation of the seedbed. By its very nature the soil is open and puffy after disturbance and it is difficult to obtain a well consolidated tilth for sowing small seeds. The indications are that a season should be allowed to elapse after initial cultivation to enable the weather to consolidate the soil before sowing. Agronomists working in Patagonia believe that there is an inhibitory agent present in diddle-dee soil which tends to delay establishment of grass seeds. They consider that this is eliminated by a year's weathering. However, one of the difficulties of leaving cultivated land unsown for a year in the Falklands is the danger of wind erosion. Consequently the strip method of seeding where bands of undisturbed native shrub are left intact between cultivated areas is advisable. This would serve two useful purposes, first to reduce wind speed and consequent soil loss and second to provide shelter for grazing stock after reseeding.

There is an implement known as the sheep's foot roller which is more efficient in consolidating soil than normal flat or ring rollers. We believe this machine to be well worthy of trial in the preparation of seed beds under light puffy soil conditions.

Consolidation difficulties can be overcome to a large extent where diddle-dee ground is burned and where sowing is subsequently carried out by drilling. It is a hazardous venture and before starting the area to be burned must be clearly delineated by ploughing out a wide surrounding fire trap. It is best burned in late winter or early spring when the soil is still wet. After burning seed should be drilled direct into the ground using a robust drill of the disc coulter type.

Basically the success of reseeding under all conditions is dependent on consolidation, soil temperature and moisture. Moisture is closely connected with consolidation. Time of sowing to enable seeds to benefit from periods of higher rainfall requires further investigation. Unfortunately meteorological data is only available for Port Stanley and some of the coastal settlements. Present evidence suggests that the wettest periods of the year are December, January and February. This period is also the one with the highest soil temperatures but is also the time when loss of moisture from an open water surface due to wind velocity is highest. This latter fact underlines the importance of strip cultivation for reseeding. The strips to counteract the wind factor should run north to south as prevailing winds are usually from points in the west.

Drilling seed to a depth of ¾ to 1 inch is recommended. Surface sowing can lead to costly failure. The type of drill is of little importance as long as it can carry out this task but it must be robust to stand up to the rough conditions and a disc coulter type corn drill with a 3½ inch spacing is suitable. This should be followed by a heavy Cambridge type ring roller.

Up to the present time and with one notable exception, the seeds sown on all large scale reseeding programmes has been Yorkshire fog alone at rates of 6-12 lb per acre. The reason given for this reliance on fog alone is that it is believed to be the only plant which will germinate and establish successfully under local conditions. From the evidence of the plots laid down by Young during the period 1965 to 1968 and one successful sowing of some 30 acres of Cocksfoot, it has emerged that other species of low fertility tolerant plants establish quite well.

Yorkshire fog has severe limitations as a pasture plant. It is late to commence growth in the spring and its growing season is short. It runs up to head very quickly in summer and in winter its leafage burns off readily leaving little winter green fodder. Reseeding with Yorkshire fog alone can exacerbate an already difficult situation where there is adequate food for the stock in summer but an acute shortage in spring and winter.

Young's plots have been exposed to uncontrolled and selective grazing by both the Upland Goose and sheep. Despite this sheep's fescue, red fescue, cocksfoot and tall fescue have germinated and established well on most sites. While it is appreciated that Yorkshire fog should still be the basis of reseeding, other plants should be mixed with fog to provide a sward with a longer season of usefulness. The block of Cocksfoot already referred to, although only 30 acres in extent and in spite of being the focus for grazing by flocks of Upland Geese is well established and productive.

It is therefore recommended that a seeds mixture should replace the present system of using Yorkshire fog alone. The earliest growing component of such a mixture could be tall fescue which is also very drought resistant and once established is very persistent. Cocksfoot has many of the attributes of tall fescue is more palatable and easier to establish. A mixture of seeds rather than separate blocks of straight grasses is recommended because we fear that the latter would be grazed too heavily by sheep and geese. Where the other species are distributed through a large area sown principally to Yorkshire fog the sheep are forced to pick at a plant here and there without concentrating in large numbers on a small area for a long time. Furthermore, many of the Falkland Island reseedings are open at the base and the addition of sheep's or red fescue would help to fill the ground.

On Young's plots sheep's fescue has established better than red fescue but seed may be difficult to obtain. We therefore recommend the following seeds mixture

Yorkshire fog - husked seed	7
Tall fescue	2
Cocksfoot	2
Red or sheep's fescue	1
TOTAL	12 lb/acre

The additions would increase the cost by a small amount, due mainly to the price of the sheep's fescue.

The cost of reseeding has already been discussed and although the figures refer to programmes covering several thousands of acres the cost is low by United Kingdom standards. On smaller farms costs would of course be higher if reseeding were approached on a single farm basis. If such farms were to co-operate in the ownership of machinery and the operation of specialised gang labour, costs would be reduced. We recommend this approach.

On some of the smaller islands there are ridges carrying short lawn-like pastures which suffer severely from drought in summer. These areas are characterised by dispersed open plants of diddle-dee growing on very shallow soils with a comparatively low peat content. The grasses they carry are usually dominated by goose grass which is an annual, Vulpia bromoides (barren fescue), the meadow grasses and Rumex acetosella (sheep's sorrel) and in some areas by Poa robusta (prickly meadow grass). These pastures are quite productive during wetter seasons but are liable to become very bare during the drier periods and are prone to mechanical damage by sheep's feet leading to surface erosion. Once erosion starts on these soils the only remedy is to fence out stock completely until recolonisation takes place. Oversowing has been moderately successful in establishing Yorkshire fog on these eroded areas. In view of the steepness of the terrain where this problem exists surface sowing by hand is necessary.

II. WHITEGRASS DOMINANT CAMP

While it is admitted that diddle-dee camp is the easiest and cheapest land to improve, the Team detected an all too ready acceptance of the idea that whitegrass camp offers little if any possibility for improvement. However, our survey showed clearly that whitegrass camp of one sort and another is by far the most extensive vegetative type in the islands. Its improvement therefore shows most potential in terms of area. Furthermore, some farms have little if any diddle-dee camp so that if they wish to become more intensive they must tackle whitegrass camp.

Earlier reports tended to deal with whitegrass camp as though it were all of the same type. Inspection soon shows that it is not. Whitegrass occurs on all the different types of peat soils in the islands excepting the very best drained. It takes on a different character according to soil and the pressure of grazing to which it is exposed. It is important to differentiate between the types of whitegrass when considering possible improvement.

The most valuable whitegrass camp occurs on the shallower peat soils overlying permeable subsoil or where quick run-off of moisture occurs as on the sides of valleys. In these situations individual plants become formed into tall tussocks known locally as "bogs" and a sward of finer grasses covers the ground between them. Whitegrass areas of this type are highly prized for shelter and good grazing. Further improvement of these areas would be difficult and unlikely to be justified economically. The finer grasses between the "bogs" would probably respond to fertilizers or clovers might establish if oversown and trampled in. The best recommendation that can be made for these areas, however, is that they should be used to better advantage. At present they, together with the "greens", carry the brunt of the grazing throughout the year while the remainder of the camp is neglected. "Bog" whitegrass should be included in an area fenced off from the indifferent parts of the camp so that the excellent grazing and shelter it affords can be controlled. It can then be used at the appropriate time in the nutrient cycle of the sheep. This aspect is dealt with more fully later in the report.

Another type of whitegrass camp occurs on soils which are slightly poorer and wetter. Individual plants are again tall but they are not separated into "bogs". They form a complete ground cover and do not allow the development of a sward of finer grasses. If camp of this type could be converted into "bog" whitegrass it would represent a considerable improvement. It is interesting therefore to speculate on the factors which cause whitegrass to develop into "bogs". A reasonably good and dry soil is the first essential but thereafter the character of the sward seems to be determined by the grazing habits of livestock. Sheep congregate naturally in valleys and hollows for shelter and prefer to lie in the drier parts of the camp. Here they graze harder than elsewhere. At the same time they tramp about and deposit dung and urine. Three factors are thus brought to bear on the character of the sward - hard grazing, consolidation and increased fertility. It is probable therefore that the change from continuous to "bog" whitegrass takes places as follows. As a result of concentrated grazing, the sheep eat and tread out the weaker whitegrass plants. Those remaining grow taller from the increased fertility and lack of competition, finally developing into "bogs". Light and air then have access to the soil between "bogs" and, with enrichment from dung and urine, pasture grasses are able to form a sward.

The Team recommends that farms with suitable areas of good whitegrass camp should attempt to convert them into the "Bog" whitegrass type. A conveniently situated area of 100 to 300 acres should be burned over and fenced off. It should then be stocked at the rate of two sheep or their equivalent to the acre for three or four consecutive summers. The stock used should be able to absorb possible punishment without any great economic loss through being forced to eat long mature herbage. "Scroggs" and mature dry sheep would probably be most suitable - though it is not necessary to use sheep only. Because of their grazing mechanism, cattle would be even more useful for tackling long mature herbage. A pre-burn is suggested as part of the technique since the green regrowth would be more attractive to stock. It would also have an improved nutritive value and therefore be less punishing to the animals at the high stocking density necessary. A flail-type mower could be used as an alternative to burning. Flail mowing on its own promises to be useful in improving good whitegrass camp, especially from the aspect of extending "greens". The Team's experiences with the machine are described in the appendix.

The methods so far discussed are aimed at replacing whitegrass by other native species - the sward of finer grasses and the "greens". Improvement can also be achieved by replacement with imported species of grass. Thus, oversowing or sod-seeding can be included in the above methods and will hasten improvement.

Since good whitegrass camp occurs on the better soils, however, reseeding is also possible in many situations. The special problems likely to be encountered are removal of heavy top growth, difficult cultivations due to tough plants of whitegrass, and consolidation. Top growth can be dealt with by burning or flail mowing. First cultivation, whether by rotavating or ploughing, will require robust tackle and much patience. Consolidation has been considered at length previously in this chapter. The most suitable approach for good whitegrass camp would be to let the broken turf lie over winter to weather and settle. In the following summer it should be possible to drill seeds direct. If further cultivation is necessary, this should be confined to the minimum. A seeds mixture rather than straight Yorkshire fog is recommended.

As the camp becomes softer and less well drained, whitegrass of another type is found. Individual plants are short, less luxuriant and adopt a straggling habit of growth. On these soils whitegrass seldom occurs as a pure stand and is most commonly associated with oreob. Such camp is less suitable for improvement by fencing and heavy stocking. The whitegrass does not develop into "bogs", and heavy grazing results in a greater area of bare ground and the spread of oreob. If it is attempted at all, it is essential to combine heavy stocking with oversowing. Because the soil where this type of camp flourishes tends always to be moist, and since the straggling plants offer little resistance to implements, sod-seeding seems likely to be the best method of improvement and is recommended. Results with a rota-seeder type of machine at Port Stephens are most promising. Managers interested in improving this type of camp could profitably visit Port Stephens over the next year or so.

Another promising technique for soft whitegrass camp is the combined use of the flail mower and oversowing. Following successful results in the United Kingdom (Chippindale and Davies 1962), the Team tried this method at Fairy Cove and Hill Cove. Grass seeds were broadcast prior to flail mowing in November 1969. The trash from the mown whitegrass lay as a mulch over the seeds, and at both sites many seedlings were becoming established at the time the Team departed. These experiments would also repay observation by interested Managers. Further details of the work are given in the appendix.

Reseeding is just feasible on this class of camp. There is only a moderate amount of dead top growth to be dealt with and this can be burned off. The greatest problems are the destruction of the "mat" of turfy material on the surface of the peat and the consolidation of the moist spongy tilth. Both are best dealt with by allowing a lengthy period of time to elapse between ploughing or rotavating and seeding. The whole of one winter should be the minimum period, and 12 months would not be too long. There is little danger of wind erosion on this type of camp. Decomposition of the "mat" might be accelerated by rotavating once or twice at intervals after the destruction of the original sward. An adequate period must be left, however, for the seed bed to settle.

On deep wet peat soils whitegrass becomes thin and straggling. It is associated with much oreob and Astelia is usually present also. Little can be done with this type of camp. Accumulations of dead herbage can be removed from time to time with a "singe" burn. It is most unlikely that any treatment, even drainage, would be economically worthwhile on this type of camp. In the wettest areas Astelia, short brown rush and oreob become dominant, and this type of community is, for all practical purposes, not worth attempting to improve. Any money available will show a much better return from being spent on land of greater potential.

III. ECONOMIC ASSESSMENT OF PASTURE IMPROVEMENT

Methods of pasture improvement have been described in the previous sections and from these it should be possible to select a programme of operations to improve the grassland under most situations. Unfortunately, it is not enough to know how to improve grassland. It is more important and far more difficult to know whether to improve it.

A true assessment of the worthwhileness of improving grassland is possible where information is available on all input/output relationships. In practice this information is hardly ever complete. Nevertheless, a reasonable estimate of the economic consequences of pasture improvement can often be made. First, the method of improvement must be selected and an estimate made of its cost. A decision must then be made on the number of years over which it is desired to recoup the expenditure. An estimate of the probable additional or follow-up expenditure during the period of recoupment is also necessary.

A calculation on the lines of the following example can then be made. The example is purely hypothetical and deals with the simplest possible type of situation.

Example 1. Improvement by Fencing

Period of recoupment - say 5 years

Cost of Fence - say 3 miles at £330 per mile approximately	£1,000
Additional expenditure during period of recoupment - repairs say	£200
Total Cost	£1,200
Annual Cost	£240
Add interest on initial investment at say 10 per cent	£100
Total Annual Cost	£340

If the Gross Margin per sheep is known a calculation can be made to determine how many additional sheep need to be carried to cover the total annual cost. This is known as the "break-even" point. In the Falkland Islands there would be two difficulties here. First, it might not be possible to work out an accurate Gross Margin per sheep from the farm's financial records as they are kept at the moment. (See footnote.) Second, basic technical information is not available to make a realistic assessment of whether or not the extra sheep can be carried. Until such time as trial work provides this basic information the Manager's judgement would have to be relied upon.

The hypothetical example already given can also be used to calculate the probable return on extra capital used for improvement, that is, on marginal capital investment.

(Footnote. Gross Margin is calculated by subtracting the variable costs of an enterprise from the relevant output. It represents the total contribution of that enterprise to paying off the fixed costs of the farm (representing the common services provided by the farm). Any balance, after all fixed costs have been met, is the net profit, or net farm income. - For further information see "The Farm as a Business", No 1. Introduction to Management, HMSO, London.)

Example 2. Improvement by Fencing

340 more sheep are technically possible

This would require an extra £1,000 in fencing

No extra regular labour is required

Assume a Gross Margin of £1 per sheep

Extra Gross Margin 340 x £1		£340
Extra Costs - Annual interest on £1,000 at 10 per cent	£100	
- Repairs £200 over 5 years	£40	£140
Extra Income per annum		£200

Capital required - 340 sheep at say £2 each	£680
- Fencing	£1,000
	£1,680

Return on Marginal Capital Investment = 12 per cent

The cost of improving an acre of pasture is high in relation to the cash output of that acre, but it may not be in relation to the farm as a whole. Falkland Islands farms are large and no one, including the Team, envisages that every acre will ever be improved. Rather the profit from the many acres should be used in part to improve the few selected acres so that the viability of the farm as a whole is increased.

CHAPTER 10 - SHEEP NUTRITION

I. EVIDENCE OF POOR NUTRITION

The two pointers to under-nutrition of sheep in the Islands in the absence of a serious disease problem, are the high stock losses and the slow growth to mature size of the young stock. The Farming Survey was intended to provide broadly-based information on stock numbers but additional information was obtained on farm visits and has been quoted where relevant.

Stock Losses

Seven farms were able to give the total losses of all sheep as a percentage in each of three years.

TABLE 16

SHEEP LOSSES ON SEVEN FARMS 1966 TO 1969

	1966/7	1967/8	1968/9	Mean
Farm 1	9.3	9.9	9.9	9.7
2	12.3	14.0	14.0	13.4
3	9.5	11.4	12.3	11.1
4	10.7	10.9	15.1	12.2
5	13.7	11.5	14.4	13.2
6	9.1	9.4	8.7	9.1
7	9.6	8.6	9.8	9.3

The two lowest lines refer to islands. Farm 5 has a 24-year average loss of 15.1 per cent with a range of 11.5-19.3 per cent.

In the survey it was shown that the ewe loss on 20 farms was 9.8 per cent in the period between dipping and shearing in the 1967/8 stock year. Simultaneously the wethers sustained a 6.3 per cent loss which was slightly higher (6.9 per cent) in the following year. Figures from one farm show these effects from another view-point. In this case the history of the ewes put into the flock as replacements aged 2½ years in each of the years 1959, 1961, 1962 and 1963, was followed until the survivors were 8½ years of age. The average proportion surviving is given in the following table.

TABLE 17

EWE SURVIVAL ON ONE FARM

Age	2½ years	100%
	3½	89
	4½	81
	5½	73
	6½	63
	7½	50
	8½	32

Rather less than two-thirds of the ewes were fit to be put to the ram for the fifth time, rather less than one-third were fit to go for the seventh time. Such losses and the lack of sufficient replacements may have led to the retention of ewes with sub-standard wool qualities.

The loss of lambs between marking and dipping, covering the losses of lambs at marking and weaning, was 10.5 per cent in 1967/8 according to the survey. The validity of the figure is supported by data from the seven farms covering lambs born in the seven years 1961/7 inclusive.

TABLE 18

LAMB AND HOGGET LOSSES ON SEVEN FARMS

	Lamb Loss Marking to Dipping	Hogget Loss Dipping to Shearing
Farm 1	12.5%	9.9%
2	12.9	9.6
3	10.9	12.0
4	11.1	7.5
5	8.9	6.4
6	6.8	14.5
7	9.4	9.4

In the survey the comparable hogget loss was 9.6 per cent which is equivalent to 8.7 per cent of the lambs marked. Thus 19.2 per cent or 1 in 5 of the lambs marked did not survive the following 12-13 months.

There is one further factor which also points to under-nutrition and that is the very high level of neo-natal mortality. When marking figures of 60-65 per cent are recorded and every Manager and shepherd asserts that practically every ewe carries a lamb to full term, then the conclusion is inescapable. Body reserves and winter feed intake are adequate for maintenance and pregnancy but lactation brings a nutritional crisis which many sheep cannot meet. However, the climatic conditions at lambing time also play a considerable part in neo-natal lamb mortality.

The Growth of Young Sheep

The growth of lambs in the camp was not recorded by the Team but evidence, of limited value, was obtained on lamb marking weights and on the weights of samples of sheep in each age group at dipping. On one island 25 ewe lambs taken at random averaged 28.4 lb and 25 ram lambs averaged 31.7 lb at marking. As the average age was probably about eight weeks the daily gains may have been of the order of 0.35 and 0.48 lb per head per day respectively. On a mainland farm a succession of 72 ewe lambs marked averaged 27.1 lb at an estimated age of six weeks with a probable gain of 0.45 lb per head per day, while the figures for a similar number of ram lambs were 29.5 lb and 0.50 lb daily. A sample of stud lambs on the latter farm showed that both males and females were 7 lb heavier although born at the same time.

The numerical, as opposed to visual, evidence of slow progress to maturity is from samples of 50-57 sheep of each age-group at dipping in 1970 on one farm.

TABLE 19

THE ABSOLUTE AND RELATIVE WEIGHT OF DIFFERENT AGES OF EWE

Size of Sample	Age (yr)	Weight (lb)	Weight as % of weight of oldest two ages
50	½	45.8	51
50	1½	62.6	70
51	2½	78.2	87
50	3½	89.2	99
53	4½	85.1	94
53	5½	85.8	95
54	6½	89.9)	100
57	7½	90.4)	

This is typical of adverse conditions.

The 3½ year-old group is probably just an exceptional year's crop.

The Feeding Value of the Pastures

In addition to the samples taken from the experimental plots, herbage samples were taken from single species and swards. These were sent with the experimental samples to be analysed by National Agricultural Advisory Service Nutrition Chemists. A summary of the analyses which they found are given in Table 20. A medium quality UK sward is shown for comparison, the source being Ministry of Agriculture, Fisheries and Food Bulletin 48, Rations for Livestock.

The Metabolisable Energy (ME) has been derived from the "D" value by the formula of Alderman (*). The Digestible Crude Protein (DCP) has been estimated by applying the "D" value to the Crude Protein data. Formulae suggested by the ARC (1965) were used to calculate the potential dry matter intake and the maintenance energy requirement of a 100 lb sheep according to the energy density of the various grasses or swards. The maintenance requirement for DCP was calculated in the light of the various dry matter intakes. It was then possible to tabulate (Table 21) the intakes of dry matter, ME and DCP and express the last two as a percentage of maintenance. X

The first line of the Table demonstrates the complete worthlessness of whitegrass. The samples were regrowths occurring on the control sections of the whitegrass growth experiment. They were therefore the best the species has to offer. This is probably not so true of the mixed swards without whitegrass and the Yorkshire fog. These would both contain a proportion of seedheads and stemmy material and to that extent may under-value what the sheep selects from these swards. As analysed these do not indicate pastures suitable for ewes and lambs but the naturally improved sward sampled in December is acceptable especially in terms of energy. A figure of twice maintenance is adequate for a ewe in the last stages of pregnancy and in mid-lactation but not quite enough for a ewe in the first month of lactation. Nevertheless if she had reserves to draw on no harm would result. The analysis of the tussac is disappointing. If this single analysis is typical, the usefulness of the grass would seem to lie more in its winter green-ness than in its feeding value. However, it would be wrong to draw any firm conclusions from one sample.

If it were palatable, a diet of pigvine could supply maintenance for a 100 lb sheep. This would also be welcome from the point of view of mineral intake which is discussed later.

* (the missing material will appear in the printed version)

TABLE 20

THE FEEDING VALUE OF CERTAIN GRASSES AND SWARDS

	No of Samples	Starch Equivalent (SE)	Crude Protein (CP)	Crude Fibre (CF)	Digestible Organic Matter ("D")	Metabolisable Energy (ME) (Kcal/1b)	Estimated Digestible Crude Protein (DCP) (%)
		(% in Dry Matter)					
Whitegrass (green material)	20	19.3	9.8	32.1	37.9	660	3.03
Mixed swards (including whitegrass)	8	20.1	8.4	31.6	39.2	680	3.29
Tussac	1	22.5	11.5	34.1	42.3	725	4.86
Mixed swards (no whitegrass)	9	31.3	12.8	26.5	46.7	790	5.98
Yorkshire Fog	4	34.1	9.9	28.3	51.0	855	5.05
" " sward	1	37.0	11.8	25.4	51.7	865	6.10
Naturally Improved sward (December)	1	47.3	12.1	26.7	62.7	1,030	7.59
UK extensive grazing (spring)	Not known	56.0	17.5	20.0	64.0	1,050	11.20

TABLE 21

THE NUTRIMENT AVAILABLE TO A 100 LB SHEEP FROM VARIOUS GRASSES

	Expected DM Intake (lb)	Resultant ME Intake (Kcal)	ME Intake as % of Maintenance	Resultant DCP Intake (lb)	DCP Intake as % of Maintenance
Whitegrass (green material)	0.9	595	39	0.03	33
Tussac	1.4	1,015	67	0.07	64
Mixed swards (no whitegrass)	1.8	1,422	93	0.11	85
Yorkshire fog	2.2	1,881	128	0.11	85
Naturally Improved sward (December)	2.7	2,781	196	0.20	125
UK extensive grazing (spring)	2.8	2,940	212	0.31	182

The only native grass for which a reasonably reliable estimate of growth rate over the Islands was made was whitegrass, but this is not worth pursuing. At Fox Bay East and at Darwin the data for the growth of Yorkshire fog indicate summer yields of 300-800 lb DM per acre without nitrogenous fertiliser and 500-2,600 lb with it. At a yield of 600 lb annually an acre would support 2 sheep of 100 lb liveweight at the maintenance level for a period of 6 months. It follows that at least 8 such sheep could be maintained at the higher yield.

The information presented on the feeding value of the grasses emphasises the evidence of stock losses and poor growth that there is undernutrition of sheep in the Islands.

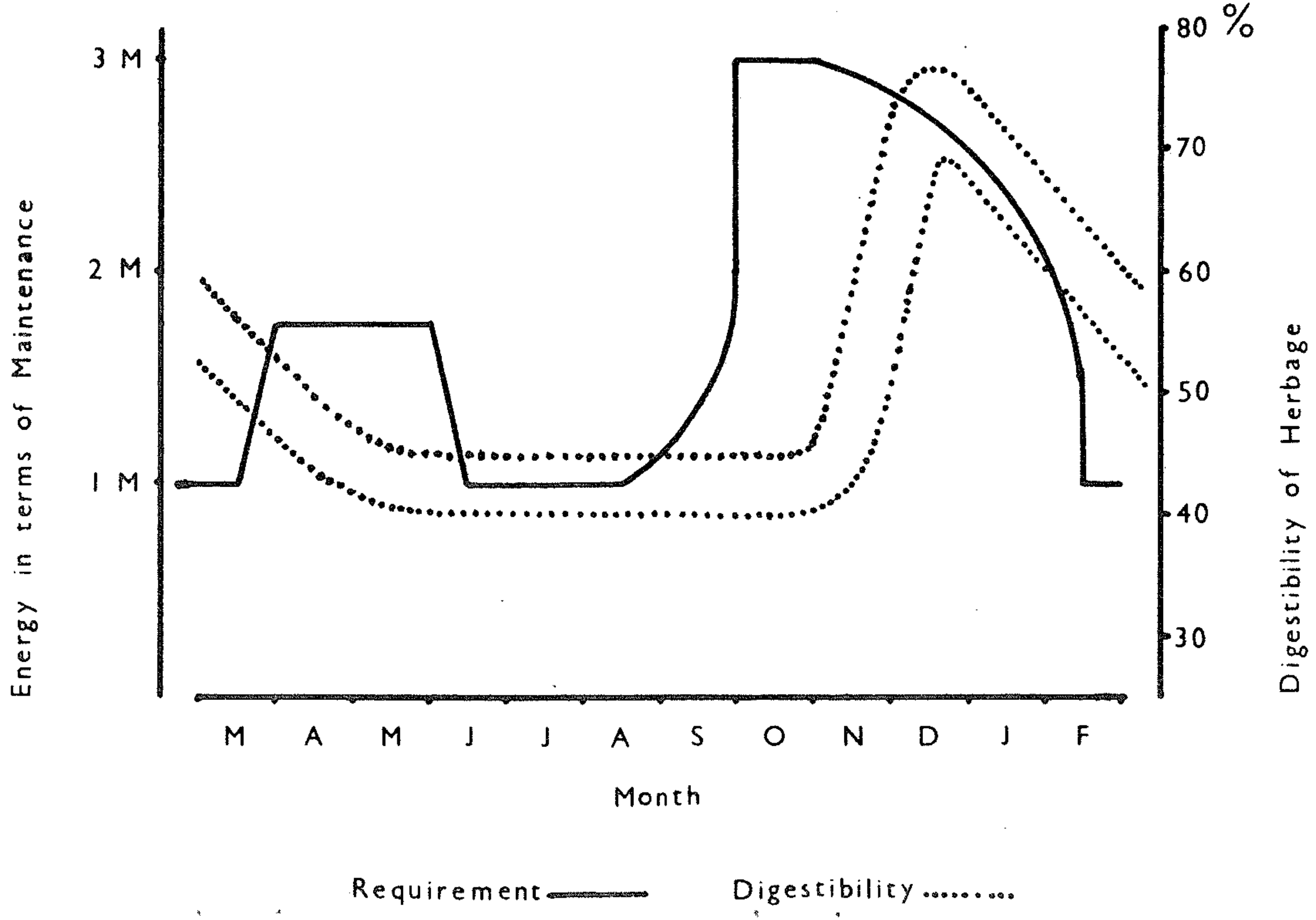
II. THE ANNUAL NUTRITION CYCLE

Extensive sheep farming is founded upon the sheep's ability to lay down reserves at one time of year and draw on them at another. The art of sheep husbandry in such situations is the choice of pasture and stock management techniques which will permit the maximum number of sheep to be kept on the area concerned on a continuing basis, the quality of the produce being economically optimum.

For young stock and mature wethers the ability to survive without having a break in the wool is probably a good measure of economic success but the position is different with ewes where reproduction is involved. In the latter case the pattern of nutrient requirement is for a minor autumnal increase over maintenance in order to facilitate conception, followed by a mid-gestation requirement for maintenance only. There is a greater increase in the requirement for the last six weeks of pregnancy and a considerably greater increase during lactation. This can be shown diagramatically:-

Figure 2

The Variation in the Energy Needed by a Ewe and the Digestibility of Herbage Eaten



Superimposed on the energy requirement curve is a band of the probable pattern of seasonal variation in the digestibility of the dry matter of the herbage actually eaten by the sheep in the Islands. There are two important features in this curve. The first is the probable brevity of the season of high (more than 65 per cent) diet digestibility compared with the comparable situation in the United Kingdom. The second is the consequent long interval between the beginning of lambing and the growth necessary to give such digestibilities.

In the Falklands, as in all other extensive situations, the factor which remedies this deficiency is the sheep's ability to lay down reserves of fat in late summer and autumn and draw on them in late winter and early spring. Improved pastures in the Islands have been used to

allow the sheep to lay down greater reserves

allow a greater number of sheep to be kept

delay the onset of negative energy balance.

The spelling of pastures has the same ends in view. Nevertheless the effects of a late spring in increasing the gap between lambing and the growth of young grass are felt in the inability of ewes to draw on any further source of energy. The consequences are lean ewes, small weakly lambs and a very reduced milk supply leading to a high death rate in newborn and young lambs.

It would be very much more efficient to supply the energy for late pregnancy and early lactation directly in spring rather than draw on body reserves. Such feed can only come from tussac or from rested improved pastures. This practice certainly would not obviate the effects of a late spring but would reduce the waste of energy involved in making up and then breaking down body fat reserves. The autumn feed saved could be used to improve the status of the weaned lambs as well as to aid conception and build up moderate body reserves in the ewes.

However, because what happens in one part of the annual cycle has its effects in another part, there is one imponderable in this situation. If the ewe is allowed to go into the winter with lower reserves than at present, can she maintain her weight and condition on the present natural herbage? Only future studies can determine this fact, but there is a probability that she can do so, or suffer only a slight loss.

There is therefore every reason from the animal point of view to utilise the improved pastures for late pregnancy and early lactation and again in autumn to build up some body reserves and to achieve good conception rates. This topic is discussed more fully in Chapter 11.

III. THE USE OF UREA-BASED FEEDS

It is generally agreed that ruminants have the ability to achieve better digestion of low quality roughage when it is supplemented with urea plus a readily available source of carbohydrate. From the animal production point of view there are three ways of using urea

for survival at a low safe weight

for maintenance of a slow growth rate

for economic productivity.

In general terms the first two involve the supplementation of a low quality diet with a deficient nutrient for a limited period and should be measured in economic terms over at least 12 months by mortality rates or by comparison with control animals exhibiting compensatory growth or accumulation of reserves. There is no satisfactory evidence of economic advantage from the use of urea for these purposes for wool-producing sheep under extensive conditions. Most of the experimental work has been carried out with cattle and sheep in drought conditions and hand-fed in pens. Furthermore, Loosli and McDonald (1968) state "No reference has been noted in which it is demonstrated that the urea supplementation of low quality pasture has increased the wool production of sheep".

Using urea for economic productivity means feed substitution and would be quite unprofitable in the Falkland Islands.

Starting from the basis of improved intake and digestion of low quality roughage under laboratory conditions, it has been postulated that poor pastures can be improved by cattle forced to graze them but given a supplement of urea and carbohydrate. There is no scientific evidence that this can be achieved under free-grazing conditions for either sheep or cattle. Economic evidence is similarly lacking. Nevertheless there ought to be a scientific assessment of the validity of the theory.

IV. VITAMIN AND MINERAL NUTRITION

The veterinary aspects of this subject are considered in Chapter 17 but some comments on the mineral content of the pastures seem appropriate at this point.

Russell and Duncan (1956) make two statements; "Sheep are not as susceptible to phosphorus deficiency as cattle, and this has been attributed to their less massive skeleton and to their habit of grazing selectively the meristematic tissues in which much of the phosphorus of the plant is stored". Again, "Pastures with a very low content of calcium have been reported, but there is no evidence that grazing animals suffer from calcium deficiency". These remarks will explain the rather dramatic differences between the amounts of these elements found in the analysis of the Falklands grasses and the requirement for them given by the ARC. The ewe referred to weighs 110 lb and is 2 months' pregnant.

TABLE 22

THE INTAKE OF CALCIUM, PHOSPHORUS AND MAGNESIUM
AS A PERCENTAGE OF MAINTENANCE FOR A EWE

	Calcium	Phosphorus	Magnesium
Mixed sward (no whitegrass)	33	43	271
Yorkshire fog	47	38	254
Tussac	9	46	102
Pigvine	107	119	441

With such low levels of calcium and phosphorus bone troubles would develop if Vitamin D were lacking. The absolute levels of calcium and phosphorus are in the range 0.05-0.30 per cent. Bone abnormalities have been reported in hoggets on small islands (Chapter 17) and if tussac formed a large part of the diet the data above would provide the explanation. It would therefore be advisable to provide high calcium mineral blocks to sheep or cattle grazing tussac for a prolonged period. Pigvine is eaten by horses to their advantage, it seems.

There seems to be little likelihood of magnesium deficiency (range 0.08-0.30 per cent).

Analysis for copper was carried out on only a small number of samples. Only one, the tussac sample, showed a level below the 5 parts per million recommended by the ARC. Its level was 4 and so is probably not seriously inadequate.

Cobalt figures are very variable. Of the grasses referred to in Table 20 none of the 8 mixed swards containing whitegrass had more than the 0.1 parts per million advocated by the ARC. Five of the 9 mixed swards without whitegrass also had less. The tussac sward had an adequate amount, but the Yorkshire fog sward did not. These figures reflect the variable occurrence of deficiency in the Islands. The best diagnosis comes from either liver analysis or response to treatment. Pigvine appears to be a rich source of cobalt.

V. HOGGET NUTRITION

The Survey showed that in 1967/8 one out of every five lambs marked was not present at shearing twelve months later. Half of this loss occurred before dipping. Numerical allocation of losses between nutritional and other effects is not possible but all are to some extent influenced by management decisions. Only the nutritional aspects will be discussed here.

The required quality of the pasture immediately after marking is govered by the needs of both ewes and lambs and so in practice must remain as high as before marking. Nevertheless where improved pastures are used for late pregnancy and early lactation, marking is the time when a change of pasture may be essential. It is desirable that the sheep should go to a rested camp of good quality. The weaning check may be lessened by putting the lambs back in the camp they occupied before weaning because they know the former feeding areas. This can only be of value if the feed has not been eaten out beforehand. Another way of lessening the check would be to put the lambs on to a newly reseeded area for its first grazing or on to improved pasture rested from marking time. In both cases the lamb is getting a readily available and fairly highly digestible feed in place of milk instead of having to search large areas of poor camp for isolated areas of good quality feed.

The younger a sheep is, the greater is its growth rate relative to its own body size and so the lower is the proportion of the diet needed for maintenance as opposed to growth. It is therefore an economy in feed to have young sheep enter their first winter as well grown as possible. However it is at this time of year that the young lamb's needs conflict with the ewe's need to be given good feed to build up body condition for the winter. Thus where only limited reseeding has been carried out, weaned lambs may only be able to receive a very brief period on improved ground before transferring to the hogget wintering camp. The Managers recognise the needs of the hogget by allocating them the camps with food quality second only to that of the ewes.

The general picture regarding the beneficial effects of dosing hoggets with cobalt bullets is discussed in the Veterinary section. Two points are emphasised here. First, the dramatic nature of the improvement when dosing is employed on an affected farm can be seen in results from Chartres where the mean hogget loss from dipping to shearing in the eight years prior to cobalt dosing was 12.0 per cent and in the eight years after dosing started was 7.4 per cent. Second, when an experiment is set up to test whether cobalt dosing is necessary in any hogget camp the following points should be borne in mind.

The larger the number of animals in the comparison the better

The animals chosen should be representative

There should not be any initial difference between the groups compared (eg liveweight, body condition, sex)

The means of identification should be "permanent". Eartags cannot be relied on to stay in place

Differences between the averages of groups need to be considerable to be meaningful, because of individual variation in the factor being measured. If measurements can be recorded for individuals a statistician can speedily assess treatment effects relative to individual effects.

CHAPTER 11 - UTILISATION OF IMPROVED AREAS

There is evidence that much of the grassland improvement carried out has not resulted in increased profits for the farms concerned. The Team believes that this is probably due to failure to exploit the improved areas to best advantage.

Looked at from the standpoint of exploitation, there are 3 types of pasture available in the Falkland Islands, though they are not always present together on the same farm. They are unimproved, improved natural and reseeded camps.

Unimproved camp covers a wide variety of natural pastures. However, all are characterised by the predominance of an unpalatable (or unattractive) low feeding value species such as whitegrass or diddle-dee in association with sparse but widespread "finer" grasses of a somewhat higher feeding value. Overall, they provide a low maintenance type of feed, but due to the several species present there is some variety in the diet.

Improved natural camp, for the purpose of this classification, also covers naturally better areas. Thus it includes "greens", green valleys, "bog" whitegrass, open diddle-dee with turf between, and whitegrass camp improved by heavy stocking, sod-seeding and oversowing. This type can provide grazing of high quality over a long season. Because it is palatable it tends to be overgrazed by sheep and geese. Any grassland which is continuously defoliated produces only a limited bulk of herbage - albeit of high quality.

Reseeded camp is taken to include oversown or sod-seeded areas where the naturally occurring species have been completely displaced by sown ones. The only seed used to any extent in the Falkland Islands to date has been Yorkshire fog. The main potential of this species is an ability to put up a considerable amount of summer growth. The quality of this growth when green is high. Yorkshire fog also has severe limitations. It is slow to start growth in spring, has a tendency to send up an excessive number of seed heads in summer, unless heavily stocked, and it quickly dies off in autumn. Once seed heads are formed feeding value drops to a low level. Heavy summer grazing keeps Yorkshire fog prostrate and leafy, and in this form it retains a high feeding value into autumn.

Upon the growth pattern of these three types of grassland sward the cycle of nutrient requirements of the sheep has to be superimposed. If sheep, and ewes in particular, are to be given better nutrition at critical times of the year areas of better pasture capable of providing this better feed must be fenced off from the areas of poorer pasture. Wannop. (1961), laid great stress on sub-division of camps. This may well have been of paramount importance at that time. We are by no means convinced that sub-division of itself, the dividing of camps into halves and perhaps halves again, is likely automatically to result in greater sheep carrying capacity or even better performance of existing sheep numbers. Because it does nothing to improve the winter feed position it does not ease the bottle-neck discussed in Chapter 5 and therefore cannot help to any extent in increasing overall stocking. Even when sub-division is accompanied by rotational grazing there is not necessarily any improvement in the nutritional state of the herbage offered to the sheep. Unless the interval between grazings is the correct one, and nothing is known about correct recovery periods for Falkland Islands grasses, the spelled grass may well become too mature to be of optimum feeding value for the sheep. With conventionally sub-divided camps better and poorer areas of pasture are normally to be found in all paddocks. Even when rotationally grazed the sheep still eat down the greens and other palatable herbage first - indeed they will continue nibbling at these areas rather than move on to the rougher areas that the system was designed to "force" them to eat. It is in any case questionable whether it is right to force sheep to eat off poor quality, fibrous herbage regardless of their nutritional needs at the time. Even the introduction of cattle into a rotational grazing system to eat off the coarser material does not always work. Observation and opinion in the Islands suggest that cattle too spend all their time grazing on the same greens and other palatable herbage as the sheep.

The Team therefore are firmly of the opinion that the logical way to utilize improved areas better is to fence the good from the bad. It is realised that better areas, greens and green valleys especially are irregular in shape and cannot be fenced off absolutely. Obviously the most economical line of fencing should be chosen to fence off the mainly better from the mainly poorer herbage. If this is done an attempt can be made to supply the correct nutrition for the requirements of the sheep.

A ewe camp can be taken as an example. The ewes should be turned into a better area in late April as tupping time approaches and remain there for six to eight weeks until tupping is over. The object of this under Falkland Islands conditions is not to flush the ewes to obtain twins but partly to ensure as good a conception rate as possible and partly to bring the ewes into good condition to face the winter. It is used as a restoration area for the ewes. They should then be turned back into the poorer part for the winter. This area will have been spelled for the period when the ewes were in with the tups. After spending the winter foraging in this poorer part of the camp the ewes are moved just prior to lambing back to the better area. This will have been spelled all winter and will provide better nutrition during lambing and lactation. The ewes will also be in a more confined space for shepherding. At weaning the feed requirement of the ewes is greatly reduced. They can therefore return to the poorer area for the summer while the better area is spelled in preparation for tupping. This describes the concept of using better and poorer areas in its simplest form but its success depends on a certain minimum nutritive level from the mid-winter camp in relation to ewes' body conditions. Undoubtedly many variations can be thought out to suit individual cases. It has even been pointed out to us that on some farms extra fencing may be unnecessary. Many larger farms have several ewe camps and usually one is acknowledged to be better then the others. Under these conditions it may be possible to use the better camp as the lambing/restoration area for, say, three ewe flocks and to spread all the ewes over the other two camps for the winter and summer periods.

Sub-dividing camps into better and poorer areas as described so far is mainly applicable to farms which have improved natural pastures. On farms where special circumstances apply, such as the smaller islands, the same concept can apply in fencing tussac from dry ridges and wet areas from dry. The latter can be important in erosion control and ameliorating the effects of drought.

The position regarding reseeded camp is somewhat different. As has already been explained such areas are not particularly valuable in early spring or late autumn so that they are better not used for lambing and tupping. On the other hand they produce much valuable summer growth and they should be fenced off to exploit this potential. If only unimproved camp and Yorkshire fog reseeds are available the fog should be stocked with ewes that have already lambed as soon as there is sufficient growth to keep them. They should be stocked as heavily as possible and shorn to prevent the fog sending up an excessive number of seed heads. For this purpose hoggs should be used to supplement the ewes and lamps as they will benefit most from the good quality summer growth of the fog. At weaning the ewes can be removed and the lamps left on with the hoggs. The ewes should be tupped, wintered and lambed on the spelled natural camps which have a greater variety of species present and provide more shelter than the levelled-off reseeded areas.

A better arrangement however is to combine the use of reseeded areas with both unimproved and improved natural camps. The ewes can be tupped on the improved natural, wintered in the unimproved, lambed on the winter spelled improved and moved to the fog as soon as growth starts. The lambs can remain on the reseeded areas for the whole summer supplemented by hoggs if necessary. At weaning the ewes should be moved back to the unimproved until tupping time.

This chapter can be briefly summed up by the slogan - "Fence the better from the poorer - if you haven't any of the better, make some. Then graze the parts alternately according to the nutritional requirements of the sheep."

CHAPTER 12 - SHEEP BREEDING AND WOOL

I. PRESENT CROSSES AND THEIR WOOL QUALITIES

1. Breeds Used

In the adverse conditions of soil and climate in the Islands the sheep need to have the qualities of wool fine-ness, yield and character combined with activity, mothering ability and hardiness. The history of sheep breeding in the islands in the last half century is a chronicle of attempts to blend these qualities from different breeds. The Romney is the basic breed. Some farmers imported Merino from New Zealand, Australia and South America in the first half of the century to raise quality count, to even up the distribution and density of the wool, to increase fleece weight and generally to give the wool character. Simultaneously the Merinos brought too much wool near the udder for newborn lambs, too thin a skin (insufficient wool cover) on newborn lambs, a reduction in body size and a loss of activity. In order to counteract these faults it was then considered necessary to go back to Romney sires to re-introduce size, constitution and mothering ability and simultaneously to lower wool qualities. The ban on the export of Merinos from Australia in the last twenty years necessitated a change to the Polwarth as a substitute. Other farmers had similar policies but their choice of the Corriedale in place of the Merino probably reflected their greater anxiety about the survival of lambs. The owners of Port Howard considered that the desirable characteristics were obtainable within one breed, the Corriedale. The Cheviot has also played an important part on a small number of farms where its function was to reduce wool cover on the face and to increase activeness.

2. The Organisation of Breeding

There are three strata in the breeding programme which most farms adopt. At the top is a small flock of stud ewes which are mated with the very best rams. The rams are very often the imported pure-bred rams or their fairly close offspring. The ewes are, with one or two exceptions, either the best ewes from the flocks or are the offspring of ewes once selected on that basis but now kept in a self-contained flock. Thus they are cross ewes to the purist. The Corriedales at Port Howard certainly warrant the term pure. There have been importations of Romney females so that there are some pure Romneys in the Islands. Stud flocks provide young rams to be used in the middle stratum or ram-breeding flocks which in turn supply the rams needed for the camp ewes.

Under this regime of natural breeding it takes about five to six years for an imported ram to influence the quality of the flock wool. It takes a first-class stockman to forecast the qualities which are going to be lacking in the wool in five to six years time and choose his stud rams accordingly.

The hybrid vigour or heterosis which can accompany a cross-breeding programme may appear in the stud flock but will have been eliminated in subsequent crossing through the lower strata. The time-lag in changing wool quality could be markedly reduced, and the effect of the heterosis increased if artificial insemination were to be adopted.

3. Falkland Islands Wool

Wool Quality

According to Hurd (1958) "The Falkland Islands wools consist of crossbred and half-bred types, the qualities ranging from 46's to 58's. The particular characteristics of the wool from these islands is their lofty nature, resilience and springiness, which makes them speciality wools, most attractive for hosiery and the woollen trade purposes, while the best of the finer qualities are much sought after for knitting yarns. There is an additional demand from Scottish buyers for the higher-grade qualities which they find particularly valuable in the manufacture of some special yarns. The medium-type wools are taken by top-makers, principally for blending with New Zealand and other cross-breds." It may be concluded that in the blending process much of the speciality character will be lost. Information obtained during the visits paid to farms in South America suggests that wool from the Islands enjoys a price premium of 10 per cent over their wool. Their farms are in similar latitudes but with different soils and a wider range of temperature. The Corriedale predominates.

More recently it has been stated (Smith 1970) that the great bulk of the clip (B and BB classes) covers bulk 56's quality, the range extending between 60's in the A grades and 48's in the CC grades. The speciality uses are also confirmed. The speciality characteristics of the wool are -

> "First, soft handle, as against comparative qualities in other origin;
> Second, white colour;
> Third, cleanliness, freedom from vegetable fault and contamination;
> Fourth, good style and strength;
> Fifth, crimp and loft of staple without the harshness of wools of other origins."

However, there appears to have been more 56's quality on the market in recent years than could be taken up easily. It has therefore been suggested that the spread of qualities should be at least maintained in the Islands.

Wool Classing

The extended shearing season due to the effect of weather and the comparatively low daily tallies makes it uneconomic to employ professional classers. A member of the farm staff is trained to class the fleeces according to tradition, experience and the advice of the buyers. Inevitably this means that the letter classifications are not necessarily comparable between farms. The breeding system itself militates against the kind of narrow-band classing common in Australia. A bale of B wool may be sorted into as many as 16 different qualities. The sorted matchings are then scoured to produce superior washed wools to an exact specification for the various outlets. To some extent this may explain why a reduction in the number of classes from a farm or a slight relaxation of standards within classes, is not necessarily penalised.

Wool faults

Vegetable matter, paint and colour are the predominant faults but enough has been said about them elsewhere to make it unnecessary to comment further.

Fleece Weight

Guillebaud (1967) has pointed out that while total wool production stayed within the range 4-4¾ million lb annually in the period 1909/1963, a progressive reduction in the number of sheep shorn has been accompanied by an increase in average fleece weight from 6.7 to 8.6 lb. The Team obtained further information on variation in average fleece weight by class of stock from 15 farms in 1969/70. The usual method of arriving at the averages was to add to the known average clean fleece weight a share of the weight of pieces. This share was obtained from the ratio of the clean fleece weight of that class, to the total clean fleece output of the farm. Pieces were found to form 16-25 per cent of the total weight sold by the farms which gave this information. The average of the farm average fleece weights were found to be:-

TABLE 23

FARM AVERAGE FLEECE WEIGHTS

	Hogget	Gimmer	Ewe	Wether	Ram
15 Farms	6.8	8.0	8.3	9.0	10.5 lb
10 Farms	6.8	7.9	8.3	9.2	10.6 lb
Range (10 farms)	5.3-9.6	6.0-10.2	6.6-11.3	8.0-10.9	6.7-13.8 lb
% wether fleece	74	86	90	100	116%

The ten farms were those able to give complete information for all classes. While the average ewe fleece weight was 90 per cent of the average whether fleece weight the range was from 74 per cent to 130 per cent. The latter figure must be considered exceptional. The next highest was 100 per cent.

As in any other animal production situation both genotype and environment can be limiting factors. The genetic material to increase yield is available even if it is not already present in the Falklands. There is a real fear that success would be achieved at the price of increased mortality of lambs at birth because of excessive wool in the region of the udder, and of older stock, expecially hoggets, because of wool blindness. Judging by the scarcity of open-faced individuals in the wool breeds this may be true as a generalisation. The need is to take extreme care in the selection of the rams, to ensure that they come from open-faced lines. Further, if the extra wool weight comes from increased density rather than staple length there is less liklihood of trouble with newborn lambs.

In the Rio Gallegos district of the Argentine interim findings of part of an experiment were quoted. Open-faced ewes exhibited greater productivity and lower mortality than a random selection of ewes on the station. Experiments in New Zealand have shown that lamb production was about 20 per cent higher with open-faced Corriedale ewes and differences of a similar order were found with Romney ewes. Fleece weights tended to be higher in sheep with woolly faces, although the differences were small.

There is no doubt whatsoever that the greatest single factor affecting wool yield is the level of nutrition and the distribution of the nutriment throughout the year. The feeding experiment at Douglas Station was to have given preliminary information on the effect of improved nutrition on wool growth and quality. It failed to do so because the sheep had not previously become accustomed to concentrates.

II. IMPROVEMENT OF WOOL INCOME

Three problems stand in the way of progress in wool production:-

To improve the level of nutrition of the sheep. This point has been discussed in Chapter 10. The effect of improvement would be not only to increase wool yield but also to lower mortality and so permit a useful level of culling of replacement ewes on their wool qualities. Better nutrition might lessen the character of the wool a little but increased selection could counter this.

To assess the permanence of the present sluggishness of the market in respect of crossbred wool of 56's quality. Choice of breeds is one aspect of this problem.

To organise sheep-breeding so that only the best rams influence the flock and then do so as widely and as quickly as possible.

1. Deciding on Objectives

World production figures given in World Wool Digest (1970) show the following percentage trend with the four years 1956/57 to 1960/61 as a base:-

TABLE 24

INDICES OF WORLD WOOL PRODUCTION

	1956/57-1960	1965/66	1966/67	1967/68	1968/69	1969/70
Merino	100	104	106	108	114	116
Crossbred	100	114	116	118	120	120
Other	100	103	106	106	107	106

First it is obvious that there is a rising trend in total production and second that crossbred wool production is rising at a faster rate than Merino. Although there is some overlap 60's quality may be taken as the margin between the two types. Falkland Islands wool therefore tends to be in the upper end of the Crossbred range.

Henderson (1969) addressing a Ruakura farmers meeting used information from World Wool Digest to calculate fleece value indices for various qualities of fleece. He then showed that relative to 46's there had been no better income from 48's or 50's. However, 56's fleeces had a fairly consistent 22 per cent value advantage over 46's and this increased to 44 per cent for 60's. He went on to show that in the early 1960's Romney 40's fleeces also had a distinct value advantage over 46's although this differential has diminished since then. He suggested that 48/50's fall between the wools really preferred for furnishing fabrics on the one hand and apparel on the other. Their value would therefore be very sensitive to the withdrawal of demand in either group. Henderson then examined the price differential in New Zealand wools in the range 56/60's from 1962/63 to 1967/68. He found that as quality count fell so did the price. There was a 6 per cent fall in value between 58/60's and 58's and a further 14½ per cent fall from 58's to 56/58's. If these differentials also apply to Falkland Islands wool there is every reason for moving towards still finer wool.

It seems probable that the market for wool of 56's quality will at best remain sluggish. The dilemma is whether to ride out the storm with 56's or to let quality drift back a little to 54's; or to aim higher for 58's or 60's. Managers whom the Team met in South America face exactly the same quandary. Their problem is greater to the extent that they are wholly committed to the Corriedale and it seems that the breed society will not register a ram with a higher count than 54's. Despite the sex difference this effectively puts a ceiling on the quality that can be produced. Their loyalty to the Corriedale breed is being severly tested. The Polwarth or Argentine Ideal may become more popular there as a result but no immediate change is imminent.

The Falkland Islands have a dual advantage, first in their use of cross-bred sheep, which permits more flexibility and second in their environment which gives the wool the character which earns it a premium. Furthermore that environment is not uniform but varies from locality to locality, some more suited to the production of stronger and some to the production of finer wool. If, then, those farms that are capable of producing finer wool do so, this is likely to relieve the pressure on the Falkland Islands 56's. Meanwhile those in the 54's region would be unwise to move up the scale but should concentrate more on improvement of fleece character, wool faults and presentation. There is a reasonable market for Falkland Islands 54's. The 48's should be phased out and perhaps also the 50's.

In summary this means overall encouragement towards finer qualities, eliminating the 48's and reducing the 56's so that the range becomes 50's to 60's. The market seems likely to be able to cope with such modifications provided the wool's character is maintained. The price level at which it will be taken up is quite another matter.

Such advice is more easy to give for the Islands as a whole than for individual farms, yet it is at farm level that advice is most needed. To generalise, the higher the proportion of dry camp and the greater the scope for pasture improvement the more a change to a finer-wooled sheep is justified, but there must be a proviso that lamb survival should not be affected adversely. Attention must be paid to the ability of the sheep to survive in their environment in numbers sufficient to permit at least a minimum amount of culling among the female replacement breeding stock. This is another way of saying that the environment in the Falklands sets a limit to the wool fineness which can be sought.

In considering changing a farm's policy it should be remembered that four factors are involved in maximising income;

Fleece weight
Fleece quality
Acreage required per fleece
Wool price

The argument may be exemplified thus:- Is it more profitable to sell an 8 lb fleece of 58's quality from a ewe occupying four acres or, to sell a 9 lb fleece of 54's quality from five acres? Until the physical relationships of the factors are known for a least one place in the islands, the answers to the questions are bound to be intuitive although they may be based on years of experience. This is a major argument in favour of setting up an Experimental Unit. It should not be concluded that a small sheep is necessarily less active and able to cope with rough terrain. Vigour and size are sometimes inversely related. Size and acreage requirements are likely to be directly proportional. Size in relation to fleece weight and quality is therefore the core of the argument.

To return to breeds, it may be said that the relaxation in March 1969 of the ban on the export of Merinos from Australia may make them once again a proposition for the Islands as crossing rams. The relaxation relates only to auctioned rams. However, the rather better mothering and lamb survival qualities of the Polwarth may allow it to continue its present popularity as the breed to improve fineness and density of fleece in Falklands sheep. These breeds are likely to be the choice of those farming the harder camp. The present policy on the majority of farms of varying the proportion of Corriedale and Romney to suit the prevailing conditions of the farm and of the market seems likely to remain the best policy for the majority. Their need is to eliminate the lowest qualities and to reduce the variation in quality within each fleece. There is also a small number of farms whose wool is poor in style, shows colour and vegetable matter and tends to be low in the quality scale. These appear to be the farms with the poorest camp and the smallest areas of greens. They are caught in a downward spiral of poor nutrition leading to lack of replacements and so a high proportion of older stock. This leads to poorer incomes and so lack of capital to carry out improvements to land or stock. For them the ways to arrest this spiral are attention to detail in the care of the wool, making maximum use of the best grazing and investing in good quality rams.

2. Control of Breeding

Stud Flocks

To spend up to £1,000 to buy and transport a ram from Australia to the Islands and then use him on cross ewes does achieve the aim of getting good qualities into the flock but it is both a slow and an expensive way of doing so. The rate of dilution of his qualities is very rapid. Secondly, the difficulties of getting transport for the buyer to inspect the stock and for the ram to the Islands in the face of veterinary regulations in trans-shipment countries, are formidable. These two factors suggest that it is time to set up pure-bred registered flocks of stud sheep in the Islands by the importation of ewes as well as rams. If the sheep were to come from Australia in a single importation the shipping line whose ships pass the Islands at intervals might be persuaded to carry them. This procedure might take place every five to seven years if desired. In each instance an importation should be preceded by inspection of the stock.

From what has been said earlier the breeds chosen would be Polwarth, Corriedale and Romney. This immediately throws up the problem of the expense of bringing three Breed Society inspectors to the Islands. If the recommendation is to be limited to one breed then the intermediate one, the Corriedale, is the answer. The present system of importing sires occasionally could be used to bring fineness (Merino or Polwarth) or size and mothering qualities (Romney). The pattern of crossbreeding would then be maintained in the camp flocks. A further advantage of choosing the Corriedale as the resident pure-bred is that there are many registered Corriedales within a day's journey of Punta Arenas in both Chile and Argentina. The quality of the studs seen there was very good, the sheep having good frame size and wool quality.

Artificial Insemination

An example of the method was seen in Southern Chile and is described elsewhere. The attraction is in the large number of ewes that can be inseminated from one ram in a season. At 100-140 per day the figure could easily be 1,000 without exhausting the ram. On a farm with 6,000 ewes coming into heat evenly over 15 days about 400 ewes per day could be inseminated. This would be 2½-3 hours work including an hour to set up and tidy up. This suggests that farms within 2-3 hours travel of each other could share an inseminator's time, if everything went smoothly. The biggest disadvantages lie in getting the ewes to the inseminator daily. First there is the problem of having enough pasture to hold the ewes near the settlement until they are inseminated. Second, they have to be drafted daily. Finally there is the matter of detecting and settling those ewes which do not hold to first service. The latter point suggests that perhaps 1-1½ per cent of rams would be required to fulfil that function.

Australian workers have suggested that with one ram per 500 ewes, the use of artificial insemination to improve clean fleece weight in Merinos would be an advantage in flocks of 3,000 ewes or more, but that in a flock of 1,000 the effects of inbreeding would more than counterbalance the gains from increased selection. Obviously care is needed. Yet if a conception rate of 60 per cent is achieved, the use of natural service to settle the balance of ewes will reduce the chances of intense inbreeding.

These difficulties seem to limit the possibility of using artificial insemination in the Islands but its potential for rapid change cannot be ignored. Perhaps the wisest course would be to use natural service in the stud or nucleus flock and in a smaller ram-breeding flock than exists at the moment. Artificial insemination could then be used for that fraction of the camp ewes which could be held near the settlement. Thus if the flock consisted of 4,000 ewes perhaps 1,000 each year could be artifically inseminated using two rams. The ram breeding flock would supply rams for the other 3,000 ewes and as followers in the artificial insemination group.

No such scheme can operate successfully without proper control and this implies the keeping and use of records and the testing of rams to ensure that only the best are used in the stud flock and in artificial insemination and to avoid inbreeding.

3. The Organisation of a Breeding Scheme

The scheme which follows is intended to allow the flock to become self-supporting or nearly so. However, because it depends on the females in the stud flock to maintain freedom from inbreeding, there is a strong case for periodic importation of new stud rams. These should be subjected to the same test as home-bred rams before being used widely. The progeny-testing proposed is to ensure that only the best rams exert an appreciable influence on the flock as a whole. Selection pressure has to be exerted on the male side because the environment is such that virtually all females have to be kept for breeding. The scheme assumes the present system of crossbreeding with occasional importation of rams. Some comments where a pedigree flock forms the Stud Flock are given later.

Sub-division of the Flock

The Scheme involves the sub-division of the flock into four sections namely

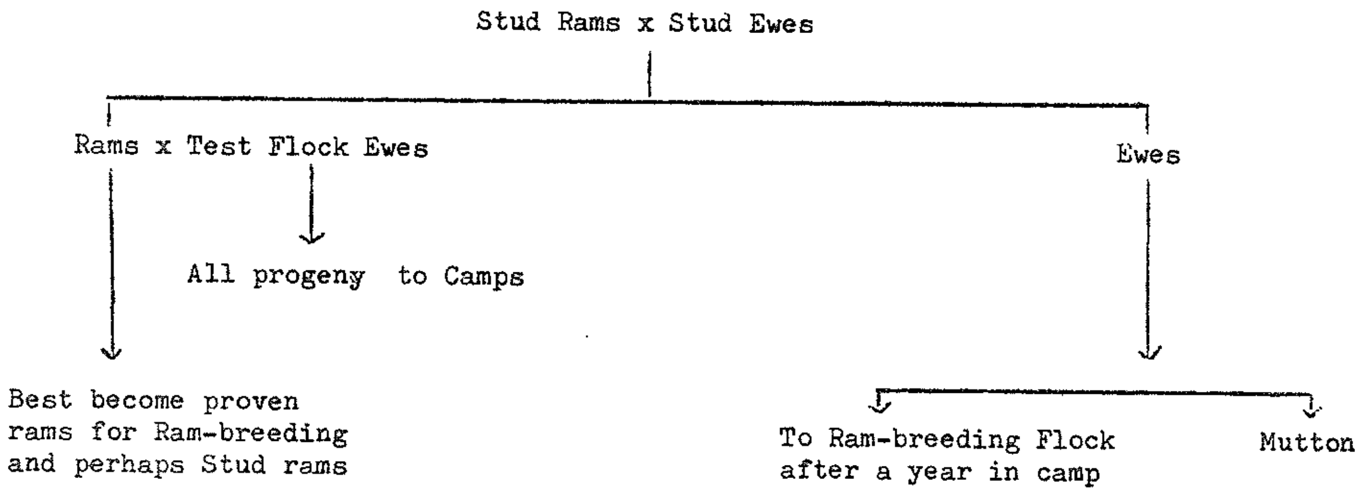
the Stud Flock - the elite flock of the outstanding rams and ewes.

the Ram-breeding Flock - in which the proven sons of the Stud rams are mated with selected ewes to provide flock rams (ie for the camp).

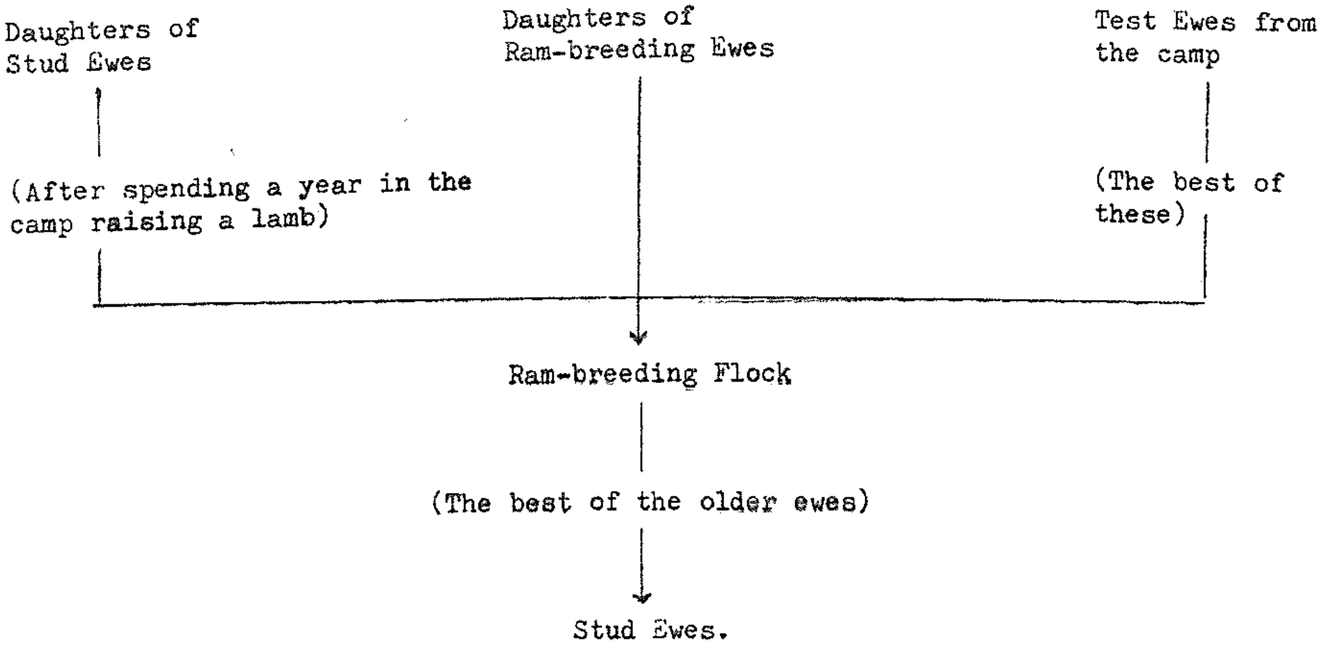
the Camp Ewe Flocks

the Testing Flock - in which to evaluate the breeding worth of the Stud Flock's ram lambs. It would consist of camp ewes which should all be of the same age and have produced lambs. On that basis it is suggested that the $4\frac{1}{2}$ year old ewes be allocated ie to have their 3rd lamb from the test rams. No ram lambs born in the Testing Flock would be kept for breeding.

Multiplication of Rams



Sources of Ewes



Requirements for the Ram-breeding Flock

Rams would be selected on

Ability to produce viable lambs	Fertility Willingness to seek out ewes Hardiness in offspring
Wool quality of his progeny	Fleece weight Fineness and crimp Lack of faults
Freedom from undesirable traits	Wool blindness Inverted eyelids Leg weakness etc.

These characteristics would be determined in two stages in the life of a ram's offspring:-

at weaning. The number of lambs weaned would be an indication of hardiness etc. Any undesirable faults might also be evident at this stage.

at first shearing. Examine the group for wool qualities and for undesirable faults (by eye). Weigh all the fleeces from the group in one batch. This gives a measure of both survival and yield.

The implication of this scheme is that the ram would be used as a lamb, laid off as a shearling and used as a two-shear after his progeny have been assessed.

Ewes should be selected on

Hardiness and mothering ability	The ability to rear a lamb as a maiden ewe under camp conditions
Wool yield and quality Freedom from undesirable traits	As a yearling and two-shear

It should be noted that since fertility and hardiness are so essential, no ewe should ever be allowed into the Ram-breeding flock unless she has reared a lamb to weaning in her first mating season. For this reason also this test should be carried out in the camp. The temptation to relax this standard will be great but must be resisted. Only the best are good enough.

TABLE 25

FLOCK STRUCTURE FOR 10,000 EWES

	No. of Rams	No. of Ewes	No. of Ram lambs weaned
Stud Flock to supply 8 ram lambs for testing annually	1 or 2	60	20-25
Test Flock to find the best 4 rams annually as replacements for Ram-breeding Flock	8	240	none
Ram-breeding Flock to supply 100 rams annually as replacements for Camp rams	15	700	up to 200
Camp Flock(s)	300	9,000	none
	325	10,000	

It will be seen that 10 per cent of the ewes are involved in ram production. In addition to the usual complement of young stock there would also be a flock of young rams awaiting test results. Also to test 8 ram lambs means having 8 small flocks both at mating time and at lambing until the lambs can be tagged (or marked) to identify the sire.

Culling of Females

The extent of the selection pressure which can be exerted on the female side can be seen from the following table.

TABLE 26

SOURCES OF REPLACEMENT EWES AND POSSIBLE CULLING RATES

	Flock	Replacements			Maximum cull
	Size	Bred	Required	From Test Flock	of own daughters
Stud Flock	60	25	15	-	10 (40%)
Ram-breeding Flock	700	230	175	Up to 30	Up to 85 (37%)
Camp Flocks	9,000	2,250	2,250	-	0

It would obviously be desirable to cull the camp flock replacements severely but, since this cannot be done on the type of grazings available, it is all the more essential to be as selective as possible on the male side. This scheme is considered practicable in the Falkland Islands and its organisation within the capability of the farm managers. Any relaxation in the standards set will reduce the effectiveness of the scheme.

Records

The records for ewes and rams are clearly implied if not stated above in the discussion of requirements for the ram-breeding flock. The record for a ewe would not go beyond the two-shear stage until she was under consideration for the stud flock at least two lambings later. Her presence in the flock would indicate that she had lambed on first exposure to the ram. With her wool and lamb productivity established, inspection and recollection of her performance would be the only possible basis for promotion to the stud flock from among 700 others in the ram breeding flock. Records for all are clearly not practicable.

Pedigree Studs

The flock would probably be 75-100 strong for the 10,000 ewe farm envisaged. It cannot be emphasized too strongly that only rams tested as lambs should have access to the ram-breeding flock because it will be they whose offspring have adapted best to the climate. It is these tested rams that should be used for artificial insemination. Where A.I. is used either the number of ram lambs tested annually could be reduced or more wisely, the same number tested but more stringent standards applied. The widespread use of all ram lambs from the pedigree flock would be an unwarranted risk.

III. THE MARKETING OF WOOL

The wool of the Islands' farms is generally sent to the London auction market and sold in bales of classed wool by farm name. It has been pointed out that classing is not to narrow specifications and that price penalities have not necessarily followed relaxation of standards. This seems to signify that the purchaser already has too much sorting to carry out on these wools. Nevertheless before considering alternatives to present methods it is advisable to take note of the changes the textile industry is currently experiencing.

The British Wool Marketing Board made a submission to the Ministry of Technology in January 1970 on the future structure of the UK Textile Industry pointing out the dangers to consumers and to wool producers in the vertical integration of the textile industry, leaving it in the hands of the manufacturers of synthetic fibres. To quote, "As suppliers of raw materials to the textile industry, wool producers are at a great disadvantage compared with man-made fibre producers, and are much less powerful in competition for fibre outlets. Quite apart from the involvement of fibre producers in textile manufacturing, organisations producing man-made fibres also distribute them to users. Thus, ICI, even while adopting a 'non-involvement' policy, is able to sell direct to textile manufacturers, and to procure sales by financial inducements, research and development, promotional facilities, and so on".

"In the case of wool, the units of production are small, and producers do not normally sell to manufacturers. Distribution is in the hands of companies which are, in turn, small and under-financed compared with their synthetic fibre competitors. Even on the UK system, bulk marketing extends only to the point of auction sale, where the wool passes into the hands of merchant distributors, or firms which may take the material up to the stages of blending and scouring or topmaking, but seldom beyond."

"The vulnerability of wool producers stems, therefore, from the fact that they sell their commodity to a distributive trade, which is itself vulnerable. Most of the British wool clip is sold to merchant distributors, scourers and topmakers, who have no 'captive' outlets of their own (and the same is true of most wool in world trade). Comparatively few firms in the wool textile industry are vertically integrated (eg only 4 per cent of organisations on the worsted system, and 22 per cent of organisations on the woollen system undertake more than two activities - EDC Report).

This means that the wool textile industry as a whole is vulnerable to capture by, and integration with, man-made fibre interests. Already, it consists of a chain of weak sellers from the wool producer onwards, and the wool producer is the weakest of all, as was demonstrated dramatically in 1967."

"The EDC Report on the Strategic Future of the Wool Textile Industry, published in June 1969, forecasts the elimination within five years of 400 of the present 1,000 firms in the industry. It also forecasts a reduction of 23 per cent in wool consumption by the industry between 1968 and 1975 - and an increase in man-made fibre consumption of 62 per cent! It is therefore going to be difficult enough to get outlets for wool through 'fibre-neutral' manufacturers. If man-made fibre producers are to be allowed to extend their interests into further captive outlets in the wool textile industry, then there will be no hope of countervailing influence by wool producers and distributors, and, hence, no hope of their future viability."

"If wool were to be pushed out of its markets as a result of the genuine preference of the final consumer, this would be accepted as being in the public interest. Also, the Board has for long accepted the view that a certain degree of rationalisation in wool marketing and processing channels is desirable, in order to cut costs and introduce efficiencies that would benefit manufacturers and consumers. But the Board submits that it would be wrong for wool to be excluded from outlets because the outlets were owned (or unduly influenced) by man-made fibre interests. The Board believes that such a situation would be contrary to the public interest. Similarly, a welding of the present fragments of the wool trade and industry into a more viable form should be a gradual process assisted by Her Majesty's Government, where appropriate. In many wool-producing countries, there is a need for more co-operation in marketing between producers and distributors of wool, and for less bickering between them. It may be that less wool of certain types will be required to meet consumers' needs in the future. If so, adjustments in production, which present serious problems in countries with economies dependent on income from wool, should be gradual. The interruption of natural economic processes by a ruthless scramble by man-made fibre producers for captive outlets could precipitate a disastrous collapse in certain sectors of wool production, trade and industry."

"A study of the present profit margins of wool growers, brokers, merchants, fellmongers, scourers and combers, will show that this is not an extravagant warning. Merino wool prices are currently at the lowest level for 10 years. New Zealand wool prices are approximately 25 per cent below the average for the 10 years 1956 to 1965. The New Zealand Wool Commission has still on hand a stockpile of 125,000,000 lb carried forward from 1966. The income of brokers, whose commission depends on price level has fallen considerably, and the recently-published financial results of public companies engaged in scouring, fellmongering and woolcombing, indicate an inadequate return on capital."

In the face of this threat it seems essential for those involved in the production and preparation of wool for manufacture to protect their interests by working more harmoniously together. How can this be applied to Falkland Islands wool?

The conversion of whole fleeces into different specifications of prepared wools, ready for manufacture is a highly specialised function. The expertise is not available in the Falklands and the Falkland Islands are unlikely to be able to offer the necessary specialists sufficient inducement to go there. Again there is advantage in having the sales force in close touch with the preparatory process as well as with the manufacturers. It therefore seems inevitable that such work will be carried out after the wool has left the Islands. Thus there will continue to be a difficulty over communication between grower and processer aggravated by distance and transport frequency.

Perhaps the only way to solve the communication problem is to follow the lead of the Falkland Islands Company and buy shares in a processing company. It would be futile to do this piecemeal. The farm owners should consider forming a holding company to appoint directors to such an amalgamated firm and provide capital for its expansion. In this connection it must be pointed out that the total clip from the Islands is only 4½-5 million lb annually worth some £0.75-£1 million. If this was all handled by one firm it would not be a particularly big one. Nevertheless it would have a monopoly of a specialty wool with the possibility of advertising a branded product. Have the owners sufficient confidence in the future of wool to adopt such a suggestion? It is certainly difficult to see the Government playing any part in the encouragement of such investment.

CHAPTER 13 - SHEEP MANAGEMENT

This part of the report is intended to comment upon all sheep handling operations. It is then that man's own actions influence the ease with which these operations are carried out, their effectiveness and the extent to which stock are subjected to stress by these actions.

I. GENERAL HANDLING

As was expected, the Managers were found to be very much aware of the profound influence that a man or men can have on the ease of stock movement and the animals' ability to withstand stress. Managers face the twin problems of large numbers of stock and workers of very variable sensitivity towards the sheep, so that it is sometimes not possible to achieve the standards they themselves know to be desirable. Nevertheless no opportunity should be missed of pointing out that the true stockman's method is simpler, less fatiguing for the man and less frightening for the sheep. A familiar example would be to persuade sheep to move forward in a long narrow space. If the sheep in front are suspicious no amount of noise from man or dog at the back will make them move. If, however, the man walks slowly down the side of the pen from front to back the sheep will believe they are escaping from the man by moving forward out of the pen. The dog at the back may hardly be necessary. A shepherd's work will always be easier for the man who knows from observation how sheep react to any situation and can anticipate and utilise that reaction.

The counterpart and consequence of variable stockmanship is variable control of dogs. The full range of skills was seen by the Team, from the dogs which with a minimum of commands kept the sheep moving steadily in the right direction, to the one which caught an escaping lamb in its mouth, shook it and threw it down, meantime allowing a greater number to scatter from the mob.

Under present circumstances some bonus payment scheme seems to be the best way to encourage good dog-control. Some factors in the scheme would be:

A limit to the number of approved dogs per shepherd

Approval to be by a director of the farm and a union representative both with practical experience

Approval to be for a limited period

Approval to follow a recognised test of the dog's ability

The test might consist of a haul from or through an unseen point some $\frac{1}{4}$-$\frac{1}{2}$ mile distant through two gates some distance apart, round an obstacle or across a stream and then return, the handler being mounted on a horse. It might also include holding the mob virtually stationary in open country. The number of sheep should probably not be less than 40. The test should be completed "in a reasonable time" but this should be at the adjudicators' discretion.

It should be noted that there has been no suggestion of a limit to the number of dogs a shepherd could keep, only to the number eligible for approval and bonus payment.

It is self-evident that the manager's dogs must be exemplary, or not be used.

Generally the layout of handling pens was satisfactory, the important points of construction having been included. Certain principles are worth reiterating.

Long races permit greater accuracy of drafting

Sheep move more easily through races which slope uphill from the point of entry; and when they can see daylight and other sheep at the far end

The amount of concentration and speed of reaction required to operate a three-way drafting gate precisely make it a dubious advantage

Corners forming acute internal angles should have the apex fenced off

Gateways and corners should not have sharp edges

It is an advantage to have the forcing pen and the race floored with concrete for safe animal movement and ease of cleaning to minimise dust.

Anyone contemplating changes to handling yards should consult Bulletin No 353 or the New Zealand Department of Agriculture - Design and Construction of Sheep-handling yards.

II. AT MATING

The suggestion has already been made that the ewes should be in improving condition in autumn to build up their winter reserves. Flushing is unnecessary in such circumstances. Falling condition at service is undesirable. The rams too require to be fit or improving in condition. The practice of using 3 per cent of rams in the open camp is wise but if the ewes were stocked more densely on improved camp the figure might be brought down to 2¼-2½ per cent and in stud flocks in small paddocks it might be down to 2 per cent where no control was exercised. By the use of teaser rams in an elite flock to detect heat it might be possible to so limit the number of services made by an exceptionally good ram that he could settle 100 ewes in a season.

In this special field of making maximum use of top quality sires there is little doubt that artificial insemination would lead to the most rapid spread of his qualities throughout the flock, and possibly eliminate the need for a ram-breeding flock. At Cerro Negro in Chile we saw a veterinarian and his assistant carrying out A.I. on sheep. Two men were handling and positioning the ewes. Because there was only one ewe stance the throughput was three ewes a minute but a second stance would have raised the rate to perhaps five a minute. In this way it was possible for a ram to settle 100-140 ewes per day. The implications of this technique for speedy change are obvious, but so is the need to be sure that the ram's qualities are desirable. The apparatus required is not complicated and although thorough training of the operator is essential there is no reason to insist on having a veterinarian carry out the work.

III. AT LAMBING

As far as the tasks undertaken by the shepherd at lambing are concerned, there is nothing more to be done than he does already. However, the manner in which the unskilled shepherd sets about his chores has led many to question whether shepherding is wise at lambing time. It is a pity that this question should arise for the skilful shepherd can make a considerable difference to lamb numbers by mothering separated pairs, by moving sheep off the poorest grazing or away from danger spots. It is a lambing time that only the very best dogs should be used, remaining beside the shepherd until sent out and obeying each signal instantly. To permit a standard lower than this implies the willingness to accept losses from the separation of ewes and lambs.

IV. AT MARKING

While time is what the farms pay cash for, haste with young lambs can be just as costly. It pays to hasten slowly when driving. By the nature of extensive farming, docking and castration must be delayed till the end of lambing. While the use of rubber rings for castrating lambs at the age of six weeks is a greater strain than at an earlier age, it must be accepted as inevitable. The knife is employed universally for docking tails. It is speedy and simple but it leads to some loss of blood. The Team recorded one death due to loss of blood so there must be others. The alternative docking method is the rubber ring but it causes greater discomfort and so could lead to slower mothering up.

The manner in which lambs are put to the ground after marking is crucial. Too many are dropped tail-end first on to the ground. First this is an unnecessary extra blow to the lamb and second it exposes an open wound to the inevitable carpet of dung at the marking bench. Lymphadenitis (boils) is therefore one of the diseases to which they are exposed at a very early age. Septicaemia is also a risk.

The biggest single cause of losses at marking time is failure of ewe and lamb to pair off after release from the pens. Present practice of expecting the ewe to stay near the pens till marking is carried out is dependent on her mothering instinct which is then in conflict with her hunger and her instinct to return to her own feeding ground. The larger the cut taken in the more difficult the problem is. Where numbers are large a holding pen, or posting a man and dogs to retain the ewes costs money. This can save lives. There are no figures available to evaluate the equation economically, but the need to have the largest number of replacement stock is very important.

V. AT SHEARING

Shearing methods or styles in the Islands are certainly effective but are varied, show and wasteful of energy by comparison with those of Australasian professionals whose success is founded on

> A complete understanding of the ways of immobilising the sheep with minimum effort during shearing, and
>
> Minimising the distance the shears have to travel to remove the fleece. This is achieved by maximising the width of blows, minimising the number of blows and ordering the sequence of blows.

Two reasons have been given for failure to adopt these styles in the Islands. The first is that practised shearers find it extremely difficult to change styles. The second is that contract money would be lost during the re-learning period. The young men inevitably copy the ways of the seniors in the shed. This reasoning is understandable and will only be changed if a professional from Australia or New Zealand works alongside the men and makes big tallies of clean-shorn, cut-free sheep with no more expenditure of energy than his neighbours. It is believed that the professional can achieve 200 a day, often before 4 p m, the Islander 100-140. The facts are that the shearers have a certain number of sheep to shear on the farm so the number of days spent shearing is irrelevant to the men. A declining number of shearers would appear to put the men in an even stronger bargaining position, but the consequence of maintaining shearing tallies per head at their present level in such circumstances would be a later end to shearing, leading to greater winter losses of stock. Sheep-farming would then become extremely difficult financially and perhaps impossible. Expansion would be out of the question. For these reasons a change in shearing output per man is essential to the economy, and can be achieved without any greater energy expenditure than at the moment.

The need of newly shorn sheep for shelter in cold weather is well-known and usually met. An overnight loss of 300 sheep was quoted to the Team by one Manager.

VI. AT SPRAYING AND DIPPING

Policy and practice in respect of the ked problem are dealt with in the Veterinary Section.

Two alternatives seem noteworthy in the event of reconstruction of dipping facilities. These are the provision of a decoy pen to persuade the sheep to approach the dipper or the use of a circular catching pen immediately before the bath.

VII. CARE OF WEANED LAMBS AND HOGGETS

The size of the problem will be recalled from the Survey and is partly re-stated. Unfortunately the data are from marking not weaning and they are for one year only. They are the best measures available.

In terms of ewes put to the ram the lamb crop had shrunk from 62 per cent at marking to 50 per cent at hogget shearing 12 months later although three out of 20 farms had hogget shearing figures of less than 40 per cent. In other terms, 81 per cent of the lambs marked were shorn as hoggets, 10 per cent having disappeared by dipping, 9 per cent thereafter. Eleven of the 20 farms had marking to shearing losses of 20 per cent or more.

The factors involved in these severe losses are

Methods of weaning

Weaning is a time of severe stress for a lamb. It is unwise to add to it unnecessarily. On most small farms weaning is over in a day for any individual lamb. The camp is gathered early in the morning, the lambs are drafted off and are in their new camp in the late afternoon. This is the ideal arrangement. At the other end of the time-scale at Packe's Port Howard the actual weaning process is no longer than one day but the lambs are retained in the weaning paddock for up to four weeks before spending four days en route to the wintering ground. No objection can be raised to this method. In both these situations the lambs come to no harm from being subjected to other operations such as wigging, pilling, drenching or dipping provided these are done gently but firmly. Lambs' behaviour is very frustrating so patience is needed.

The really objectionable way of weaning lambs is to gather the camps and draft the lambs one day; hold the lambs in the pens overnight, walk them to the settlement and put them into a bare paddock there on the second day; carry out all the above extra operations on the third day; and then move them to the hogget ground on the fourth day. Losses are bound to be high following such treatment.

The principle is to get the lambs from the ewe ground on to nutritious feed on their own as speedily as conditions will permit without harsh handling.

Ditches and Coastline

All unaccountable hogget losses are attributed to ditches although on camps with coastline that too gets its share of blame. It must be accepted that these are real hazards and that they are the most common causes of death. On the other hand, wool-blindness and under-nutrition are also factors in such deaths. Opening up and reshaping the sides of these ditches by mechanical means is the obvious solution, (but see also Section). While a low coastline is usually an advantage because of the presence of greens and of kelp, the search for food or shelter from the wind can ofter lead sheep into danger from the tide. Cliffs are another hazard.

Where a length of ditch coastline is dangerous, the economics of making it safe depend upon the annual charge for work necessary placed upon the hoggets lost.

Wool-blindness

This is a factor predisposing to losses in ditches and to under-nutrition. It is a genetic problem and is mentioned in Chapter 12.

Shelter

The Managers are fully aware of the need of the sheep to be able to escape from the ever-present wind in the Islands. Valleys, peat-banks, diddle-dee, rushes and coastline all play their part. The economics of creating shelter are very doubtful.

VIII. STOCK RECORDS

Irrespective of what information the Government requires, the Managers ought to have sufficient records to allow them to make comparisons between camps, between years etc, in order to help them consider whether climate or management or some other factor was responsible for the results in any year. Insofar as management is a major factor influencing results, it is desirable that the Managers should be willing to discuss and compare their results at private confidential meetings. Because of their multiple directorships, the directors of a company are at present in a better position than the Managers to make comparisons with, and draw conclusions from other farms' records. This means that the confidentiality is already overlapping but is not benefiting the Managers as directly as it ought to.

Young Stock

Ideally, complete marking and weaning information from each camp or group of ewes in rotation or alternation is advisable. Since marking is a two-phase operation and so yields unsatisfactory figures, it is to be regretted that so few farms keep adequate weaning records. Weaning is harvest time. The number of lambs of each sex (ewe, wether and ram) ought to be recorded for each camp. A true measure of the productivity of the ewes under the management imposed is then available for comparison with earlier years or with other camps in the same year. When the sum of the weaning data is compared with the dipping data similarly divided by sex, the true post-weaning loss will be revealed. Management factors can play a large part in this loss. Losses in the first winter will be shown up by shearing records.

These three records of weaning, lamb dipping and hogget shearing are considered essential. In addition it is thought to be essential to follow the young female stock through the 16 months following first shearing to the point of first entry to the breeding ewe flocks. This information permits the kind of analysis of young stock losses that has been carried out in the Survey but with weaning figures taking the place of marking figures as a baseline.

Dry Stock

A more complete picture of losses would be obtained from sub-division of dry stock tallies by age, sex and camp at shearing and dipping. Except in the case of shearling ewes it is debatable whether this is worthwhile unless a problem with one age-group is suspected.

Ewes

Gross tallies at dipping and shearing are essential for each camp to relate to the lamb data and to give winter and lambing losses. It is not possible to break down ewe losses any further from that information. The next essential step would be to separate the ewe losses between dippings into categories so that the reasons were clarified. Death or disappearance, culling because of faults, casting because of age and use for mutton would be the four categories listed. It would be of interest to ask how losses within each age-group of ewes are distributed. Tallying the dry ewes at shearing by age might prove informative too.

Wool

Another optional extra might be wool records. It would be daunting to make an analysis of records of samples of each class of sheep. However some indication of wool facts should be recorded. It is suggested that whethers being shorn for the third time are probably most typical of the farm and so should be used. The sample size should be approximately

50	from	a flock of	less that 1000
100	"	"	1000 to 2000
150	"	"	2000 to 4000
200	"	"	more than 4000

In order to ensure a random sample of 50 from 1000 the sheep should be put through the drafting race and every twentieth sheep drawn off. The sample would then have the fleeces classed on the sheep and be divided into A's, B's and C's. The fleeces would be weighed immediately after shearing with only dags removed and simultaneously classified as "clean" or "dirty". They could then go to the tables for normal handling.

This information would give numerical indication over the years of trends in fleece quality and weight distribution within the flock. Fleece data of this type together with liveweights would help to answer the question of whether it pays better to keep finer or coarser wooled sheep, remembering that the area of grazing required is approximately proportional to liveweight.

Wool prices

The Manager should have enough information to enable him to calculate the average clean fleece weight, price per lb and clean fleece value for each class of sheep and for each sale.

CHAPTER 14 - MUTTON PRODUCTION

It has been pointed out that the supply of young stock coming forward as replacements without culling permits 25 per cent of the ewes to be replaced annually. The implication is that many ewes are expected to yield more than four crops. The young wethers are also required to keep the wether average age down and therefore wool quality up. The majority of the wether camps do not have the kind of herbage which would permit a change of use from wethers to ewes. In such circumstances there is no hope of producing lambs for sale. All surplus animals are likely to be in the range 4-8 or more years and of very variable quality. The ewes in particular are likely to be lean, although the best of both sexes make admirable eating.

The number of animals which might be available can be estimated thus:-

Ewes		
Average number in returns for years 1963/4 to 1967/8		224,812
Average number of maiden ewes for years 1963/4 to 1967/8		57,369
From maiden ewe numbers deduct		
6 per cent death during that winter	3,442	
1 per cent culled at shearing	574	
10 per cent of ewe numbers (deaths)	22,481	26,497
Balance is the maximum numbers of ewes available		30,872
If 20 per cent are assumed inedible, balance available is		24,698
Wethers		
Average number in returns for these 5 years		207,024
Assume 25 per cent replaced		51,756
If 12½ per cent of these are inedible		6,469
Balance available is		45,287
Total number of animals		69,985

One further deduction needs to be made for the mutton eaten by the population. If Stanley's consumption is 170 a week and the camp's 250 then 21,840 is the annual total. Thus approximately 48,000 sheep are the maximum number likely to be available annually. If the carcases average 50 lb deadweight the total would be a little more than 1,000 tons. Practically all the killing would have to take place in the months December to April inclusive.

Exactly the same difficulties face the Islands in respect of mutton sales as the beef sales which are discussed in the next chapter. Canning for pet food is a possibility to be considered.

CHAPTER 15 - CATTLE PRODUCTION AND BEEF

I. PRESENT POSITION

The Survey describes present methods of cattle production adequately. It was made clear from discussion when the Survey was being carried out that the Managers generally regard the cattle as a necessary evil from which milk, butter and an occasional bit of beef can be obtained. Few take cattle seriously as grassland improvers. Unanimously they regret the effects of cattle walking through the present fences on the camp. Under such circumstances they are going to have to be assured of a stable, profitable outlet for beef before investing either time or money in beef-raising. This hesitance was also very obvious in the Managers' replies to the Joint Government and Sheep Owners Association recent questionnaire on the subject of a possible beef industry. The offers of regular deliveries of cattle were usually given as a range. The range for the whole Colony was 200-500 head annually from three milion acres. Despite the acknowledged difficulties in respect of fencing and especially of winter feed there is little doubt that more could be raised if the inducements were attractive, and the men liked cattle. Even if Falkland Islands' beef could only command a price of 2s 6d per lb, a 450 lb carcase would sell at £56 on the UK market. The mean daily prices of Scottish-killed sides in London in 1969 averaged from a high of 3s 5½d per lb in June to a low of 2s 11½d in October and November. This is premium meat in the fresh meat market, however.

II. TECHNICAL CONSIDERATIONS

Imported Grain

Fattening cattle over several summers on grass is cheap but slow, and restricts the numbers which can be kept. If acres were bought in the form of imported grain, faster growth would lead to a quicker return on capital and free more land for breeding cows. However, as a general rule, it is cheaper to move cattle to grain than vice versa. Secondly, once capital is sunk in an enterprise dependent on one commodity, a buyer's market in that commodity tends to become a seller's market. Agricultural capital is notoriously difficult to retrieve. For these reasons, we believe that practically all the feed for beef should come from within the Islands. Nevertheless, if the abattoir were to be set up, there would be good reason to import smaller quantities of grain for finishing cattle out of season in order to keep the factory open.

Displacement of Sheep by Cattle

The low quality of the pastures and lack of special winter feed means that growth is slow and it is not surprising that cattle take about four years to reach a weight of 9-10 cwt. It is therefore necessary to find out how many cows and younger cattle are needed in order to produce 100 beef cattle annually. The following figures are based on assumptions which can only be approximate. A range is therefore shown.

TABLE 27

POSSIBLE AGE STRUCTURE OF CATTLE HERDS

Cows	225 (80% calving)	180 (90% calving)
Calves	180 (17% mortality)	162 (10% mortality)
Yearlings	150 (3% ")	146 (2% ")
Two-year-olds	145 (3% ")	144 (2% ")
Three-year-olds	142	141
Replacement heifers	40	38
	882	811

Thus some 8-900 supporting head must be kept in order to produce them at an age of four years. It is extremely difficult to hazard a guess as to the grazing acreage required by the various classes of stock but if a cow with calf required 25 acres, a yearling or two-year-old 15 acres, and three and four-year-olds 20 acres each then the area needed would be 14-16,000 acres.

It is even more difficult to assess the number of sheep which would be displaced under these circumstances; or to assess the number which might be brought back later as a result of improvement of the grazings. There is no doubt that the cattle congregate at the greens in the same way as the sheep. The fact that they have to use their tongues to grip the grass means that they can obtain very little of the true greens which the sheep keep extremely short by their tooth-and-pad method of grazing. It is at the fringes that the cattle can get the medium length grass which they can eat easily. It is in the area of improving ground between the greens and the camp herbage that the two classes come into conflict. If only two sheep were displaced for each bovine put on (assuming equivalence throughout the age groups) then the output of 100 beef animals annually would mean the displacement of 1,600 to 1,800 sheep. Ewes would not be expected to be productive if kept on wether ground. Cattle should not be expected to be either - especially if kept on a commercial scale.

Winter Feed

It is almost certain that the farms would have to provide some additional feed for the calving cows in late winter and spring if beef were being produced on a commercial scale. This is thought to be true even with the assumption that calvings will continue to be in spring. Such feed could come from grass or oat hay at 15 cwt per head or from tussac at 3 cows per acre. Hay feeding would give a better quality of fat if there were a commercial need to fatten out-of-season. The need to create and fence arable paddocks or tussac plantations is a further disincentive.

Fencing and Corrals

The Government's survey showed the Managers to be very much aware of the need to re-fence in the event of a cattle industry starting. Present 7-strand plain wire fences have proved inadequate to hold cattle and it is doubtful whether the replacement of the top strand by barbed wire would alter the situation appreciably. Nevertheless it ought to be tested on a tight fence with cattle which have not been accustomed to wandering through fences at will, before the idea is completely discarded. The probability is that a barbed wire six inches higher than the present top strand will be required.

It is certain that a new cattle corral would have to be built at the point where beef cattle are to be despatched and perhaps one other in the camp would be required for ease of working.

Breeds of Cattle

In the event of a beef industry being introduced, the beef cattle on any farm would probably be kept separate from the dairy cattle. The latter would remain dual-purpose, while the beef cattle would be distinctly hill types. This implies that the foundation would be laid with Galloway, Welsh Black or Shorthorn cross Highland cattle. These would be either pure-bred for female replacements or crossed for beef production. In the UK bulls of the South Devon, Sussex and Lincoln Red breeds are becoming increasingly popular for crossing because their progeny make faster gains than those of the traditional beef breeds. Both types would need to be compared if a beef industry were to be developed in the Islands. Breeds from other European countries should also be considered.

III. BEEF PROCESSING AND MARKETING

The principles of two possible schemes for getting the beef from the farm to the market have been considered. The first involves the purchase of a fairly large ship with slaughterhouse and cold-store facilities. Scows would ferry the live animals out from the settlement. Some three to four journeys annually to the UK would be feasible. The advantage of this type of vessel is that it has some resale value if markets change but the disadvantages are the high cost of running an expensive vessel round the small islands and the ferrying and killing crews would have to be laid off during oceanic journeys.

In the second scheme a smaller vessel for jetty work is envisaged. Killing and cooling would be carried out on board and then the carcases would be delivered to a central cold-store awaiting bulk shipment on a hired ship. This gives flexibility in killing dates and keeps men in more regular employment. The two problems in relation to the cold-store are its resale value if markets change and the availability of fuel.

Although the UK market is the one to which most farm Managers would prefer to send their meat there is doubt about access whether Britain joins the European Economic Community or not.

There are four very important marketing matters to be settled before a beef industry could be encouraged:

Will the UK Government permit entry of Falkland Islands beef and on what conditions? What other country would be interested?

Will the market be for beef (and mutton) on the bone, boned or canned? Will it be for human or animal consumption?

By what means will the collection, killing, processing and transport of the meat be carried out from a multiplicity of small islands?

What would be the capital cost and expected returns in both the production and processing sectors?

The Team does not consider itself competent to answer these questions and suggests that further studies should be made by experts in the fields of slaughter-house organisation, of meat marketing and of meat shipping. The experience of those running the South American frigorificos should not be overlooked. Particular care is needed in this matter in view of the Ajax Bay fiasco in the 1950's.

CHAPTER 16 - VETERINARY INVESTIGATION

An early report on the Falkland Islands by an outside authority Munro (1924) states that all classes of stock are free of contagious disease and that defective nutrition, coupled with lack of vitality are the main factors bearing on the high mortality in young sheep. Fern (1956) and Wannop (1961) also stress the connection between high mortality rates particularly in young sheep and poor nutrition.

The writers of these earlier reports had no facilities for carrying out veterinary diagnostic tests. The Team had the advantage of being able to take out to the Colony sufficient equipment to set up a veterinary investigation laboratory. Items included were a high quality binocular microscope, large bench centrifuge, incubator, water bath, refrigerator, colorimeter and a galvanometer-titrator. The laboratory was also intended to serve the needs of the rest of the Team, so that there were facilities for preparing herbage and soil samples for despatch to the United Kingdom for analysis. The equipment travelled by sea and was delivered on 13 October. A vacant room, at the King Edward Memorial Hospital, Stanley, was put at the disposal of the Team by the Senior Medical Officer. The laboratory became fully functional on 29 October. A circular letter was sent to all farm managers listing the facilities offered by the laboratory. This letter stressed the importance of immediate notification of deaths so that the carcasses of freshly dead sheep could be promptly picked up by the Government Air Service. These facilities were used on 46 occasions for post-mortem specimens. Doubtless if any farms had suffered from epidemic disease during the period of operation, more carcasses would have been sent for diagnosis. It is difficult for managers on the large farms to collect carcasses of sheep dying in the camp and get them delivered in Stanley while they are still fresh enough for worthwhile examination. The time when a laboratory can be most useful to sheep farmers is during the month preceding and also during lambing. Unfortunately the laboratory was not yet functioning fully when the lambing season commenced in September 1969.

At the commencement of the visit, a brief questionnaire was sent to all farms in order to obtain an estimate from managers of the ages at which greatest mortality occurred in young sheep. They were also asked what the outstanding disease problems needing investigation were. Of the 23 who replied, 17 considered 1-7 days of age was the worst period for mortality. No manager asked for any particular disease to be investigated, though two requested tuberculin tests on dairy cattle.

During camp visits the opportunity was taken to carry out as many post-mortem examinations as possible. Blood samples and dung samples were collected when appropriate. From the laboratory test results and the information collected during consultations and inspections, a picture of the overall disease pattern was built up. In general, this confirms the views of Munro, Fern and Wannop. The final conclusion is that only a very small percentage of the high annual wastage in sheep is due to disease. Certain conditions merit special mention. No infectious abortion was found. Specific deficiency diseases were generally absent, apart from cobalt pine. Hydatid disease was present in alarming proportions. Worm infestation was found on a few farms during mid-summer affecting young sheep. Caseous lymphadenitis at the time of our visit was increasing on a few farms. Epididymitis, though present, was not found to be a general problem. The cattle population also was found to be remarkably free of disease. Tuberculosis in the dairy stock appears to have been eradicated.

In the following chapters all relevant diseases of sheep and cattle are discussed in detail.

CHAPTER 17 - DEFICIENCY DISEASES OF SHEEP

Gibbs (1946) quoted earlier analyses of pasture samples by the Rowett Institute as showing the native pastures to be deficient in most minerals. He attributed the absence of widespread deficiency disease to the fact that most stock have access to the coast when they consume kelp. He suggested that the slow maturing of stock might be associated with lime deficiency in soil and herbage. Gibbs and Weir reported losses due to pine in hoggets though neither author suspected the pine to be due to deficiency of specific factors in the diet. King, et al (1969) said it was probable that calcium and phosphorous were the most serious mineral deficiencies in the sheep diet. They went on to suggest that supplementation with these minerals and possibly Vitamin D should be considered.

Calcium

King, et al (1969) state that although calcium deficiency in sheep is rare, it is likely to occur when the calcium content of the herbage is below 0.1 per cent which is the case with a very large number of their Falkland samples.

However, between September 1969 and April 1970 evidence of rickets and osteomalacia was looked for in vain in both West and East Falkland. Very few bone or joint abnormalities were seen. No clinical evidence of calcium deficiency in sheep was found on farm visits. Blood analyses were carried out on 10 farms. Out of 72 blood serum samples, 8 from cattle and 64 from sheep, only 3 samples were below the normal range for calcium (8.5-11.5 mg per 100 ml serum). It is noteworthy that none of the three low samples was from lambs. Bone fragility in lambs was reported only from Dyke Island, Port Stephens. When hoggets are wintered on this island poor quality bone formation evidenced by fractures of long bones is noted in up to 4 per cent of the hoggets at the time they are taken off in the spring. It was not possible to obtain any blood samples from affected lambs in the spring of 1969. One hogget which had broken limb bones twice on the mainland part of this farm was blood sampled in April 1970 and the blood was found to have normal values for both calcium and inorganic phosphate.

Twisting of limb bones resulting in permanent crippling of hoggets is reported to have occurred one year when ram hoggets were put on Christmas Island and Thursday Island, both in the Pebble Island group. Of these hoggets 60 per cent were affected. The description of the condition tallies with an acute deficiency of calcium or phosphorus. These two small islands have not been used since.

Phosphorus

King, et al (1969) reported inadequate levels of phosphorus in the majority of the herbage samples analysed. During our farm visits no cases of phosphate deficiency in sheep were identified. Forty two oxalated blood samples from five farms were examined for inorganic phosphate and only one was below the normal range (3.5-6.0 mg per 100 ml blood). The Team's visit covered the spring and early summer, the seasons when bone and joint abnormalities indicative of calcium, phosphorus, or vitamin D deficiency are easily visible in lambs or one year old sheep.

In view of the extremely low levels of herbage calcium and phosphorus quoted by King, et al (1969) it is perhaps surprising that bone or teeth disorders do not affect the greater portion of the growing stock in at least some areas. Since sheep are very selective feeders their intake of minerals is probably higher than is suggested by the bulk herbage samples of King, et al (1969). It is known that sheep thrive better than cattle in mineral deficient areas because the bony skeletons of sheep constitute a smaller percentage of their body weight than do those of cattle. Our observations showed the quality and lasting power of the teeth of Falkland sheep to be good, with the exception of sheep wintered on tussac.

It would seem that overall the intake of calcium and phosphorus is sufficient for maintenance of health in the sheep though possibly not for rapid maturation. If growth rate was on a par with that in the United Kingdom deficiency disease might become a problem.

Selenium and Vitamin E

No selenium or vitamin E estimations were carried out. When it is suspected, the white muscle disease caused by a deficiency of these substances is best confirmed by histological examination of sheep muscle. The main symptom is muscular stiffness without bone or joint abnormality. Sheep over six months are not usually affected.

Three farms may have been effected in the past. Two of these, one an East Falkland farm and the other an island farm off the South West of the East mainland reported occasional stiffness developing in a small percentage of lambs and hoggets. It was not possible to get live specimens to investigate whether this was white muscle disease (muscular dystrophy).

A similar but more acute seasonal condition is known to occur irregularly in the extreme south west of West Falkland. This affects mainly very small lambs three weeks old and upwards. Symptoms are stiff gait and arched back and the more acute cases are unable to stand to suckle and consequently perish. A batch of these cases occurs every four years or so. At the last outbreak four years ago 100 lambs died or had to be killed. The condition was diagnosed by a veterinary surgeon, as muscular dystrophy, the characteristic bundles of white muscles in the thighs being seen at post mortem examination. No reports of affected lambs were received last season.

Magnesium

Magnesium levels in herbage are known to be satisfactory. During our visit no cases of magnesium deficiency were seen and no evidence suggesting magnesium deficiency in the past has been collected. Seventy two blood samples, 64 ovine and 8 bovine were collected from 10 farms and all were found to be within the normal range for magnesium (1.8-3.2 mg per 100 ml blood serum). With the present types of grass sward and rate of growth cases of magnesium deficiency are unlikely.

Copper and Cobalt

These two trace elements will be considered under the same heading since there may be an inter-relationship between copper and cobalt metabolism in sheep. Failure to thrive in lambs can be due to a shortage of one alone or, more rarely, both as in Coast Disease in Australia.

King, et al (1969) state that under normal conditions wool sheep require feed containing between 5 and 10 ppm of copper though sometimes 1 ppm has been sufficient for maintenance. Veterinarians working in the United Kingdom have found that hill sheep thrive even though many have blood and liver copper values below the accepted normal range.

During the Team's visit 101 sheep blood samples including 64 from lambs were analysed for copper. Only 9 samples were found to be below the normal range (0.07-0.15 mg per 100 ml).

In other parts of the world copper deficiency is known to cause marked lowering of wool quality (steely wool) in adult sheep and also swayback or ataxia in lambs. Neither of these conditions has been found in the Falklands. The only farm which claimed to have improved lambing percentages by dosing pregnant ewes with copper sulphate was Port Stephens. Because of the time of year it was not possible to investigate either the need for, or the possible benefits accruing from giving extra copper to pregnant ewes.

No evidence of copper deficiency in Falkland Islands sheep has been found Consequently copper supplementation cannot be recommended. In this context a note of caution is necessary. Because of the high toxicity risk of copper, no copper supplement or dosing should be used anywhere without conclusive evidence of a deficiency.

Cobalt supplementation of the diet of lambs and hoggets by dosing with cobalt bullets has been carried out annually on some farms and intermittently on others since 1959. In that year trials with cobalt bullets were carried out at Fox Bay West on both wether hoggets and 18 month old sheep of both sexes. In four groups of sheep on different camps the dosed sheep showed a distinct advantage for the cobalt treatment judged by apparent survival rates in the divided groups. Since then cobalt bullets have been administered annually to lambs at this farm and at other farms belonging to the same company. Neighbouring farms have demonstrated a considerable decrease in the total mortality from marking to shearing since cobalt dosing was started. At the present time nine farms are administering cobalt bullets to lambs either at weaning or dipping. A further six farms have tried the practice in the past but have since discontinued it. Only four of these six farms mounted controlled trials. Two farms claim that sheep dosed when young with cobalt produce a heavier fleece at subsequent shearing and that this increased wool production effect fades with each succeeding year.

The Team carried out a controlled experiment on lambs at Port Stephens. The three experimental groups received respectively: copper, cobalt, and copper plus cobalt in January. At subsequent weighings 10 weeks and 23 weeks later none of the 3 treated groups showed any weight gain advantage over the controls. Details of the experiment are given as an appendix to the report.

Cobalt deficiency is peculiar in that even on cobalt deficient soils, the deficiency symptoms and growth retardation in lambs and hoggets are not manifest every year. For this reason the use of cobalt bullets in likely cobalt deficient areas should not be ruled to be unnecessary and discontinued if no benefit is obtained the first year they are used.- Controlled trials based on weight gains and survival percentages should preferably be run on the same ground for three successive years. Some points to bear in mind in setting up trials have been made in Chapter 10, section V.

Up to the time of the Team's visit there were no records of cobalt levels in the Falkland Islands. Since it is not possible to demonstrate cobalt deficiency by examining blood samples the Team sent a number of soil and pasture samples to the United Kingdom for estimation of cobalt and other minerals. Care was taken to include as many hogg camps and ewe camps as possible in this sampling. The various sampling sites were widely separated and included some small island farms as well as larger farms on the two main islands. All results received show low or very low figures for cobalt.

CHAPTER 18 - PARASITIC DISEASES OF SHEEP

I. ECTOPARASITES

The four main types of skin parasites affecting sheep are lice, ticks, sheep scab mites and keds. At the present time and for some time past only one of these, the ked, has been endemic on Falkland Island sheep.

Ticks There are no records of ticks in the earlier reports. It would however be remarkable if sheep ticks had never been brought in by any of the numerous importations of sheep in the past. None were found by the Team. Some confusion in terms has occurred and still occurs because keds are commonly referred to as ticks.

Lice Both biting and sucking lice were at one time endemic in the sheep. Neither are thought to exist today. Without doubt the annual dipping of sheep which became compulsory in 1907 was a major factor in clearing sheep of lice. Gibbs (1946) states that lice were eradicated in 1939. Farmers who obtain dispensation from dipping when they eliminate keds from their farms should inspect their sheep very carefully for lice since the smaller species are very difficult to see. This point needs to be emphasised even more with regard to imported sheep undergoing quarantine.

Sheep scab caused by the sheepscab mite was eradicated from the colony in 1895. Since then the country has been almost free of the disease although it has occasionally been reintroduced on imported sheep. The last outbreak was in 1928.

Keds The sheep ked (Melophagus ovinus) is a wingless fly and should not be referred to as a tick. It is world-wide in distribution. Since the whole of the life cycle from pupa to adult is passed on the sheep, keds are easily kept under control by regular dipping. Rapid multiplication is characteristic of keds. If dipping is neglected they multiply enormously. They suck blood but only very heavy infestations cause anaemia. Most damage is done by the intense skin irritation they set up, causing the sheep to bite, rub and scratch, thus damaging and staining the fleece lowering its value. There are conflicting reports on the effect of ked infestation on production. Workers in South Africa and North America have reported on the basis of experimental work that keds did not adversely affect weight gains or wool growth in sheep. Nevertheless Nelson and others in Alberta have limited evidence that ked-free lambs make better gains and that ked-free young sheep yield more wool. Their work strongly suggests that poor nutrition and/or the acquisition of resistance to keds would lead to lowered production whilst infested. The resistance mechanism is thought to take the form of a reduction in blood flow in the skin.

In the Falklands keds were in the past kept under reasonable control by the dipping measures specifically designed to control sheep scab and lice. In view of their damaging effect on the wool it is surprising that their presence has so long been tolerated. Gibbs (1946) reported that keds were still prevalent and pointed out that they could be eradicated by concerted action on the part of the sheep owners, thus doing away with the need for annual dipping. Since then a start has been made in this direction. The first two farms to eliminate keds were granted exemption from compulsory dipping in 1959 after a proving period of two years. Steady progress towards eradication has been made on several other farms notably the island farms. On the remaining farms the number of keds on the sheep varies from year to year depending on the season, the number missed when gathering is carried out and the thoroughness of the dipping. It is claimed that six farms are free of keds and that a further six have very few keds. The Team's veterinary surgeon and sheep husbandry specialist were asked for advice on control measures. After consideration it was felt that certain basic principles of ked control should be restated. Sheep can be freed of keds by one total immersion dipping in any one of several insecticide dips. One dipping kills all adult keds but not the pupae. The residual effect of the dip in the fleece kills the young keds which emerge from the pupae 19-24 days after the pupae are deposited on the wool fibres. Spraying is less effective and a complete kill is more certain when the sheep are dipped. Using and maintaining dips at the recommended strength is very important. Chemicals which on grounds of safety or efficiency are not permitted in sheep dips in the United Kingsom should not be allowed on the Falklands. The consideration of these points led to the drawing up and distribution to all farm managers of the outlines of one eradication scheme and two control schemes to enable them to discuss possible amendments to legislation. It was stressed that eradication is the more logical policy and should be considered first. These schemes are given in full as an appendix. Should eradication be chosen, a campaign director would be required and he would need to have the full backing of Government and the Sheep Owners' Association. It is well known that some farms find clean gathering extremely difficult to achieve. Special consideration would be given to such farms and they might require outside help in the form of extra labour.

To sum up it is thought that the time for an eradication drive is overdue and while alternative control schemes have been mentioned, it is thought that it is somewhat pointless to maintain legislation for anything short of eradication because the continued presence of ked-stained fleeces on a farm itself carries a built-in financial penalty. An additional incentive to eradication would be for the Government to make it an offence to sell or export ked-stained wool. The effect of ked eradication when it is finally accomplished will be not only to lower the cost of wool production, but it will also show an overall improvement in wool quality and raise even higher the reputation of Falkland Island wool on the world market.

Mycotic dermatitis

This is a common fleece condition which in its mild form often goes unrecognised. Some confusion has arisen as it has been referred to under the names: wool rot, lumpy wool and its more severe form scrofula. It is caused by multiplication of the fungus Dermatophilus dermatonomus and secondary bacterial invaders on the skin surface resulting in matting, scabbing and discoloration of limited areas of the fleece often in successive layers. The effect is more easily seen as the wool grows away from the skin. Sometimes the matting of the wool is very pronounced in local areas of the trunk giving rise to the term "lumpy wool". Wool quality and value may be affected.

Munro (1924) comments on references to scrofula in earlier annual stock reports. Gibbs (1946) mentions it as being present in imported South American sheep in 1937 but states that it had become rare by 1946.

No active cases in live sheep were seen in the summer of 1969-70 although samples of affected fleece wool were seen. The initial cause is a fungus which requires prolonged damp conditions in order to grow and multiply. Its effects can best be seen when mild weather follows a prolonged wet period. It has been found by wool merchants and mycologists to be relatively common in most countries. Mycotic dermatitis is not likely to become a problem with the local climatic conditions. Should it ever become necessary to use treatment, dips containing aluminium sulphate or potash alum are said to be effective. Potash alum can also be used as a dusting powder.

Flystrike

This parasitic condition is usually included with the ectoparasites. Flystrike or flyblow is caused by the larvae of the blowflies commonly called bluebottles. Several species of blowflies are capable of causing strike in sheep in temperate climates. Although one bluebottle fly is present and has widespread distribution in the Falklands, apparently it does not cause strike on live sheep. Bluebottles were not seen in the Falklands before about 1875, and are said to have been introduced about that time by an English ship.

II. GASTRO-INTESTINAL PARASITES

Earlier reports agree in maintaining that while worm infestation was known to be present in Falkland sheep, the degree and extent of infestation was not known. These writers thought it was not high or of great importance. The species of worms mentioned in the early reports are the common ones present in sheep in the United Kingdom, and have been confirmed by our work. Of the carcasses investigated, approximately half were sheep that had died and the remainder were unthrifty sheep killed in a weak condition in which parasitism was strongly suspected. For a general assessment of the picture it is as well to look at the results from the larger number of dung samples examined, even though a worm count on gut contents is the more accurate method. A truer picture would have been obtained if it had been possible to use both methods on a single farm through one or two complete seasons. Fifteen batches of dung samples amounting to 144 separate samples were examined from lambs or hoggets, 10 of these (7.1 per cent) had high levels of worm eggs classing 200 eggs per gram or above as abnormally high. Five batches, totalling 32 separate samples of freshly voided dung samples from adult sheep were examined and worm egg counts in excess of 200 eggs per gram were found in only 3 samples (10 per cent). The dung samples were in the main collected in areas heavily grazed by sheep. On 2 farms the suspicion of parasitism raised by individual high egg counts in samples from hoggets was followed up and borne out by high worm counts at post mortem examinations.

The Table shows the results of total worm counts on 5 adult sheep, 5 hoggets and 1 lamb.

TABLE 28

RESULTS OF TOTAL WORM COUNTS 1969-70

	Category	Stomach (Abomasum)	Small Intestine
E2	Ewe	Nil	Nil (very little ingesta)
E14	Ewe	1,900 Ostertagia circumcincta	Nil
E19	Wether	Nil	Nil
E24	Ewe	100 Ostertagia circumcincta	Not counted
E25	Ewe	4,600 Ostertagia circumcincta	100 Nematodirus filicollis
E20	Hogget	Nil	8,800 Nematodirus filicollis 6,200 Trichostrongylus vitrinus
E26	Hogget	6,500 Ostertagia circumcincta	300 Ostertagia circumcincta 600 Nematodirus filicollis
E27	Hogget	2,500 Ostertagia circumcincta	3,100 Trichostrongylus vitrinus 1,200 Nematodirus filicollis
E29a	Hogget	1,400 Ostertagia circumcincta	3,100 Trichostrongylus vitrinus
E29b	Hogget	500 Ostertagia circumcincta	2,500 Nematodirus filicollis 3,800 Trichostrongylus vitrinus
E36	Lamb	300 Ostertagia circumcincta	200 Trichostrongylus vitrinus 17,500 Nematodirus filicollis

The following species of worms were recorded:-

Stomach:	Ostertagia circumcincta
Small intestine:	Trichostrongylus vitrinus Nematodirus filicollis Strongyloides papillosus Moniezia expansa
Large intestine:	Trichuris ovis
Lungs:	Dictyocaulus filaria

Haemonchus, Cooperia, Bunostomum and Chabertia were not recorded but both Haemonchus and Chabertia have been recorded in the past.

A striking feature of the recent worm examinations was the preponderance of Ostertagia circumcincta and the infrequent occurrence of Trichostrongylus worms, the only genus normally represented in both the stomach and small intestine. Ostertagia is one of the most pathogenic worms because of the damage it inflicts on the wall of the abomasum. No severe cases of abomasal damage were found. This was surprising; it may be because the stomach wall of the local sheep has to contend with a very fibrous diet from an early age and the resulting thicker mucosal wall is more resistant to worm damage. Some lambs between two and four weeks of age were found to have considerable quantities of fibrous grass in their stomachs.

In the United Kingdom worms of the Nematodirus species are noted for causing sudden outbreaks of parasitism characterised by the simultaneous death of a number of lambs in early summer. Such outbreaks are referred to as Nematodiriasis. There was no evidence of this in the Falkland Islands 1969-70 season, though individual lambs died due to high Nematodirus filicollis infestation. One such lamb was received for autopsy in January 1970.

British workers have shown that there is a build-up of worm larvae on pasture in the warmer summer months to a peak a month after midsummer. This is not usually harmful to the majority of adult sheep already on the pasture, but lambs moved on to such pastures in midsummer are even more at risk. It was found that under Falkland conditions individual sheep and sometimes whole batches of young sheep develop significant worm infestations. Undoubtedly such sheep will benefit from dosing with an efficient anthelmintic drug. Often the benefit will be only temporary if the sheep are not moved to fresh pasture. On one East Falkland farm the hoggets each year used to show unthriftiness and scouring. When the management here was changed so that hogg camps were rested through the summer months and the lambs were put onto clean ground after weaning there was no longer a worm problem. On another large farm in West Falkland the practice is that the stud flock lambs are left on the same pasture after weaning and the ewes are moved off. These practices have much to commend them. However, the build-up of worm infestation on the pasture and in the sheep varies from season to season and cannot be accurately predicted. Many factors influence this, among them ground temperature, humidity, length of herbage and not least the grazing behaviour of the sheep themselves. Generally speaking extensive grazing and low stocking tend to result in low worm burdens. Higher worm burdens may be expected however when most of the animals are concentrated on a limited area of green valleys. The microclimate afforded by heavy growths of pasture tends to prolong the survival time of worm larvae. Intensive stocking resulting in shorter open herbage gives full scope to the lethal effects of sun and wind. This happens on the smaller islands when the stocking rate approaches one sheep to the acre. West Point Island is such a case. No worm drugs are used here and yet two large batches of dung samples from young sheep showed very low worm egg counts, much lower than on any mainland farm.

The result of dosing trials on Falkland farms have been variable. Some have shown a weight gain advantage in favour of the dosed lambs. Some have shown no advantage, possibly because dosing was carried out at the wrong time. Experience has shown that the dosing date should be dictated by the state of the sheep, the calendar being used only as an indicator of the season when they are most at risk. Unfortunately the most effective anthelmintics are the most expensive. Having considered the expense and organisation involved together with the likelihood of dosing at the time of maximum benefit to the sheep, the Team considers that the benefits obtained from the wholesale dosing of lambs and hoggets do not merit the considerable expenditure involved.

It is infinitely better to adjust husbandry methods on farms where parasitic trouble occurs annually. It is recommended that all sheep be observed carefully in the danger period from November onwards, so that when hoggets or other sheep go down badly in condition they can either be moved or dosed and moved as recommended earlier. The first six months are the critical time in the life of the sheep in developing resistance to worms. The Team has recommended that a central supply of the most effective worm drugs should be maintained in Stanley so that when needed they can be quickly obtained. Some farms will prefer to carry small quantities of anthelmintic themselves. Finally it should be remembered that parasitism may often be secondary to malnutrition.

The only adult tapeworm recorded was Moniezia expansa. Moderate numbers of tapeworms were found in some of the lamb carcasses examined, but never in adult carcasses. No deaths were attributed to tapeworm and farm investigations did not show it to be an important factor in unthriftiness. Undoubtedly it is very widespread in lambs on some farms and in individual lambs with high infestations it must play some part in lowering the efficiency of the digestive system. Fortunately tapeworm infestation is self-limiting, the average duration of a single infestation being about 60 days. Since different drugs need to be used to control tapeworms, the advice on dosing given for round worms applies even more to tapeworms. Whole flock treatment would never be economic but it would be wise to dose badly affected ram lambs in the stud flock.

III. DISEASE CAUSED BY TAPEWORM CYSTS

Hydatid Disease

Hydatid disease in sheep results in cysts mainly in the lungs and liver. It is caused by the cystic stage of the dog tapeworm Echinococcus granulosus. It is estimated that approximately half the adult sheep in the colony are affected. There is clearly a public health hazard.

There is very little reference to hydatid disease in earlier reports. Reference to two Government reports show that there has been a very considerable increase in incidence during the past 40 years and even during the last 15 years. Gibbs (1946) reports that in 1941 the Government stock inspector examined 2,000 sheep livers at one farm and found one affected. Regular meat inspection by qualified inspectors was carried out during the period 1952-54 when the freezer was in operation at Ajax Bay. One of the inspectors, Fletcher (1953), recorded that in 14,226 sheep slaughtered 478 livers or lungs (3.3 per cent) were condemned because of hydatid disease. Rippon (1954) gave no figure but noted that hydatid cysts were common in the liver and lungs of sheep and cattle.

Present Position

First investigations made by the Team at farm killing sheds and at the Stanley butchery, showed a variable but alarmingly high percentage of sheep lungs, and a lesser number of livers badly affected with unilocular hydatid cysts. Many were white in colour and contained cloudy fluid indicating that the cysts were degenerate and therefore non-virulent but a high proportion were found on laboratory examination to be virulent containing hundreds of proscolices. Inspection of plucks from all sheep slaughtered at the butchery were carried out from November 1969 to April 1970 and during that period 2,221 plucks were seen.

At farm visits whenever possible the weekly killing was witnessed and the offal disposal arrangements noted. With few exceptions the farm staffs at all levels were found to be very poorly informed regarding hydatidosis. Some confused the disease with caseous lymphadenitis. Most people grossly underestimated the hydatid incidence in their own sheep and cattle. Typical lesions were shown to two managers who claimed to have little or no hydatid disease in their sheep. One of these subsequently killed 19 old sheep and found all 19 affected. The other was later shown lesions in 18 out of 18 old ewes. Some farms were found to be really concerned about the disease. These had been taking some precautions since the time they received the Government's locally compiled information pamphlet issued in 1965. Dogs on a few farms were being dosed with "Tenoban" from Government sources. Offal was being disposed of in a variety of ways, the most common being discharge via a chute onto the shore. Some offal retention bins and tanks were in use, but unfortunately the belief was current that the cysts died within 24 hours, and that the offal was non-infective for dogs after this period. At many farms control of dogs was poor. Dogs were on occasion seen in the killing sheds when killing was taking place. Most farms had more dogs than they needed. The first dog census (1965) in the camp showed there were more dogs than people. Many people did not appreciate the vital role of the dog in the hydatid life cycle. On some farms no killing sheds existed and invariably cattle were killed in the open, the site of the beef scaffold not being fenced in any way. Mass killings of batches of between 100 and 4,000 surplus aged sheep took place on some farms annually. Thus many factors combined to facilitate the perpetuation and increase of the disease. In one area, Weddell Island, the very high incidence was thought to be connected with the abundance of foxes though this was not proved.

The table shows the numbers of sheep found affected with hydatid cysts in the liver or lungs or both.

TABLE 29

HYDATID EXAMINATIONS AT STANLEY BUTCHERY AND ON CAMP TOURS

Place of Slaughter	Sheep killed	Sheep affected	Percentage affected
Stanley Butchery	2221	1172	52.7
Camp	238	125	52.5
Overall Total	2459	1297	52.7

In table 29 the carcasses inspected in the camp included old ewes and rams as well as mutton sheep from 16 farms and therefore covered a wider range than the butchery sample of wethers from 9 farms. The percentage affected is very similar.

TABLE 30

HYDATID INCIDENCE IN FARM WETHERS INSPECTED AT STANLEY BUTCHERY

Farm	Sheep killed	Sheep affected	Percentage affected
A	670	359	58.9
B	183	81	44.2
C	151	97	64.2
D	150	46	30.6
E	66	33	50.0
F	391	198	50.6
G	337	192	56.9
H	231	107	46.3
I	95	37	38.9

Table 30 is a breakdown by farms of the sheep slaughtered at Stanley butchery. In the limited number of farms represented there is a considerable incidence variation from 30-64 per cent. All but one of these nine farms were in East Falkland.

The overall picture shows a lower incidence (44 per cent) in West Falkland farms than East Falkland farms (53 per cent) and lowest of all on the smaller island farms. On two of the smallest farms and on two of the farms observing control measures, no infection was found but the number of carcasses inspected was small.

TABLE 31

DISTRIBUTION OF LESIONS BETWEEN LUNGS AND LIVER

Hydatid Distribution in Pluck	Number of Carcasses	Percentage
Visible cysts in lungs only	644	54.9
" " liver "	207	17.7
" " lungs and liver	321	27.5

Table 31 shows the distribution of gross lesions between lungs and liver in the butchery survey. The examinations consisted of visual inspection and palpation and did not include close sectioning of the organs. Undoubtedly some lesions were missed but it is still remarkable that lung tissue was affected three times as often as liver tissue. Kidney cysts were seen on two occasions. One cyst was found in lumbar muscle and one in connective tissue. Badly affected livers and lungs were always grossly enlarged. One such liver was four times the weight of unaffected livers in this batch. The performance of such sheep cannot match that of unaffected sheep.

One case was found of generalisation of cysts due to earlier rupture of a hydatid and the dispersal of the "seed". This sheep had widespread distribution of cysts in the thorax and abdomen. Many cysts were free in the two main body cavities and also attached to the serous coverings of the organs and the chest wall. Such cases, although rare, represent the worst risk to dogs.

Control

Awareness of the necessity to control the disease has naturally increased with the appearance of human cases. Public interest in the camp was stimulated by a veterinary surgeon attached to the British Antarctic Survey during a camp tour he made in 1964. More positive action followed:

1964 - Compulsory dosing of dogs suggested.

1965 - A Government order empowered honorary inspectors to order the dosing of dogs on farms with "Tenoban". This also forbade the feeding of raw offal to dogs. An information pamphlet was circulated.

1966 - Individual objections to dog dosing because of unpleasant side effects.

1969 - Sheep Owners Association asked by Government to discuss the whole question. They requested strong action by Government to enforce compulsory dosing of dogs with "Scolaban" which they suggested be supplied free.

The initiative came from enlightened individuals. The implementing of the control measures was made difficult by the absence of a general understanding of the disease and its implications for human health.

At this stage Government consulted the Team. The first step in the new campaign was the formation of a Hydatid Control Committee consisting of farm representatives and heads of Government departments. Whilst new legislation was being formulated the Committee concentrated on education and publicity. Illustrated literature, posters and a film were obtained from London. Several broadcast talks were given. Public exhibitions with examples of hydated specimens were arranged. The film was shown in public 19 times and proved to be one of the most useful measures since it always provoked thoughtful discussion. It was recommended that film showings should take place once or twice a year if possible using fresh films or slides. The new legislation included a clause requiring offal to be kept out of reach of dogs for 28 days after sheep slaughter. The dosing of all dogs with "Scolaban" became compulsory. The Police undertook to supervise the dosing of dogs in Stanley. New offal disposal methods were publicised and examples of recommended offal disposal apparatus were sent on tour abroad a Government vessel. The reasons for the new ordinance were explained by the veterinary surgeon on the radio. This talk was summarised in explanatory notes which were circulated to farms with the new order. The eight points embodied in these notes laid down a safety code for sheep dogs kept near human habitations. Recommendations regarding mass killings were included in these notes.

Finally it was recommended that if the impetus of the initial response to the new campaign was to be maintained it was essential for Government to obtain the services of a person experienced in Hydatid Control.

CYSTICERCUS TENUICOLLIS

There is another tapeworm cyst commonly called the thin necked bladder worm or false hydatid. This was recorded by Fletcher (1953) and Rippon (1954) frequently attached to sheep offal at their inspections of slaughtered sheep at the Ajax Bay freezer. It is now less common but specimens are still seen in most batches of wethers slaughtered at the Stanley butchery. In the present survey it was found to be much less common than the more serious hydatid cyst with which it should not be confused. The tenuicollis cyst is always loosely attached to the mesentery or surface of the liver. In an economy where livers are not exported, it is of very little importance.

CYSTICERCUS OVIS

Infestation with this cyst is commonly referred to as sheep measles. Degenerate cysts were seen on one occasion in the heart of a wether sheep killed for mutton.

MULTICEPS MULTICEPS

This tapeworm cyst although regularly seen elsewhere, has not been recorded in the Falklands. It occurs in the brain of sheep causing the condition known as Gid.

IV. SARCOCYSTIS TENELLA

This parasite is not a tapeworm, but a species of protozoa. It is conveniently dealt with here as like Cysticercus ovis it occurs in the musculature of sheep. The most frequent sites affected being the oesophagus and diaphragm. Except when it occurs in a more generalised form, the four quarters of the carcass may be used for human consumption. In Falkland sheep carcasses it is recorded by Rippon (1954) without mention of frequency. In the course of the recent butchery inspections the characteristic small nodules were seen in the oesophagus of several sheep in a single consignment of mutton wethers from one farm.

V. LUNG WORMS

Dictyocaulus filaria was the only species of lung worm found. It was quite widespread. The larvae were found in sheep dung samples from seven different farms. Adult lung worms were found several times at post mortem examination of lambs and adult sheep, but not in association with pneumonia. It was not responsible for any of the deaths investigated. In most cases only small numbers of lung worms were present, the only exception being a heavy infestation in one lamb in a batch of fat lambs slaughtered for the Christmas trade in Stanley. At several farms single individual sheep in pens were observed with the characteristic cough caused by lung worms. There seems to be little likelihood of regular trouble from lung worms, although outbreaks do occur rarely. One such outbreak of parasitic pneumonia occurred on West Point Island in 1945, when 25 per cent of the hoggets are said to have died. There is appropriate treatment if required.

VI. LIVER FLUKES

There is no record of liver fluke infestation in earlier reports. The intermediate host of this serious parasite of sheep and cattle is the small snail Limnea truncatula. No specimens of this snail were found. No liver fluke eggs were found in sheep or cattle faeces and no evidence of liver fluke infestation was found in approximately 2,500 livers examined. It may be assumed that no species of liver fluke are present in the local sheep.

CHAPTER 19 - BACTERIAL DISEASES OF SHEEP

Caseous Lymphadenitis

This is a disease of adult sheep resulting in slowly enlarging chronic abscesses mainly in the superficial lymph glands. The glands most commonly affected are in the shoulder and flank areas. The causal bacterium Corynebacterium ovis gains entry only through superficial wounds. The disease steadily increases where sheep are badly shorn under any dusty conditions.

There are very few references to the condition in earlier reports. Gibbs (1946) records that in 1941 the Government stock inspector found three of a batch of 50 ewes were affected. The meat inspectors at the Ajax Bay Freezer recorded that less than one per cent of the total kill in the year 1953 to 1954 was condemned because of caseous lymphadenitis.

An assessment was made of the incidence on Falkland farms. On two farms it was troublesome and had increased over the past few years. On seven farms it was regularly seen but less common. On another seven there were few or very few cases. On the remaining 13 farms surveyed it was either absent or very rare. Batches of 100 or more wethers from nine farms were inspected after slaughter at the Stanley butchery and these batches also fell into one or other of these four categories. In batches of carcasses from one farm several cases of long-standing duration were seen in which abscesses were present in the lungs and various internal lymph glands.

The disease has very little effect on the health of the sheep. Its main importance concerns the suitability of carcasses for human consumption. Affected quarters containing large abscesses full of caseous pus are clearly objectionable and quite rightly condemned.

Predisposing factors are shearing cuts, dusty unpaved pens outside the shearing sheds and poor standards of cleanliness inside shearing sheds. Infection is contracted most frequently in and around the shearing sheds but also in some cases at lamb marking.

Control Measures

Machine shears once contaminated are a potent source of infection. On most Falkland farms some sort of disinfectant was provided for shears. The causal bacterium is readily destroyed by a wide range of common disinfectants. It is important that the disinfectant is only diluted as far as the makers recommend and that it is renewed twice daily. It is recommended that even small shearing wounds should be dressed, the most convenient method being an aerosol spray. The floors of counting out pens should be kept moist. It is also recommended that freshly shorn sheep should be held for as short a time as possible. On one farm considerable improvement had been noted since spray dipping off the shears was instituted some years previously. Plunge dipping off the shears is unwise as the chances of wound infection are higher. Sheep with open abscesses are a potent source of infection and should be culled.

Once established in a flock it is extremely difficult to effect a reduction in this condition because of its chronic nature and the difficulty of detecting early cases. Extreme measures are then called for. Scrupulous cleanliness of all fittings in pens and the shearing floor itself is particularly important. A hitherto clean farm beginning to have occasional cases would be well advised to cull such sheep and if possible put a man on manual examination of freshly shorn sheep to pick out less obvious cases.

Epididymitis

There is a specific form of epididymitis (inflammation of part of the testicles) affecting sheep caused by the bacterium Brucella ovis. This bacterial disease has only fairly recently been recognised and described in sheep raising countries where it is still thought to have a limited distribution. There is no mention of it in published reports referring to the Falkland Islands.

A visiting veterinary surgeon from South America diagnosed it on one farm which had imported rams from Australia. Despite numerous manual examinations of rams during the present investigation, no other Falkland farm was found to be affected.

At this farm rams are examined manually twice a year for testicular abnormalities. Between 1 and 2 per cent are found with either one testicle smaller than the other or the epididymis of one or both testicles enlarged. The abnormal testicles from three rams were received at the laboratory and Brucella ovis infection was confirmed in two of these rams.

It is regretted that only a few other farms observe the routine of regular manual inspection of the scrotum in rams. Rams found to have epididymitis should be culled. Despite the fact that epididymitis may be caused by other factors such as mechanical injury, it is sound policy not to retain any affected animals. Farms which import rams should examine all male breeding stock three times a year to remain free of the disease. The disease does not spread rapidly. This means that where large flocks of ewes are run in large camps its effect on the conception rate may go undetected for a number of years. Unless breeders are constantly vigilant this disease could become a widespread problem in the Falklands.

Specific Opthalmia

This is a transitory inflammation of the superficial layers of the eyeball in sheep caused by a Rickettsia organism. The condition has world wide distribution. In the Falklands it has been regularly reported in the annual stock reports and is mentioned by Munro (1924). Gibbs (1946) and Fern (1956). Although the disease is widespread geographically, many of the farms are never affected and other farms only see it in certain years. Specific Opthalmia is seen more commonly when the lambs are young and it disappears in the winter. Generally it is of fairly short duration and flock outbreaks are self-limiting in character. In individuals it can cause temporary blindness and may then be a cause of drowning of lambs in deep ditches.

Clostridial Disease

In previous reports there is very little mention of diseases from this large group which include tetanus, lamb dysentery, enterotoxaemia type C, pulpy kidney disease, gas gangrene, blackquarter, braxy and black disease. Gibbs (1946) states that on certain farms in 1910 malignant oedema (gas gangrene) was serious following lamb marking but that as lamb marking technique improved it ceased to be troublesome. The same author quotes an unpublished report by Weir reporting pulpy kidney disease on Pebble Island in 1936. Fern (1956) suspected that enterotoxaemia occurred at times but queried the earlier report of pulpy kidney disease.

All unexplained deaths in carcasses received at the laboratory were investigated for clostridial disease without any being found. None of the post-mortem examinations at farms or cross-examinations of farm managers gave indication even of small outbreaks of these diseases in recent years. No cases of gas gangrene of the womb following difficult lambing were seen but it is known that such cases do occur, both aerobic and anaerobic bacteria being concerned. One manager described a series of sudden deaths in hoggets following dipping some years ago that closely resembled blackquarter.

The absence of clostridial disease in epidemic proportion over the years is remarkable. This may be due in part to the type of husbandry followed. Since these anaerobic bacteria normally lead a saprophytic existence in the soil and the local sheep are regularly concentrated on the soil in the pens, it seems likely that the Falkland soil contains few of the pathogenic anaerobes. There is certainly no case for advising the use of Clostridial vaccines.

Mastitis

As would be expected with the present extensive system of farming and type of pasture in use, mastitis in ewes is rare. One case of staphylococcal mastitis in a lactating ewe was seen.

Johne's Disease

This chronic disease caused by an organism related to Mycobacterium tuberculosis can long remain undetected on sheep farms. It has not been diagnosed in the Falkland Islands and is probably absent at the present time. In 1953/54 up to 1 per cent of certain batches of sheep slaughtered at Ajax Bay were condemned for jaundice. This jaundice could have been caused by Johne's disease one form of which does produce localised jaundice of the bowel and mesentery.

Surprisingly foot-rot, erysipelothrix joint infection and vibrionic abortion were not found. It seems probable that the acidity of the soil is an unsuitable habitat for the foot-rot organism. No farms have a history of abortion but vibrionic abortion like epididymitis is a disease which importing farms should watch out for.

CHAPTER 20 - VIRAL DISEASES AND MISCELLANEOUS CONDITIONS OF SHEEP

Contagious pustular dermatitis

This benign disease commonly known as 'orf' principally affects lambs. It has a wide but local distribution in the Falklands. Most of the smaller island farms remain free. Fern (1956) records four outbreaks in one year, one of them affecting most of the sheep on the farm. Early exposure leads to a natural immunity. Individual lambs may become severely handicapped due to local sores but the disease is not of much economic importance at present levels. Effective vaccines are available if required but need to be used annually on all ewes.

Foot and Mouth Disease

This disease, the most highly infectious of all animal diseases, has never yet been introduced. The FAO Animal Health Yearbook (1968) describes its incidence in cattle in South America as widespread in Uruguay and confined to certain areas in Chile and Argentina. Although the present risk of its introduction from South America is small the position may change. It would be very serious indeed for the Falklands if ever foot and mouth disease were introduced. It is therefore vital to protect the sheep industry from any risk however slight. It should be remembered that the virus can travel on soiled clothing and on material such as feed bags. It is recommended that the Government takes steps to ensure that they are quickly informed of foot and mouth disease outbreaks on those parts of South America from which stock, merchandise and visitors periodically come to the Colony so that appropriate delaying action or other precautions may be taken. A skeleton plan of action for such an eventuality was submitted. It was pointed out that the experience of other countries has been that pig-keeping establishments are often a starting point for foot and mouth disease outbreaks. The reason for this being that all manner of imported food scraps are included in pigs' rations.

Enzootic Abortion of Ewes

This has not been recorded but a more extensive laboratory survey throughout a complete breeding season would be necessary before its presence could be completely ruled out.

Louping ill and Tick-born Fever

Both diseases need the presence of ticks to spread from sheep to sheep and are not present in the Colony.

Scrapie

This nervous disorder affecting adult sheep has not been diagnosed in Falkland sheep. Nothing resembling scrapie has been described.

Liver Pigmentation

This has been relatively common in Falkland Islands sheep as long as residents can remember. It was referred to under the term melanosis by the Ajax Bay meat inspectors in 1953 and 1954. The condition is widespread in both West and East Falkland being absent from only a few farms. It is alleged by some managers to occur more commonly in particular parts of their farms. It is found in all classes of sheep irrespective of age, sex or bodily condition. As far as could be ascertained it does not affect the health of the sheep. In affected sheep the colour of the liver substance varies from slightly darker than normal to dark purple or almost black depending on the amount of pigment present.

Samples of liver were collected in 1970 and submitted to a veterinary pathologist who reported that the microscopic structure of the liver was normal apart from the presence of pigment granules in almost all the liver cells. He was unable to identify the pigment. All tests carried out were negative for the three most likely pigments haemosiderin, melanin and lipofuscin. He suggested that the pigment was more likely exogenous in origin, either from plants or soil rather than a product of abnormal body metabolism.

The opportunity was taken whilst the Team was visiting South America to question the veterinary surgeons doing meat inspection. None of them had seen this condition. A letter sent to an international veterinary journal has also produced no information. The fact that the condition has not been described elsewhere supports the theory of a direct association with Falkland pastures.

CHAPTER 21 - DISEASES OF CATTLE

Apart from hydatid disease and isolated cases of mastitis in milking cows very little disease was found in the cattle. The two Stanley dairy herds and most of the milking cows at the farms were inspected and a considerable number of the beef cattle on open camp were seen also. Farm managers were asked in the early part of the visit what cattle disorders they wished to have investigated and the only items mentioned in their replies were tuberculosis and mastitis. Advice on machine milking, udder sores and artificial insemination was requested and given.

The fairly large number of bovine skeletons seen on camp journeys suggests that the general health and hardiness of the cattle is due to the survival of only the fittest. On some farms the young stock and dry cows were very poor in the spring. Several farms had suffered heavy losses during the preceding hard winter. Other likely causes of debility were investigated. Individual faeces samples did not show any high worm egg counts. Johne's Disease was suspected on two occasions but laboratory tests were negative. No clinical evidence of copper deficiency was seen. Hypocuprosis could be one of the factors responsible for the slow maturing rate of the cattle. It would however require an extended survey of blood copper levels to determine if this is so.

Simple Deficiency Conditions

Gibbs (1946) quotes isolated cases of hypomagnesaemia and of milk fever in cows. These responded to treatment with magnesium and calcium respectively. The same author reported a case of rickets in calves. Fern (1956) reported calves being successfully treated for grass staggers (hypomagnesaemia). Such cases appear to have become rarer. There are numerous accounts of bones being eaten by cattle. This form of depraved appetite or pica is indicative of phosphorus deficiency. In the 1969/70 season no clinical signs of gross phosphorus deficiency in the form of deformed joints or limb bones were seen.

It would appear that the cattle like the sheep are generally able to adjust to low levels of both phosphorus and calcium in the natural herbage, part of this adjustment to local conditions being a slower growth rate. There is evidence from some of the islands that cattle and sheep when very limited in their choice of herbage develop symptoms indicative of mineral deficiency. Carcass Island is one of the few places where cattle are grazed for long periods in tussac plantations. Here individual young animals suffer from a deficiency causing stiffness of the limbs and knuckling over in the joints. This condition is usually temporary and because none were affected during the Team's visit to Carcass Island it was not possible to investigate which elements were lower than normal in the blood. The lambs from ewes pastured during pregnancy in the tussac areas are normal.

Breeding Disorders

Another of the islands has for three successive years lost calves due to their being stillborn. Three out of eight cows here lost their calves at full term. The cause was not found. Blood and milk samples from eight cows were negative for antibodies to the Brucella bacterium. Because these cows had been grazing tussac grass the blood samples were also tested for calcium and magnesium but no deficiency was found.

Mastitis and other udder infections

The two Stanley dairies and the milking cows in the camp are periodically affected with mastitis. The amount of mastitis occurring in the Stanley herds is less and in the settlement cows considerably less than in commercial herds in the United Kingdom. The reasons for this are thought to be the different bacterial background, the lower fly population and the much smaller size of the cow units. In the camp an additional reason is the fact that hand milking is still the rule on most farms. Many of the cases are traumatic rather than bacterial in origin.

Forty two individual milk samples were received at the laboratory. In 25 of these no significant infection was found, in 16 haemolytic staphylococci were cultured and in one only Corynebacterium pyogenes was cultured. The majority of these samples and a number of milk samples representing six different parts of the Falklands were tested for brucella abortus antibodies. All gave negative results. Sufficient number of samples were taken in the Stanley area to be sure there was no brucella infection in the Stanley cows. Insufficient samples were tested from the camp to entirely rule out brucellosis though none was found in the samples tested.

Tuberculosis

Gibbs (1946) reviews the history of bovine tuberculosis in the colony. Tuberculosis was reported in 1911 and 1914 but the overall incidence was low (2 per cent). In 1927 an imported Dairy Shorthorn bull died of the disease and many of his progeny were killed. In 1936 the Senior Medical Officer tuberculin tested the Stanley dairy cows and found several reactors which were all killed. Weir (1937) tested an undisclosed number of cows on the farms without finding reactors. During the years 1940/45 a total of 2,055 cattle were tested and 57 reactors were disclosed. Positive reactions were in the same ratio in the camp as in the Stanley area. On the basis of two clear tests (June and December 1945) Gibbs (1946) rightly concluded that the Stanley area had been cleared of tuberculosis. He also left an account of the method of testing and at that time both avian and mammalian tuberculin were being used.

Since 1946 only incomplete records of testing have been kept. For most of this period the test results are missing. Fern (1956) records that in the season 1955/56 he tested 1,625 cattle at 28 centres and found 75 reactors. Reactors were found at 13 centres but not at the remaining 15, and there were no reactors in the three Stanley dairies. It must not be inferred from this that a total of 13 farms were infected because tests would be carried out at different centres on the same farm.

The testing of the Stanley dairy herd which had been carried out at six monthly intervals during the war became infrequent being carried out at irregular intervals by livestock assistants. These men had to fit in tuberculin testing with their other duties. The camp farms selected for testing tended to be either those near to Stanley or those whose managers pressed for tuberculin tests. This is no criticism of the Agricultural Department men who carried out an exacting task very conscientously. Some of their testing notebooks were preserved and these show that skin measurements were carefully kept. Fern (1956) also found reactors in the camp but not in the Stanley area. Some farm tests carried out recently by the Agricultural Department revealed as many as seven reacting cows.

It was rather disturbing to hear that although animals classed as reactors on the farms were slaughtered at once there was usually no follow-up test two months later or at any subsequent time to pick out further infected animals which might have been in the incubation stage. It was also puzzling that no human cases in children ever occurred when untreated milk was being drunk at farms with bovine tuberculosis reactors. The Team decided to test all the Stanley cattle (Table 32). The veterinary surgeon found no reactors.

TABLE 32

STANLEY AREA TUBERCULIN TESTS

Description of stock	Number Tested
Cows from two dairies and eight other owners	63
Bulls	5
Drystock, 14 different owners	172
Lighthouse cows and heifers	17
TOTAL	257

It was then decided to test milking cows only on a number of farms.

TABLE 33

EXTENT OF FARM TESTING 1969-70

Location	Number of cows tested
North Arm	68
San Carlos	53
Fox Bay East	37
Port Howard	26
Darwin and Goose Green	84
Walker Creek	25
Weddell Island	16
TOTAL	309

The list includes some farms where reactors had been disclosed in the past. Again all animals passed the test. By United Kingdom standards there was very little reaction to either avian or mammalian tuberculin. It was noticeable that in the camp series of tests a larger number of cows showed reactions of an avian character doubtless because these cows had contact with domestic poultry.

On the basis of the present results and an examination of those past test results which are available it seems highly probable that the Falklands are free of bovine tuberculosis. It seems likely that a number of reactions classed as positive and worthy of rejection may have been the result of non-specific infection usually avian infection. It is impossible to differentiate these from reactions to mammalian tuberculosis unless the intradermal comparative test is used. Double reactions due to non-specific infection may safely be disregarded. Avian infection in cows is usually very slight and non-progressive. The single intradermal comparative test is the standard test long used by the British Ministry of Agriculture Fisheries and Food and exact rules govern its interpretation.

TABLE 34

TUBERCULIN TESTING 1940-70

Period and Location	Number Tested	Number of Reactors	Percentage of Reactors
1940/45 Stanley	453	46	10.2
Camp	1,602	11	0.7
Total	2,055	57	27.7
1955/56 Stanley	) 1,625*	Nil	) 4.6
Camp	)	75	)
1969/70 Stanley	257	Nil	Nil
Camp	309	Nil	Nil
Total	666	Nil	Nil

*No record kept of number tested in Stanley alone

For the future it is recommended that the single intradermal comparative test using both avian and mammalian tuberculin be the only test used. Detailed instructions in the use of this test and its interpretation have been left with the present Agricultural Department. It is also recommended as a minimum standard that all cows should be tested at least once in their lifetime. Further all farms should be tested in rotation except that when reactors are disclosed, tests on that farm should be repeated every two months until a clear test is obtained. The ultimate aim should be to test all dairy cows every two years. Two consectutive clear herd tests are the only reliable criteria for freedom from bovine tuberculosis. Certainty that the national herd is free from tuberculosis is very important in a community where children drink untreated milk and have no natural immunity to the disease.

Hydatid Disease

Rippon (1954) in the Ajax Bay freezer meat inspection reports states that hydatid cysts were not uncommonly recorded in cattle affecting the same tissues as in sheep. There is no mention of hydatid disease in cattle in the published reports and the fact that cattle are also susceptible and form an important reservoir of hydatid disease does not appear to have been generally known.

As cattle are mainly killed in the winter there were limited opportunities for examining cattle offal for cysts. During the 1969/70 season 17 cattle carcasses were inspected in the Stanley butchery and 13 were affected with hydatid cysts in lungs or liver or both. Because dairy cattle in camp are grazed for long periods in the vicinity of the settlements they are more exposed to infection from dogs than are sheep. This does not apply to cattle grazed in the remoter parts of farms. One batch of ten steers grazed on a wether camp were inspected after a farm slaughtering and no cysts hydatid or any other sort of cysts were found.

Traumatic pericarditis

Fern (1956) reports several cases in one year. One case was seen in early 1970. These cases are invariably fatal in cattle and result from sharp foreign bodies usually pieces of metal being picked up by grazing cattle. On some Falkland farms the danger represented by numerous pieces of wire on the ground in the paddocks seems to be entirely disregarded.

Other Diseases

Isolated cases of ringworm and navel-ill were recorded by Gibbs (1946). Neither have occurred recently. There is no history of clostridial diseases or anthrax.

Artificial Insemination of Cattle

On the suggestion of the Government Development Committee the possibility of using artificial insemination to introduce new blood for breeding was looked at. The idea of importing deep frozen semen direct from the United Kingdom is attractive. The practice is feasible but only just workable because of travel difficulties. The semen is transported in standard small containers cooled by liquid nitrogen. These containers lose liquid nitrogen by vaporization both in transit and every time they are opened. An extra large container or a reserve supply of liquid nitrogen would make the operation very costly.

Twenty doses of pedigree British Friesen semen and the spcial inseminating pipettes were ordered. The semen was supplied free of charge on this occasion by British Semen Exports Ltd. The metal cannister was dispatched by air on 20 January. The air/sea connection was very good and the "Darwin" off-loaded on 27 January. Two cows and one heifer were inseminated the same day using improvised pipettes due to the non-arrival of the special pipettes. During the next four days seven cows and heifers were inseminated. Three months later four of these were thought to be in calf to the insemination. The semen quality particularly motility was not good on arrival and was observed to fall off rapidly with every opening of the cannister.

The experience gained shows that it is possible to import semen which is still viable and useable. It is suggested that this practice may be usefully used again in the future but only on a small scale for example when the primary consideration is to provide a pedigree bull calf at one particular place. The importation of semen at present must be considered to be of limited practical application because of the necessity of using the semen very soon after it is landed. This means that cows cannot be chosen for insemination but rather that the semen has to be used in a random fashion on cows that happen to be coming into oestrus within a day or two of the arrival of the semen.

CHAPTER 22 - AGRICULTURAL ADVISORY SERVICES

The Falkland Islands has no permanent agricultural advisers or experimental workers at present. In the past there have been technically qualified agriculturalists who have combined advisory work with implementation of the Colony's Livestock Ordinances. The most recent appointment was a Grasslands officer in 1965. He was mainly concerned with experimental work on reseeding but he also organised several successful conferences on grassland improvement, the proceeding of which were published. At the end of his three year contract no successor was appointed. Various agricultural specialists from different disciplines including veterinary science have visited the islands on short tours over the years.

The entire wealth of the Colony is derived from agriculture in the form of sheep farming for wool. It therefore seems remarkable that no agricultural research or advisory service of any sort is maintained. The Team was greatly impressed with the tremendous eagerness of all managers for information and discussion on their problems. This at first suggested that some form of permanent advisory service was urgently needed. However, it became apparent that the amount of advisory work the Team was able to accomplish was severely restricted by the almost complete absence of basic information about input and output relationships of the farming system under Falkland Islands conditions. Any adviser following the Team would find himself in exactly the same position.

The first requirement is for experimental work in grassland production and livestock husbandry. Livestock experimentation is impossible unless the worker has complete control of the livestock involved. Similarly, to carry out worth-while experiments in basic factors of grassland production the work has to have the control of implements, times of operation and especially stock for management and assessment purposes in his own hands. We therefore believe that the experimental workers need to have a whole farm under their complete control. The farm should not be a large one lest farming of it takes a disproportionate amount of time. It would not be expected to make a profit in the commercial sense. It would in no way be a "model" or demonstration farm.

Our recommendation therefore is that an AGRICULTURAL EXPERIMENT UNIT should be set up as soon as possible. It is estimated that 3,000 to 4,000 sheep with the recognised distribution of classes would be required to provide adequate numbers for experimental purposes. On the basis of normal stocking rates in the Falkland Islands this would mean a farm of between 12,000 and 20,000 acres. Possibly sufficient acreage of suitable land for the Unit could be rented from one of the existing large farms. A self-contained farm would obviously be desirable and a wide range of vegetative types would enable a greater variety of work to be undertaken.

As far as staff is concerned we envisage the Unit being under the control of a Director, an experienced man fully conversant with the overall conception of livestock/grassland interdependence, and two specialist assistants, one in livestock and the other in grassland husbandry. The minimum qualification for the staff should be a University degree in Agriculture. A number of recorders as well as normal farm staff would also be required.

The Unit would be concerned with basic research work and for this reason we believe that the Director must be free to carry out such experiments as he considers to be most important. An auxiliary committee of practising managers could be of great help to him provided its role was purely advisory. Such independence would be possible only if the Unit were financed largely from outside the Colony. We recommend that an approach be made first to the UK

Government. The Food and Agriculture Organisation or an educational foundation might also be approached. We envisage however that the Falkland Islands Government would retain active participation in the project by making a regular financial contribution. Compensation for this support would come in two forms - first the ultimate benefit of having the results of the experimentation available for adoption on farms; second - in having members of staff of the Unit at hand for consultation and farm visits. We think it important that staff should make as many camp visits as possible so that they are kept in touch with practice on the different stations. Managers should be encouraged to visit the Unit as often as possible.

A very small unit of this type working on its own would be at a great disadvantage through being isolated from other research workers in the same field elsewhere in the world. It would be advantageous therefore for it to be attached to, or even part of, some larger similar institution. The Hill Farming Research Organisation in Scotland is engaged in very similar work but the emphasis is not on wool production.

One of the points in favour of the Unit being attached to some larger institute would be that it could make use of its more complex laboratory and other facilities and so avoid the expense of duplicating these. Scientific staff would be able to go to the parent body for periodic "sabbatical" work. It is realised that attracting staff for such a Unit may be difficult. The fact that the work would be basic and therefore eligible for publication in scientific journals would enable the staff to obtain recognition for their efforts and this would help.

To emphasise the urgent need for the setting up of an Experimental Unit a list of work on which the Team considers basic information is required is given as an Appendix to the report.

With regard to the question of employment of a veterinarian by the Falkland Islands Government, it is the opinion of the Team that in the present circumstances there is no case for a full time veterinarian. We suggest that a visiting veterinarian carrying out a short tour of duty lasting approximately eight weeks every two years would be adequate.

CHAPTER 23 - GENERAL MATTERS

I. RELATING TO MANAGERS

The Team was impressed with the quality and devotion to duty of managers and the long hours of hard work cheerfully undertaken by them. We were all the more surprised therefore to find that many were not kept fully aware of the financial situation on the farms they were attempting to manage. In a few instances managers do not know whether their farms are making a profit or a loss. We consider this unsatisfactory as well as unfair to managers and suggest that it is in everyone's interest for them to be kept fully aware of the financial situation on their farms. The manager's share of responsibility is increased by such knowledge.

Even on farms where managers share the confidence of the Directors output and costs are not broken down into nearly enough detail for them to be of value in making management decisions. There is a tendency for instance for virtually all costs other than labour and wool handling charges to be bulked under the one heading of "Materials". Even goods bought for the settlement store may be included under "Materials". A simple recording system which indicates levels of output in physical and financial terms, together with fixed and variable costs would, however, provide a basis for improved management. As well as giving information on output performance and a check on costs, it would enable a realistic appraisal to be made of the profitability of proposed capital expenditure.

It is felt that some guide should be given as to the type of essential physical and financial records necessary for management purposes. Accordingly, a list of such items is given as an appendix. Where records are kept they can be compared with "target" levels of performance. Information will also be available to show why targets have not been reached. Targets can be based on performance in previous years or on levels which are known to be technically possible. The latter would be difficult in the Falkland Islands where very little is known about the basic technical factors contributing to performance but the position would change as information began to flow from the Experimental Unit. A further refinement would be for a group of farms of similar size, or comparable in other ways, to collaborate so that the average of the group can be used as a basis for targets. The average of the top performers in a group would provide an even better basis.

There is a natural reluctance amongst the farming companies in the Islands to divulge details of their businesses to their competitors. They are not unique in this. United Kingdom farmers have exactly the same feelings yet over the past years of economic pressure many have joined Enterprise Recording Schemes. They have learned that records can be kept in a completely confidential way. We recommend that a "Ginger" group consisting mainly of managers be set up to consider the starting of a Farm Recording Scheme. As wool production is virtually the only enterprise on Falkland Island farms it would in effect be an enterprise recording scheme. The group would definitely require help from outside and an approach could be made to the Provincial Agricultural Economist at one of the British universities which has an Agricultural Economics Department for assistance in designing forms and calculating and analysing results. There are a few private consulting firms in the United Kingdom who specialise in farm recording schemes. One of these might be interested in organising and running a recording scheme of the type envisaged. Their fee for this service might be met by a levy on co-operating farms. Alternatively, the Farm Management Section of the National Agricultural Advisory Service might be able to provide guidance and assistance.

We were also surprised to find that managers very seldom visited one another's farms. Consequently there was a remarkable ignorance of what was going on even on adjoining farms. Alternatively, there were misconceptions as to developments and improvements on other farms. We did find that in some cases small groups of managers do keep in close touch with one another, to advantage it seemed to us, but this was not general. The proposed Ginger Group could take on the task of arranging visits to farms in rotation where, in discussion, the host manager would have the benefit of other managers' ideas and comments on his problems. Companies could encourage visits of this sort by granting leave and paying expenses.

There is another suggestion which we think would be of benefit to the management and profitability of the farms. At present some managers on United Kingdom leave try to improve their technical knowledge by visits to farms, research stations and sections of the wool-processing industry. This is highly desirable and formal educational tours during leave should be encouraged by the companies. The encouragement should take the form of a cash allowance and we recommend that Government should allow it to be free of tax. One of the places all managers should try to visit, if political conditions will allow, is the FAO/INTA Research Project on the Sheep Industry in Patagonia at Bariloche in Argentina. On arrival in the United Kingdom, managers should apply at once to the National Agricultural Advisory Service for a list of demonstrations and 'open' days being organised on hill farms throughout the summer. Research institutes would probably prefer to lay aside one day for Falklands visitors rather than receive them in ones and twos.

II. THE PROFITS TAX

Following recommendations in the Guillebaud Report a legislation was enacted whereby the Profits Tax was raised from 2s to 4s in the £ chargeable for the year of assessment commencing on the 1st day of January 1970. At the same time a rebate based on qualifying expenditure was introduced. Qualifying expenditure is restricted to various improvements, mainly to grassland, and this can be set off against the additional 2s in the £ Profits Tax. Its intention is to induce farms to invest part of their profits in farm improvements with the ultimate aim of benefiting the Colony as a whole as well as the farm owners themselves.

The Team wishes to express its hope that the recommendations for improvement given in this report will fall within the terms of the legislation and that they will be of guidance to companies and managers in spending money to best advantage.

III. LIVESTOCK ORDINANCE

The only other Ordinance of interest to the Team was the Livestock Ordinance. The section dealing with dipping and the control of keds was the only one of special interest. We were asked by Government to give our views on bringing this section up-to-date. These are given in Chapter 18.

IV. GRANT AID FOR COMMUNAL VENTURES

At present Falkland Islands farms do not receive any direct grant aid from Government. Most people prefer it this way. However there are ventures which are beyond the scope of individual farms due to expense or intermittent need for machinery but which might be possible if carried out on a communal basis. Farmers are generally thought to be too individualic to work together in co-operative ventures. But economic pressure overcomes most attitudes and in the United Kingdom co-operative ventures are becoming common. Loans and grants are available to properly constituted syndicates for initial purchase of machinery, erection of buildings and so on.

We do not know whether the Falkland Islands Government or the farms would wish to go in for ventures of this kind. Actually we found some sympathy to the idea on both sides. We would recommend that the idea be examined carefully. To give an indication of the sort of thing we have in mind the following three examples are given. There may well be many more.

Ditching

We were appalled at the loss of hoggets suffered on most farms. This may be as high as 20 per cent and apart from loss of the value of the hoggets it has repercussions on replacement and selection throughout the flock. It clearly must receive high priority in improving the profitability of the sheep industry in the islands. The method of tackling these ditches and the most suitable machine for the job is open to discussion. Unless the best machine proves to be a small and inexpensive one, and this is possible, help may well be required by farms for purchase of suitable equipment. The method of assistance need not necessarily be straight grant-aid. It could be through some form of loan to a syndicate of farms or Government might buy a machine and hire it out as was once done with the Cuthbertson drainage plough.

The possibility of external financial assistance should not be overlooked. Whatever approach is decided upon we do feel that this problem of hogget losses in ditches requires priority consideration.

Purchase of Fertilizers

It must be said at the outset that nothing is known about responses to fertilizers in the camp at the Falkland Islands. Nevertheless, all analyses of soil samples taken by us and others in the past reveal deficiencies in lime, phosphate and some trace elements. It would be remarkable if the Falkland Islands soils did not respond to applications of these minerals. The Soil Scientist from the National Agricultural Advisory Service in Newcastle-upon-Tyne who examined the samples sent home remarked in his report "... we would expect large responses to phosphorus in soil of Index 2 (which most of them are) particularly on peaty soils".* The problem is complicated however, in that responses in herbage must be translated into economic returns from the sheep if fertilizer applications are to be justified. This is clearly a subject which should receive priority for work if the Experiment Unit we propose comes into being.

The object of raising the question of fertilizers in this section, however, is not to attempt to present evidence of their value. It is rather to question a state of mind which seems to exist. Whenever we raised the question of fertilizer use the immediate reaction was to say that it was out of the question on grounds of cost. Certainly the costs quoted to us, say £30 per ton of ground limestone, are out of the question but the quotations invariably referred to small quantities brought from UK. If evidence is forthcoming that there are responses to fertilizer under Falkland Islands conditions we recommend that sources other than the UK be investigated and that the question of importing in bulk, even whole ship loads, be considered. It is in respect of this last point that the whole problem of fertilizers fits into this section. If fertilizers were imported by ship load this would have to be a communal venture and one where Government assistance through grants or loans would be essential.

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*F C Archer - private communication

Importation of stock

A case for the importation of sheep, including ewes, has been made in the livestock section. This presents difficulties of inspection and choice, freight and veterinary regulations in the trans-shipment countries. We believe this to be an obvious case for a communal venture. First, a panel of managers could select stock on behalf of many farms. We realise that this has been done in the past but the numbers involved have been small and there have been disappointments over the individual animals selected for people. We envisage rather the selection of large numbers of stock, including females, so that there is less danger of unsatisfactory single animals having a disastrous effect on a flock for years to come.

If large numbers of sheep were imported we think it might be possible to persuade a ship, say one of the New Zealand ships that already pass quite near the islands, to call at the Colony. This we feel sure would reduce freight charges and overcome difficulties of quarantine in various countries It would, however, probably require Government action and financial assistance in the first place to make it worth while for a large ship to call.

V. DISPOSAL OF EQUIPMENT IMPORTED BY THE TEAM

All the equipment imported by the Team was presented to the Colony by Great Britain under Technical Assistance. Before we left the islands we made arrangements for its disposal after consultation with Mr D Braun of the Ministry of Overseas Development who visited the Falkland Islands in March 1970. Details are given as an appendix but in essence the laboratory equipment has been left on temporary loan to the King Edward Memorial Hospital and the other equipment in care of the Government Officer in charge of Agriculture.

VI. FARM LABORATORY FACILITIES

It was rather surprising, especially in view of their size, that none of the farms visited had made any attempts to set up laboratory facilities of their own. Many managers visited the Team's laboratory and discussed the various simple but important examinations that could be undertaken with a little instruction and a minimum of equipment. In the absence of Agricultural and Veterinary Advisers there are many examinations which could be carried out by following simple written instructions. A small room in one of the outbuildings equipped with electricity, water, sink, bench top or table and a microscope would be an invaluable start and visiting advisers in the future would no doubt find such simple laboratories very useful for on the spot observations.

The team had hoped before arriving at Port Stanley that perhaps some local person could be given a certain amount of elementary training in laboratory duties during its visit but circumstances did not permit this. The use made of the Technician and laboratory by the resident doctors and also those of visiting ships demonstrated the desirability of having these facilities available on a more permanent basis.

CHAPTER 24 - SUMMARY AND RECOMMENDATIONS

CHAPTER 1 - INTRODUCTION

A brief history of sheep farming in the Falkland Islands is presented as a background to the Team's assignment. For over a century, periods of economic pressure have alternated with times of relative affluence. During each period of depression, interest has been shown in the need for improving the productivity of the industry but, with recovery, it has not been sustained. The composition of the Team, its length of stay in the Colony and method of working is described.

CHAPTER 2 - THE PROBLEM

There are two aspects. The first is the increasing uptake of synthetic fibres by the textile industry in preference to wool especially that in the cross-bred range. The second is defined as static cash output in the face of continuously rising costs and has three possible solutions.

Increasing output without proportionately increasing costs.

Reducing costs while maintaining output.

Diversification.

Cash output is the product of sheep numbers, fleece weight and price per pound of wool. An increase in one or all of these factors would improve output. Labour is the greatest item contributing to costs and shows most scope for economies. The purchase of materials from sources other than the United Kingdom might also contribute to reducing costs. Diversification, as far as farming in the Colony is concerned, means meat production, and this involves considerable problems in processing facilities and marketing arrangements. One or more of the solutions suggested might be combined on individual farms.

A change in farm structure to smaller units is not envisaged as a solution. The poor soil and climatic conditions impose an extensive system of farming. Increased output is likely to be the most attractive solution on most farms - though further extensification may suit some larger units.

CHAPTER 3 - THE GRASSLAND COMMUNITIES

Grassland is the basic asset of the Colony. The types occurring are described. They are classified into 8 communities.

TUSSAC: This valuable community is now confined to the coastal fringe.

OCEANIC HEATH: This is the most important and widespread community. It is subdivided into 2 main types. One is dominated by whitegrass and the other by dwarf shrubs - principally diddle-dee.

MOUNTAIN ASSOCIATIONS: These vary from poor whitegrass camp to lichens and cushion plants at the highest elevations. Except as summer grazing for dry sheep, they are of little value.

MARSH FORMATIONS: Sphagnum moss dominates the wettest situations, and Astelia the deep peat banks. These associations are among the least valuable grazings in the islands.

SANDGRASS ASSOCIATIONS: Marram grass and lyme grass have been introduced successfully to stabilise sandy areas. They also provide palatable grazing.

BUSH ASSOCIATIONS: Fachine can provide valuable shelter but is readily grazed out by stock. Native box has been killed out by stock except in inaccessible areas.

VALLEY FLUSH SITUATIONS OR "GREENS": Ribbon areas on banks of streams, rivers and around springs are characterised by short turf. This is composed of small jointed rush and meadow grasses and it provides valuable grazing.

COASTAL "GREENS": Nesting Gentoo penguins convert coastal areas into "greens" dominated by annual meadow grass which makes a valuable contribution to grazing.

CHAPTER 4 - PRESENT FARMING PRACTICE

Details of a survey of farming practice carried out by the Team are described. Twenty-three farms were recorded to a greater or lesser extent comprising 10 mainland and 2 island stations on East Falkland and 7 mainland and 4 island units on West Falkland. The survey figures refer to one year's results and may not be typical.

I. THE VEGETATIVE COMPOSITION OF THE ENCLOSURES

The grassland communities were further divided into 19 vegetative types. Managers were asked to estimate the proportion of each type occurring in the camps on their farms. The estimated distribution is presented separately for West Falkland, East Falkland and the islands. Whitegrass, in various forms and combinations, covers 60 per cent of East Falkland, 57 per cent of West Falkland and 39 per cent of the islands. Obviously investigations into methods of improving this type of camp merit some priority. The proportion of reseeded land is 0.66 per cent, 1.79 per cent and 0.53 per cent on East Falkland, West Falkland and the islands respectively.

The local classification of land into hard and soft camp is discussed.

II. THE STOCK CARRYING CAPACITY OF THE ENCLOSURES

Little relationship could be established between the vegetative types occurring in camps and stock carried. Nevertheless a qualified list of carrying capacity factors is suggested (Table 5).

III. LOSSES OF SHEEP

Losses in ewes, lambs and hoggets are tabulated to show their distribution. The progressive loss of young sheep from birth to shearing is demonstrated graphically. Of every 5 lambs marked, only 4 survive to be shorn 12 months later. A study of losses in young females until entering the ewe flocks shows that it is necessary to mate 4 ewes to obtain one mature replacement for them. Three out of 4 ewe lambs dipped will be available for use as flock replacements 2 years later. The average loss for 141.053 wethers dipped in 1967 was 6.3 per cent, and for 142,615 in 1968 it was 6.9 per cent.

IV. ASPECTS OF SHEEP MANAGEMENT

Imported registered rams tended to be put to cross-brew ewes to provide cross-bred rams in the second generation for use in camp flocks. Three farms of those surveyed were using Polwarth rams, one Romney, 4 both Romney and Corriedale type and 8 Corriedale type only. Two to 3.5 per cent of rams were joined with the ewes between 19 April and 18 May, though 50 per cent of farms put rams in on a date from 27 April to 18 May. They ran with the ewes for 6 to 8 weeks. A quarter to one-third of rams were replaced annually - culling, except for age, being for wool quality, body conformation, wool colour faults and wool blindness.

Most flocks were set stocked winter and summer, though provision was made on some farms for spelled camp to be made available at mating and during winter. On other farms rotational or alternate grazing was practised. Best camps were allocated to ewes then to hoggets, with the shearling ewes and wethers getting the poorest. At lambing most managers preferred shepherds to help ewes in difficulty, though in practice most of their time was taken up righting cast sheep and skinning dead ones. Twins were not wanted. Ear marking by using special pliers and tailing by means of a knife were universal. Rubber rings were the most popular method of castration. Lambs were frequently forced to travel long distances at weaning time.

Five of 22 farms were exempted from statutory dipping. The remainder used a variety of proprietary dips.

V. MILK AND BEEF PRODUCTION

The primary reason for keeping cattle in the Falkland Islands was milk and butter production for the human population. Beef was a byproduct and mainly consumed on the farms. A high proportion of cattle for grazing down rough pastures was kept on one farm.

CHAPTER 5 - GRASSLAND IMPROVEMENT TO DATE

I. RESEEDING PRACTICE

Ploughing, rotavating, sod-seeding and oversowing have all been attempted. Methods used have depended upon the type of soil and herbage cover present. Diddle-dee camp, though variable, frequently has heavy top growth which must be destroyed before reseeding. Careful controlled burning has achieved this cheaply and efficiently. Smashing and slashing machines were safer but slower. Ploughing and rotavating have been equally satisfactory. Large reseeded areas have suffered from lack of shelter. Drilling of seeds in late summer or early autumn has been preferred, although the best time for sowing has not been systematically investigated. Yorkshire fog has been universally sown at 8 to 12 lb husked seed per acre. Reseeding costs, spread over large areas, have been low but a satisfactory establishment of seeds has often taken several years.

Little conventional reseeding has been carried out on whitegrass camp. It has been successful in a few cases where the turf was burned off after rotavation. The fires have been very difficult to control. Sod-seedings of Yorkshire fog in wide rows, and more recently in narrow drills, have established well. Oversowing has also been successful. Competition from existing herbage has in both cases restricted development and spread of the sown species.

II. OTHER METHODS OF IMPROVEMENT PRACTISED

Most stations have made progress in sub-division of camps. The object has usually been to facilitate sheep handling rather than pasture improvement or the provision of better nutrition. Fencing has also been erected to protect eroded, reclaimed and reseeded areas.

Rotational grazing of sub-divided camps has been practised on one farm in an attempt to improve pastures.

It is debatable whether burning is a method of pasture improvement or not. The arguments for and against burning are discussed. Flail-type mowers can be used as an alternative means of removing accumulations of dead vegetation.

Spelling of camps has become an accepted practice on many farms. While it may allow a bulk of herbage to be built up, this is usually well past the green leafy nutritious state before sheep are turned back into the camp. Self-seeding may follow spelling in some circumstances.

Many miles of ditches were made at one time using the Government's two Cuthbertson ploughs. Water was led away from localised wet patches and regular surface drains were pulled over entire camps. Success judged visually is claimed for this work but no convincing data were presented to show an overall farm advantage in terms of extra stock carried. The most important drainage problem in the Colony concerns the improvement of ditches, streams and holes which cause high losses in sheep through drowning. Little seems to have been done about these hazards - at least since 1924. If machinery to deal with this problem has to be large and expensive, financial assistance from Government may be necessary. Care must be taken to avoid excessive drying out of "greens" and green valleys.

RECOMMENDATION Government assistance should be considered for the purchase of suitable drainage machinery to improve ditches, streams and holes which cause losses of young sheep.

III. ASSESSMENT OF RESULTS OF IMPROVEMENTS TO DATE ON FARM ENTERPRISES AND ON THE COLONY'S OUTPUT

In spite of many improvements, total stock carried and wool output of the Colony have not increased in recent years. On most farms the picture is the same. Failure to increase the amount of winter feed available is probably the main cause. Reseeding with Yorkshire fog alone does not help the situation. It is a waste of resources to improve grassland without giving proper attention to its utilisation within the context of the farm as a whole.

CHAPTER 6 - WHITE CLOVER AND OTHER LEGUMES

The value of perennial legumes in grassland is acknowledged. They provide high quality feed and assist associated grasses by improving the nitrogen nutrition of the soil.

There is no record of any native legume in the Falkland Islands. White, subterranean and yellow suckling clovers have been introduced. Subterranean clover is a Mediterranean plant unlikely to thrive in the Falkland Islands' environment. Yellow suckling clover has a low productivity and the availability of seed is erratic. White clover would be valuable if it could be established. For white clover to thrive, conditions must not be too acid, there should be an adequate supply of phosphate and moderately damp soil is required. Unfortunately Falkland Islands' soils are acid (average pH 4.5), deficient in phosphate and may suffer from surface drought for part of the year. Inoculation of clover seed by live cultures of bacteria is also required.

Lime and phosphate fertilisers, which are necessary to prepare soils for white clover, are not found locally and are expensive to import. Experimentation to establish minimum necessary rates of these fertilisers must be carried out before reasonable estimates of the worthwhileness of using clover under Falkland Islands' conditions can be made. It is unlikely that widespread sowings of clover in the open camp will be justified in the foreseeable future. Special areas such as "greens" and green valleys may repay oversowing with clovers.

There does not seem to be a case for annual and short-lived perennial legumes under Falkland Islands' conditions.

RECOMMENDATION High priority should not be given to investigational work with Legumes but, if resources were made available, efforts should be confined to the establishment of a long-lived species such as wild white clover.

CHAPTER 7 - TUSSAC (POA FLABELLATA (LAM) HOOK)

Tussac, which occurred as a fringe along the entire coastline of the Falkland Islands in the nineteenth century, has been practically obliterated except on the small islands. The great value and potential of tussac lies in its ability to provide nutritious grazing in winter. It can also be grazed in summer or at any time provided it is given adequate rest before being grazed again.

Tussac provides shelter as well as good grazing and can be used for lambing. It should be used for this purpose on the smaller islands. While mainland farms are unlikely ever to have sufficient tussac for winter grazing for all sheep, it could and should be developed for use in conjunction with ewe camps.

RECOMMENDATION Suitable areas of rincons should be fenced off and planted with tussac.

Tussac could also be used on larger farms as an alternative to oat, kale or hay crops for winter feed for the milking cows of the settlement.

RECOMMENDATION A fenced block of about 5 acres of tussac planted on the square should be established at each settlement to provide winter feed for cows.

Although so-called "Tussac Disease" has been prevalent for several years, no concerted effort has been made to establish its cause.

RECOMMENDATION A programme of work should be started to identify the organisms causing "Tussac Disease" and to discover ways of controlling them.

CHAPTER 8 - THE UPLAND GOOSE (CHLOEOPHAGA PICTA PICTA)

The upland goose is extremely numerous in the Falkland Islands. It competes directly with sheep for grass, especially during winter. It grazes the best areas of natural grasslands, and its depredations on newly reseeded areas and arable fields are considerable. The upland goose is a major pest and increased efforts should be made to control it. The present system of paying a bounty for beaks is ineffective.

RECOMMENDATION A pest control-cum-conservation specialist should be invited to the Falkland Islands to advise on the control of the upland goose.

CHAPTER 9 - GRASSLAND IMPROVEMENT

Methods of grassland improvement must be related to soil type and existing herbage cover. Four main types of soil are defined.

Deep upland peat is poorly drained and carries a flora characterised by short brown rush, Astelia and whitegrass. It overlies an impermeable subsoil of sandstone, quartzite or clay. It is soft camp.

Peat of moderate depth overlying a more porous subsoil usually carries plants such as whitegrass, pigvine and a little oreob. It forms good soft camp.

Shallow, well drained sandy peat typically carries a flora dominated by diddle-dee with Christmas bush and small fern. It is known as hard camp.

Valley flush peats, which may be deep, are associated with wash down mineral particles and are relatively fertile. The flora consists of small jointed rush, the meadow grasses and bent.

The nutrient status of the soil is also important in the context of improvement. Falkland Islands' soils are acid and low in phosphate and prices for fertilisers imported from the United Kingdom are prohibitive. Cheaper sources should be investigated, but justification for any fertiliser usage at present values of output would be difficult.

I. DWARF SHRUB DOMINANT CAMP

The soil types associated with dwarf shrub heath show most promise for grassland improvement. Since the shrub plays an important role in providing shelter it should not be eliminated completely.

In the best type of this camp individual "bogs" of diddle-dee are distinct and separated from one another by a high quality sward composed of meadow grasses, small jointed rush and bent.

RECOMMENDATION The best type of dwarf shrub dominant camp should be improved by destroying the shrubs in strips by mechanical means. Oversowing would accelerate improvement, especially on the fringes of these areas.

In some areas diddle-dee is tall and completely dominant. It forms a canopy with no worthwhile sward beneath.

RECOMMENDATION Tall dominant diddle-dee is best improved by reseeding. The bush must first be disposed of by mechanical means. On deep uniform soils ploughing or rotavating can follow. On shallow soils rotavating is preferable to avoid bringing up clay subsoil.

Adequate consolidation of the light puffy soil under dwarf shrub heath is essential for success in reseeding. Various methods of achieving consolidation are discussed. Seed should be sown when there is a reasonable chance of wet weather following, but the meteorological data available at present is inadequate for providing much guidance in this respect. There are many advantages in strip cultivation for reseeding dwarf shrub camp.

RECOMMENDATION Grass seeds should be drilled to a depth of ½ to 1 inch. A robust disc coulter-type corn drill with a 3½ inch spacing would be suitable.

Up to the present time Yorkshire fog has been used alone for reseeding in most cases. It has the advantage of being able to establish without needing fertilisers but it has limitations as a pasture plant. Other grasses have been shown by trial work to be capable of establishing without fertilisers.

RECOMMENDATION A seeds mixture containing Yorkshire fog, cocksfoot, tall fescue and red fescue should replace straight Yorkshire fog for reseeding. A suitable mixture is suggested.

The extra grasses should lengthen the growing season of the reseeded pasture and provide quicker ground cover. The cost of seed would be increased by a small amount. A mixture is preferred to separate blocks of single species so that the more palatable grasses will be spread over a wide area to avoid excessive attention from sheep and geese.

Large farms can keep reseeding costs low due to their scale of operation. Small farms could obtain this benefit by co-operation.

RECOMMENDATION Smaller farms should co-operate in the ownership of equipment and the employment of specialist gangs to keep reseeding costs to a minimum.

Dry ridges on small islands suffer severely from drought and become prone to mechanical damage by the feet of sheep and this leads to erosion.

RECOMMENDATION New areas of erosion should be fenced to keep stock out and be oversown by hand.

II. WHITEGRASS DOMINANT CAMP

Whitegrass camp of one sort or another is the most extensive and widespread vegetative type in the Colony. So far it has largely been neglected in improvement schemes but it clearly has great potential in terms of area. Whitegrass dominant camp occurs on most of the soil types.

On shallow peat soils, or in situations where there is a quick run-off of moisture, whitegrass develops into bogs with a sward of finer grasses below. These areas provide first-class grazing and shelter.

RECOMMENDATION Bog whitegrass should be included in an area fenced off from the poorer parts of the camp so that the high quality grazing it provides can be saved for special purposes.

Another type of whitegrass camp occurs on soils which are slightly poorer and wetter. Individual plants are not separated into bogs, and such finer grasses as are present are not formed into turf.

RECOMMENDATION Attempts should be made to convert suitable areas of good whitegrass camp into bog whitegrass by fencing off and grazing heavily.

Since good whitegrass camp occurs on better soils, reseeding is also possible in many situations.

RECOMMENDATION When reseeding good whitegrass camp, top growth should be removed by burning or flail mowing. After ploughing or rotavating, the broken turf should be left to lie over winter to weather and settle. Seeds should be drilled direct in the following summer. A seeds mixture rather than straight Yorkshire fog should be used.

As camp becomes softer and less well drained, whitegrass becomes thin and straggling and is associated with oreob. Improvements to this type of camp are still at the experimental stage.

RECOMMENDATION Surface sowing by sod-seeders or oversowing is likely to be the most economical means of improving moderately wet whitegrass camp. If reseeding is attempted, a period of at least one winter should be left between ploughing or rotavating and seeding to allow rotting and settling of the turf.

Following limited experimental work with a flail-type mower in conjunction with oversowing, the following recommendation is put forward tentatively.

RECOMMENDATION Soft whitegrass camp may be improved by scattering a grass seeds mixture on the surface prior to cutting the accumulation of dead leaves with a flail-type mower. The trash should be left on the surface as a mulch over the seeds.

On deep wet peat soils, where whitegrass is associated with much oreob and Astelia, improvement is unlikely to be economically worthwhile.

III. ECONOMIC ASSESSMENT OF PASTURE IMPROVEMENT

With the aid of hypothetical examples, an attempt is made to show how simple calculations can be used to assess the economic consequences of projected improvements. For realistic assessments, full and accurate farm records of performance are necessary.

The cost of improving an acre of pasture is high in relation to the cash output of that acre but it may not be in relation to the farm as a whole. Falkland Islands' farms are large and no one, including the Team, envisages that every acre will ever be improved; rather the profit from the many acres should be used in part to improve the few selected acres so that the farm as a whole is made more viable.

CHAPTER 10 - SHEEP NUTRITION

I. EVIDENCE OF POOR NUTRITION

The pointers to undernutrition of sheep in the islands in the absence of a serious disease problem are the high stock losses and the slow growth to mature size of the young stock and the low feeding value of the pastures. Evidence is presented to support this.

II. THE ANNUAL NUTRIENT CYCLE

There is an annual cycle in the ewe's requirement for energy and protein. The effect of the level of nutrition in one part of the cycle affects the level of production in another part. The critical times in all extensive situations are the autumn, when fat reserves are laid down against the winter and good conception is required, and spring and early summer, at the period of late pregnancy and early lactation. The use of a two pasture system to improve annual nutrition is discussed in Chapter 11.

At present the reserves carried by Falkland Islands sheep are less than adequate to maintain lactation and low lamb mortality. It is uneconomic to import foodstuffs to supplement the diet.

RECOMMENDATION. Better nutrition from late August to mid November should be obtained from either tussac or improved pasture (natural or reseeded) specially shut up for the purpose.

The provision of shelter would lead to conservation of energy reserves but the effect would be most noticeable in lamb mortality. Tussac is both food and shelter, but on reseeded ground shelter can only be provided by leaving strips of unimproved pasture, planting hedges, making walls with sods or stone or using old corrugated iron. For practical reasons, the last 3 options apply only to small flocks or particularly exposed "greens".

The quality of the diet of lambs immediately after weaning is critical both for survival and growth.

RECOMMENDATION. Pastures shut up since marking or reseeds being grazed for the first time should be provided for weaned lambs but, failing these, a return to the same camp to be on similar value pasture would be helpful

III. THE USE OF UREA-BASED FEEDS

Urea, as part of a food supplement, is not economic at the moment. Its use with molasses and minerals as a supplement for animals used as "mowing machines" to improve rough pasture has not yet been demonstrated satisfactorily in numerical terms.

IV. VITAMIN AND MINERAL NUTRITION

The mineral content of the herbage samples is discussed and related to intake and the requirements for maintenance of a ewe. Calcium and phosphorus content of herbage is low but magnesium is adequate. Cobalt figures are variable but generally low.

V. HOGGET NUTRITION

RECOMMENDATION. Hoggets should be given a diet of good quality for as long a time into the autumn as possible so that they will be better grown and fitter to face the winter

CHAPTER 11 - UTILISATION OF IMPROVED AREAS

There is evidence that much of the grassland improvement carried out so far has not resulted in increased profits for the farms concerned. This is probably due to failure to exploit the improved areas to best advantage.

For purposes of exploitation, pastures in the Colony are classified into 3 types Unimproved camp provides only a low maintenance-type feed. Improved natural camp (which includes naturally better areas) can produce feed of high quality over a relatively long period of the year but is generally overgrazed. Reseeded camp is capable of producing high yields of good quality feed but is late to start growth in spring, heads excessively and dies off early in autumn. Upon the growth pattern of these 3 types of pasture, the cycle of nutrient requirement of the sheep has to be superimposed. This is only possible if grazing is controlled so that the appropriate type of herbage can be presented to the sheep according to its need.

RECOMMENDATION. Better areas of camp should be fenced from poorer areas. If there are not better areas, some should be made by reseeding or surface improvement.

Examples are given of methods of alternate grazing aimed at improving the nutrition of ewes in 3 pasture situations

CHAPTER 12 - SHEEP BREEDING AND WOOL

I. PRESENT CROSSES AND THEIR WOOL QUALITIES

Viewed overall, the predominant blood in the present stock is Romney. The sheep are, however, cross-bred with an admixture of finer wooled breeds, especially the Corriedale. More recently the Polwarth has been making its contribution, and in the first half of the century some Merino blood was introduced on some farms. On others the open face and active nature of the Cheviot made it popular for crossing. The only exception to this on any scale is the pure-bred but unregistered flock of Corriedales at Port Howard. The aim of crossing is to marry the size, constitution and mothering ability of the Romney with the wool qualities of the Corriedale.

RECOMMENDATION. For the majority of farms, the Romney X Corriedale sheep is likely to remain the most profitable with the proportions of the 2 breeds being dependent on the nutritive value of the pastures on the farm. On drier camp, where pasture improvement is possible to the pre test extent, a proportion of Polwarth blood should be introduced.

It is probably unrealistic to maintain pedigree flocks of all 3 breeds on the islands. If the Corriedale were to be the only one, occasional importations of Polwarths or Romneys, as at present, would allow the maintenance of the present crossing patterns but cause the overall drift to greater fineness of wool which is required.

The great bulk of the wool clip in the Falkland Islands covers bulk 56's quality with the range extending between 60's in the "A" grades and 48's in the "CC" grades. The wool has a speciality character giving it a premium of 10 per cent over comparable South American wools. The character lies in the wool's soft handle, white colour, cleanliness, style and strength, crimp and loft of staple without harshness. It is probable that it sells as much on its character as on the quality count.

II. IMPROVEMENT OF WOOL INCOME

RECOMMENDATION. The aim for the Falkland Islands as a whole should be to move towards a finer wool.

Such a change should involve:

The elimination of wool of less than 50's count.

A fining-up of wool on a number of farms presently producing wool of lower quality than they could produce.

The return of a very small number of farms to a slightly coarser wool than at present produced.

A move towards still finer wool on farms presently at the finer end of the scale but which have the potential for greater areas of improved pastures.

These recommendations are intended to create a quality range of 50-60's with only a small proportion at the lower end.

The present structure of most flocks consists of a small stud flock usually bred to an imported ram and a ram-breeding flock in which rams from the stud flock are used to beget rams for putting to the camp flocks. The scheme is sound but it could be modified to accelerate the improvement of the flock by the use of artificial insemination.

RECOMMENDATION. Whether or not the stud flock is pure-bred and pedigreed, there is an urgent need to carry out a programme of performance and progeny testings of young rams before they are used extensively. Such a scheme is outlined.

Concentration on the qualities of the rams is doubly important in the Falkland Islands because of the lack of culling potential on the female side.

III. THE MARKETING OF WOOL

The textile industry is coming increasingly under the influence of the manufacturers of synthetic fibres who are bringing about vertical integration in order to secure outlets for their products. It does not seem likely that the specialist work of scouring blending or top-making could be carried out competitively in the Islands, but there is a need for closer co-operation with those who do so.

RECOMMENDATION. Farm owners should consider the acquisition of shares in a processing firm to handle all Falkland Islands wool, to brand-name it and advertise it.

CHAPTER 13 - SHEEP MANAGEMENT

I. GENERAL HANDLING

Standards of stockmanship are variable. Shortage of labour has led to some general reduction of standards, particularly at lambing time and in the shearing sheds.

RECOMMENDATION. The general level of dog control needs to be raised. The outlines of a bonus scheme for "approved" dogs are suggested.

II. AT MATING

In the camps there is little opportunity for change unless mating is taking place on improved camp when rams could be allocated rather more ewes. In stud flocks the use of teaser rams in conjunction with controlled mating or artificial insemination should be considered in order to maximise the effectiveness of the best sires.

III. AT LAMBING

The question as to whether shepherding is essential at lambing has an economic and a husbandry aspect. The question is valid in the case of a skilful shepherd, but no shepherd at all is a better paying proposition than one without a stockman's sense or one with an uncontrolled dog.

IV. AT MARKING

Docking with a knife is not a wholly satisfactory method but is probably the most acceptable meantime. Unnecessarily rough handling should be avoided. Care should be exercised to ensure speedy mothering-up.

V. AT SHEARING

RECOMMENDATION. A master shearer from Australia or New Zealand should be employed to teach the kind of shearing which maximises wool output per unit of human energy extended.

Thought should be given to arrangements for sheltering freshly shorn sheep.

VI. AT SPRAYING AND DIPPING

Policy and practice in respect of the ked problem are dealt with in Chapter 18.

Two alternatives seem noteworthy in the event of reconstruction of dipping facilities. These are the provision of a decoy pen to persuade the sheep to approach the dipper or the use of a circular catching pen immediately before the bath.

VII. CARE OF WEANED LAMBS AND HOGGETS

The extra operations carried out on the lamb at weaning should be executed firmly but gently. There should be a minimum time lapse between the start of gathering the ewe camp and the lamb reaching its post-weaning camp. If the work has to be done in 2 stages, the stages should be speedy and, in the interval between them, the lambs should have a period of rest on good quality pasture.

Expenditure on machinery to open dangerous ditches and on fencing treacherous coastline should be considered in terms of reduced mortality which would allow a greater freedom of choice in selecting replacement females.

VIII. STOCK RECORDS

The following records are considered necessary to allow managers to make between-camp and between-year comparisons:

Weaning tallies of ewe, wether and ram lambs (by camps).

Dipping tallies of ewe, wether and ram lambs.

Shearing tallies of ewe, wether and ram hoggets.

Dipping and shearing tallies of shearling ewes.

Dipping tallies of 2-year ewes.

Dipping and shearing tallies of ewes and wethers (by camps).

Ewe losses classified into cast for age, culled for faults (to be specified), used for mutton and "other".

Complete sale details for each bale of wool.

In addition, it would be an advantage to have an annual sampling of the fleece weights and grades of, say, the 3-year-old wethers.

CHAPTER 14 - MUTTON PRODUCTION

From rough and ready calculation it is thought that there might be about 1,000 tons of carcass mutton available annually between December and April. There are marketing problems to be overcome as well as processing problems.

CHAPTER 15 - CATTLE PRODUCTION AND BEEF

There is little enthusiasm for cattle except as providers of milk, butter and a little beef in autumn and winter. This could be changed if there were a market for beef sufficiently remunerative in the long term to justify the capital investment that would be necessary. The possibility of importing grains for finishing cattle is discussed. An 8 to 1 ratio of supporting stock to cattle in the final stages of fattening would be necessary. Calculations are presented which suggest that the output of 100 beef animals annually would mean the displacement of 1,600 to 1,800 sheep.

Grass or oat hay at 15 cwt per head or tussac at 3 cows per acre would have to be provided. New handling yards and possibly new fences would be required. Suitable breeds or crosses are suggested and some thoughts on beef processing are given.

RECOMMENDATION. An expert in slaughterhouse management and the wholesale meat trade should make further studies of the Falkland Islands in respect of the processing and marketing of beef, taking account of the surplus mutton that could also be available. A shipping expert should also be involved in discussions on the transport of the cattle or carcasses to the processing centre and the trans-oceanic freighting of the product.

CHAPTER 16 - VETERINARY INVESTIGATION

The setting up of the laboratory and the investigational methods used by the veterinary surgeon are described.

The Team is in substantial agreement with the earlier investigators from Munro onwards that only a small percentage of the high annual wastage in sheep and cattle is due to disease.

The presence or absence of certain diseases is commented on. Hydatid disease in sheep is now common. Caseous lymphadenitis has increased on some farms. Infectious epididymitis though present is not yet a general problem.

CHAPTER 17 - DEFICIENCY DISEASES OF SHEEP

Calcium and phosphorus are deficient in the soils and herbage of the Colony. Nevertheless it would seem that overall the intake is sufficient for maintenance of health in the sheep, though possibly not for rapid maturation. If growth rate was on a par with that in the United Kingdom, deficiency disease might become a problem.

No estimations of selenium or vitamin E were carried out. Although there are reports of 3 farms having been affected in the past, no cases of deficiency were encountered during the Team's visit.

Magnesium levels in herbage are satisfactory and, with present types of grass sward and rate of growth, cases of magnesium deficiency are unlikely.

Copper and cobalt are considered together. Blood samples from 101 sheep, including 64 from lambs, were analysed for copper but only 9 were found to be below the normal range. No evidence of copper deficiency in Falkland Islands' sheep has been found. Consequently copper supplementation cannot be recommended.

An advantage is claimed by some farms from using cobalt bullets. They are administered on 9 farms to lambs at weaning or dipping. The Team carried out a controlled experiement on 3 groups of lambs receiving respectively copper, cobalt and copper plus cobalt. None of the treated groups in the experiment showed any weight advantage over controlled groups at 10 and 23 weeks after treatment. It is emphasised that the effects of cobalt deficiency vary from year to year.

RECOMMENDATION. Farms experiencing widespread unthriftiness on hogg grounds should conduct controlled trials with cobalt bullets in lambs grazed on these hogg camps for three successive years.

CHAPTER 18 - PARASITIC DISEASES OF SHEEP

I. ECTOPARASITES

Ticks, lice and sheep scab are no longer present in the Falkland Islands. The sheep ked, sometimes mistakenly referred to as a tick, is still present on some farms despite compulsory dipping. On others it has been eradicated. It could be eradicated from the whole Colony by concerted effort. The Team's advice was sought by Government, and the 3 alternative schemes suggested are presented.

RECOMMENDATION. A drive for the eradication of the sheep ked is overdue and, while alternative control schemes have been submitted, it is thought to be pointless to maintain legislation for anything short of eradication because the continued presence of ked-stained fleeces on a farm itself carries a built-in financial penalty. Government should consider making the sale or export of ked-stained wool an offence.

No active cases of Mycotic dermatitis were seen in live sheep although samples of affected fleece wool were seen. The one bluebottle present does not cause flystrike in sheep.

II. GASTRO-INTESTINAL PARASITES

A total worm count was carried out on several carcasses and the results are tabulated. Dung samples from 114 lambs and hoggets were examined for worm eggs and 10 (7.1 per cent) had high levels. Dung samples were also taken from 32 adult sheep and 10 per cent were found to have high worm egg counts. One lamb which died due to high Nematodirus filicollis infection was received for autopsy in January 1970.

High worm infestation in mid summer can be controlled by dosing with anthelmintics and moving sheep on to clean pastures. These techniques are discussed.

RECOMMENDATION. All sheep should be observed carefully from November onwards so that they can be dosed and/or moved to clean camp if they go down badly in condition.

The first 6 months is the critical period in the life of the sheep in developing resistance to worms.

RECOMMENDATION. A central supply of worm drugs should be maintained in Stanley so that when needed they can be quickly obtained.

No deaths during the visit were attributable to adult tapeworms, and farm investigations did not show them to be an important factor in unthriftiness.

III. DISEASE CAUSED BY TAPEWORM CYSTS

The Team found a high percentage of sheep lungs and livers affected with unilocular hydatid cysts although there have been few references to hydatid disease in earlier reports. Tables are presented showing the results of hydatid examinations at Stanley butchery and on camp tours.

A Government Order empowering dosing of dogs and forbidding the feeding of raw offal to dogs has been in operation since 1965. The implications of the problem on human health are now becoming obvious and the Team was asked by Government for its views on a campaign to reduce and finally eradicate hydatid disease. A Hydatid Control Committee was set up and new legislation formulated. A programme of education and publicity, of which details are given, was launched.

RECOMMENDATION. To maintain the impetus of the hydatid disease control campaign, the services of a person experienced in hydatid control should be obtained.

Cysticercus tenuicollis, which causes the false hydatid, is not important in an economy where livers are not exported. Other minor diseases are also dealt with in this section.

IV. SARCOCYSTIS TENELLA

Nodules of this disease were seen in several sheep in a single consignment of mutton wethers from one farm.

V. LUNG WORMS

There is little likelihood of regular trouble from lung worm, although outbreaks do occur rarely.

VI. LIVER FLUKES

It may be assumed that no species of liver fluke are present in Falkland Islands' sheep.

CHAPTER 19 - BACTERIAL DISEASES OF SHEEP

Caseous lymphadenitis is troublesome on 2 Falkland Islands farms; it is regularly seen but not common on 7; on another 7 there are few or very few cases; it is absent or very rare on a further 13.

The disease has little effect on the health of the sheep but it makes carcasses objectionable so that they have to be condemned.

Machine shears, once contaminated, are a potent source of infection and must be disinfected between sheep.

RECOMMENDATION. All shearing wounds, even small ones, must be dressed. The most convenient method is an aerosol spray. The floors of counting-out pens should be kept moist. Freshly shorn sheep should be held for as short a time as possible.

Epididymitis appears to affect only one farm in the Falkland Island to date. Unless breeders are constantly vigilant, this disease could become a widespread problem.

RECOMMENDATION. There should be regular manual inspection of the epididymus in rams on all farms. Rams found to have epididymitis should be culled.

Specific opthalmia, clostridial disease, mastitis and Johne's disease are also discussed in this chapter. Foot-rot, erysipelothrix joint infection and vibrionic abortion were not found.

CHAPTER 20 - VIRAL DISEASES AND MISCELLANEOUS CONDITIONS OF SHEEP

Foot and mouth disease has never been introduced. Clearly it would be very serious for the Falkland Islands if it ever were.

RECOMMENDATION. The Falkland Islands Government should take steps to ensure that they are quickly informed of foot and mouth disease outbreaks in those parts of South America from which stock, merchandise and visitors periodically come to the Colony so that appropriate delaying action or other precautions may be taken.

Comments are also made in this chapter on the incidence and importance of contagious pustular dermatitis, enzootic abortion, louping ill, tick-borne fever, scrapie and liver pigmentation.

CHAPTER 21 - DISEASES OF CATTLE

Mastitis and other udder infections periodically affect the 2 Stanley dairies and the milking cows in the camp, though to a much lesser extent than commercial herds in the United Kingdom. Laboratory examination was made on 42 individual milk samples. In 25 of these, no significant infection was found; in 16 haemolytic staphylococci were cultured and, in one, only Gorynebacterium pyogenes was cultured. The majority of the samples and a number of milk samples representing 6 different parts of the Falkland Islands were tested for Brucella abortus antibodies. All gave negative results. A sufficient number of samples were taken in the Stanley area to be sure that there was no brucella infection in the Stanley cows. Insufficient samples were tested from the camp to entirely rule out brucellosis, though none was found in the samples tested.

Tuberculosis was reported in the Colony in 1911 and 1914. The history of testing for the disease is outlined. The Team tested all the Stanley cattle and many milking cows on a number of farms. The results of all tests are tabulated. The veterinary surgeon found no reactors.

RECOMMENDATION. Tuberculin testing in the Falkland Islands in future should be on the basis of a single intradermal comparative test using both avian and mammalian tuberculin. The testing of all farms in rotation should aim at ensuring that initially every milk cow is tested at least once in its lifetime and ultimately that all dairy cows are tested every 2 years.

Other diseases discussed in this chapter are deficiency conditions, breeding disorders, hydatid disease, traumatic pericarlitis, ringworm, navel-ill, clostridial diseases and anthrax.

Artificial insemination in cattle was undertaken in an exploratory way. On the suggestion of the Development Committee, 20 doses of pedigree British Friesian semen were obtained from the United Kingdom in liquid nitrogen-cooled containers. Within 4 days of the arrival of the semen, 7 cows and heifers were inseminated and 3 months later 4 of these were thought to be in calf to the insemination. The work showed that artificial insemination of cows in the Falkland Islands is possible but it is likely to be of limited practical application as the semen must be used very quickly after arrival and cows cannot be guaranteed to come into oestrus to coincide with the arrival of the "Darwin".

CHAPTER 22 - AGRICULTURAL ADVISORY SERVICES

The Falkland Islands has no permanent agricultural advisers or experimental workers at present. The entire wealth of the Colony is derived from agriculture. The Team found that Managers were eager for information and for opportunity to discuss their problems. Nevertheless the appointment of an agricultural adviser is not recommended because absence of basic information on factors contributing to the profitability of the farming system would limit his ability to give worthwhile advice.

The first requirement is for experimental work in grassland production and livestock husbandry.

RECOMMENDATION. An Agricultural Experiment Unit should be set up as soon as possible.

The Unit should be placed on a farm which the experimental workers would have under their full control. It should not be too large, nor expected to make a profit in the commercial sense nor developed as a "model" or demonstration farm. It would need to carry 3,000 to 4,000 sheep in recognised classes. Its size would therefore be 12,000 to 20,000 acres. Possibly sufficient acreage could be rented. A self-contained unit covering a wide range of vegetative types would be most desirable. A graduate staff consisting of a Director and 2 specialist assistants, one in livestock and the other in grassland husbandry, are suggested.

A considerable degree of independence is essential for the Unit. Consequently outside assistance in financing the project is suggested with the Falkland Islands retaining active participation through a regular contribution.

RECOMMENDATION. Her Majesty's Government in the United Kingdom should be approached for assistance in financing the proposed Agricultural Experiment Unit.

It would be an advantage if the Unit were attached to a larger similar institution to avoid duplication of equipment and a feeling of isolation in the staff.

RECOMMENDATION. The proposed Agricultural Experiment Unit should be attached to, or even part of, a larger similar institution.

CHAPTER 23 - GENERAL MATTERS

I. RELATING TO MANAGERS

Many Managers are in the unsatisfactory position of not being taken sufficiently fully into the confidence of their Directors. Farm records are often kept in insufficient detail for them to be used in making meaningful management decisions. Properly kept records can be used for comparison with "target" levels of performance, elucidating reasons for failure to reach targets and for between-camp, between-year, even between-farm comparisons.

RECOMMENDATION. A "Ginger" Group consisting mainly of Managers should be set up to consider the starting of a Farm Recording Scheme.

It is suggested that an approach should be made in the first instance to the Provincial Agricultural Economist at one of the British universities which has an Agricultural Economics Department for assistance in designing forms and calculating and analysing results. Other possible sources of assistance are suggested.

Most Managers seldom visit one another's farms. The proposed Ginger Group could take on the task of arranging visits to farms in rotation where, in discussion, the host Manager would have the benefit of other Managers' ideas and comments on his problems. Companies could encourage visits of this sort by giving leave and paying expenses.

Inadequate encouragement is given to Managers for visiting farms, research stations and sections of the wool processing industry while on United Kingdom leave.

RECOMMENDATION. Companies should encourage formal educational tours by Managers when on United Kingdom leave by giving cash allowances which should qualify for tax relief.

II. THE PROFITS TAX

The Team expresses the hope that the recommendations in the report will fall within the terms of the legislation and that they will be of guidance to Companies and Managers in spending money to best advantage.

III LIVESTOCK ORDINANCE

The Team was asked to give its view on the section dealing with dipping and control of keds, and these are given in Chapter 18.

IV. GRANT AID FOR COMMUNAL VENTURES

At present no direct grant aid from Government is received by Falkland Islands farms. However, certain ventures which are beyond the scope of individual farms may be sufficiently important to merit some form of assistance in future.

RECOMMENDATION. The Falkland Islands Government should examine carefully the possibility of offering grant aid for projects undertaken on a communal basis with a view to improving the productivity and viability of farms.

The following examples are given of possible suitable undertakings:

Ditching.

Purchase of fertilizers.

Importation of stock.

The possibility of external financial assistance should not be overlooked.

V. DISPOSAL OF EQUIPMENT IMPORTED BY THE TEAM

The laboratory equipment was left on temporary loan to the King Edward Memorial Hospital and the other equipment in the care of the Government Officer in charge of agriculture. Details are given in the Appendix.

VI. FARM LABORATORY FACILITIES

Farms could carry out many useful examinations for themselves by following written instructions if a room at the settlement were equipped as a simple laboratory.

There seems to be a case for training a local person for laboratory duties in Port Stanley.

REFERENCES

Agricultural Research Council 1965 — The Nutrient Requirements of Farm Livestock No 2 Ruminants

Atkins, W S and Partners 1969 — The Strategic Future of the Wool Textile Industry. Report submitted to the Marketing Study Steering Group of the Economic Textile Industry

Chippindale, H G and Davies, T H 1962 — "The use of forage harvester in the improvement of rough grazing." Journal of the British Grassland Society, Vol 17 No 4 December 1962

Davies, W 1939 — "The grasslands of the Falkland Islands." Port Stanley. Government Printer

Fern, E T 1956 — Falkland Island Government Department of Agriculture. Report for the years 1955 and 1956. Unpublished. The Secretariat. Port Stanley

Fletcher, R 1953 — Report on meat inspection at Ajax Bay. Unpublished. The Secretariat. Port Stanley

Food and Agriculture Organisation — Animal Health Year Book 1968. FAO Rome

Gibbs, J G 1946 — "Report on the work of the Department of Agriculture 1937-1946." Unpublished. Governor's Library. Port Stanley

Guillebaud, C W — "An economic survey of the Falkland Islands." Government report. Port Stanley

Hurd, A 1958 — Journal of Wool Education. Spring 1958

King, el al 1969 — Miscellaneous report No 72 "Land system analysis of the Falkland Islands, with notes on the soil and grasslands." King, R B, Lang, D M, and Blair Rains, A. Land Resources Division, Directorate of Overseas Surveys, Tolworth, Surrey

Loosli, J K and MacDonald, L W 1968 — Nonprotein Nitrogen in the Nutrition of Ruminants, FAO Agricultural Studies No 75. FAO Rome

Miller, S 1966 and 1967 — "Proceedings of conferences on grassland improvement." Port Stanley July 1966 and July 1967. Port Stanley.

Munro, H 1924 — "Report of an investigation into the conditions and practice of sheep farming in the Falkland Islands." Government Printer. Port Stanley

Rippon, S R 1954	Report on meat inspection at Ajax Bay. Unpublished. The Secretariat. Port Stanley
Russell, F C and Duncan, D L	Minerals in Pastures: Deficiencies and Excesses in relation to Animal Health. Commonwealth Agricultural Bureau. Tech Communications No 15
Skottsberg, C J F 1913	Botanische Ergebnisse der Swedischen Expedition nach Patagonien und dem Feurlande 1907-1909, III. "A botanical survey of the Falkland Islands." Uppsala and Stockholm. Almquist and Wikksells-A-B 1913.
Smith, C M L 1970	Personal communication
The Farm as a Business	No 1, Introduction to Management. HMSO London
Wannop, A R 1961	"Report on visits to Falkland Islands sheep stations." Department of Technical Co-operation. London
Williams, J H 1956	"The effect of Molybdenum on reclaimed Welsh upland pastures." Plant and Soil VII No 4. London
Young, C D 1968	Report on Pasture Improvement Experiments carried out in the Falkland Islands during 1965-1968. Government Report. Port Stanley

APPENDIX 1 - LISTS OF PLANTS REFERRED TO IN THE TEXT

SCIENTIFIC NAME	COMMON NAME
GRASSES	
Agrostis canina L	Velvet or brown bent
Agrostis magellanica Lam	Native bent
Agrostis stolonifera L	Creeping bent
Agrostis tenuis Sibth	Common bent
Aira caryophyllea L	Silvery hair grass or large goose grass
Aira praecox L	Early hair grass or goose grass
Ammophila arenaria (L) Link	Marram grass
Cortaderia pilosa (D'Urv) Hack	Whitegrass
Dactylis glomerata L	Cocksfoot
Deschampsia antarctica Desv	Common hair grass
Deschampsia flexuosa (L) Trin	Wavy hair grass
Elymus arenarius L	Lyme grass
Festuca arundinacea Schreb	Tall fescue
Festuca erecta D'Urv	Land tussac
Festuca magellanica Lam	Native fine leaved fescue
Festuca ovina agg	Sheep's fescue
Festuca rubra L	Red or creeping fescue
Hierochloe redolens Roem and Schult	Cinnamon grass
Holcus lanatus L	Yorkshire fog
Lolium perenne L	Perennial ryegrass
Phleum pratense L	Timothy
Poa alopecurus (Gaudich) Kunth	Mountain blue grass
Poa annua L	Annual meadow grass
Poa flabellata (Lam) Hook	Tussac
Poa pratensis L	Smooth stalked meadow grass
Poa robusta Steud	Prickly meadow grass
Poa trivialis L	Rough stalked meadow grass
Trisetum spicatum var phleoides (D'Urv) Hack	Native fog
Vulpia bromoides (L) S F Gray	Barren fescue
LEGUMES	
Medicago sativa L	Lucerne
Onobrychis viciifolia Scop	Sainfoin
Ornithopus sativus Brot	Serradella

LEGUMES (contd)

Trifolium dubium Sibth	Yellow suckling clover
Trifolium repens L	White clover
Trifolium subterraneum L	Subterranean clover

OTHER FAMILIES

Acaena lucida (Lam) Vahl	Native yarrow
Astelia pumila (Forst) Banks	Astelia
Azorella spp. Lam	Azorella
Baccharis magellanica (Lam) Pers	Christmas bush
Blechnum penna-marina (Poir) Kuhn	Small fern
Blechnum tabulare (Thun) Kuhn	Tall fern
Bolax gummifera (Lam) Spreng	Balsam bog
Carex spp	Sedges
Chiliotrichum diffusum (Forst f) Dusèn	Fachine
Colobanthus spp Bartl	Colobanthus
Empetrum rubrum Vahl ex Wilde	Diddle-dee
Gunnera magellanica Lam	Pig vine
Hebe elliptica (Forst f) Pennell	Native box
Juncus scheuzerioides Gaudich	Small jointed rush
Oreobolus obtusangulus Gaudich	Oreob
Pernettya pumila (L.f) Hook	Mountain berry
Rostkovia magellanica (Lam) Hook	Short brown rush
Rumex acetosella L	Sorrel
Sphagnum spp	Sphagnum moss
Valeriana sedifolia D'Urv	Valerian

SUMMARY OF STATISTICAL ANALYSIS OF VEGETATIVE TYPE AND EWE EQUIVALENTS/ACRE

VEGETATIVE TYPE	REGRESSION COEFFICIENT EWE EQ/ACRE	STANDARD ERROR	(SIGNIFICANCE) t
White Grass	+ 0.2146	0.0273	7.86 ***
White Grass /Oreob	+ 0.1933	0.0242	7.88 ***
"Greens" & White Grass bogs	+ 0.3329	0.0377	8.83 ***
White Grass /Diddle Dee 50/50	+ 0.2245	0.0748	3.00 **
Diddle Dee	+ 0.1840	0.0378	4.86 ***
Upland Associations	- .0.1402	0.0337	4.16 ***
Reseeded Land	+ 0.4452	0.1251	3.56 ***

* = Level of significance   *** = Very high; ** = High

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F REGRESSION MEAN SQUARE / ERROR MEAN SQUARE
Regression	9	113,887,200	12,654,130	28.9 ***
Residual	107	46,892,240	438,250	
Total	116	160,779,440		

R^2 of vegetative types $= \frac{113,887,200}{160,779,440} = 0.708$

ie the regression accounts for 70.8% of the variation in y, or the total area involved in the calculations

APPENDIX 3 - WHITE CLOVER ESTABLISHMENT EXPERIMENTS

INTRODUCTION

The background of the Team's decision to carry out experimental work on the establishment of white clover under camp conditions is given in Chapter 6 "White Clover and Other Legumes" in the main body of the report. It considered that more data were required on minimum dressings of lime and phosphate and that methods of inoculation of clover seed in past experiments were suspect. Recent work has shown that the use of skimmed milk as a carrier for rhizobia has been relatively useless under field conditions. Over 90% of the bacteria were frequently dead when the seed was sown. Young admits in his report that the materials he used were suspect and that pelleted seed he obtained from New Zealand took three months in transit. The route of travel of this seed was through the tropics and the manufacturers only expect the life of the inoculum to be four months under temperate conditions in New Zealand (Young 1968).

Clearly any work carried out by the Team had to be above such suspicion. Consequently the Agronomist contacted Dr Parker of CSIRO in Australia, one of the foremost experts in the world in this field. Dr Parker recommended the following technique which was closely followed:-

"ISOLATION OF RHIZOBIUM. Select healthy, vigorous plants and dig them up carefully. Wash off adhering soil under a slow running tap. The nodules are then removed from the roots with a small snag of root attached so that they can be handled. The nodules are surface sterilised using 200 ppm chlorine then mixed with sterile water to remove the chlorine. The nodules are macerated gently with a pestle in a sterile dish. The resultant liquid is then transferred to a medium made up as follows:-

Mannitol	15.0 g
Dipotassium hydrogen sulphate	0.50 g
Magnesium sulphate crystals	0.20 g
Sodium chloride	0.20 g
Calcium carbonate	2.00 g
Yeastrel	3.00 g
Agar	17.50 g
Water	1000 ml

The medium needs no pH adjustment or filtering and should be sterilised at 5 lb for 10 minutes.

After satisfactory growth of the rhizobium on this medium it is washed off using a small amount of distilled water to obtain a creamy suspension.

The suspension is added to a sticky solution of 30% gum acacia and 10% sucrose (domestic sugar) with a small amount of powdered chalk.

The white clover seed is rolled in the sticky solution at the rate of 10 lb white clover seed to ½ lb solution containing 3 oz gum and 1 oz sugar. When thoroughly wetted sufficient finely divided chalk (calcium carbonate) is added to form pellets around the seed, - about 3 lb will be needed for 10 lb seed."

(NOTE: Where laboratory facilities are not available purchased cultures of Rhizobium bacteria may be made to adhere to clover seed by following the instructions in the two last paragraphs above.)

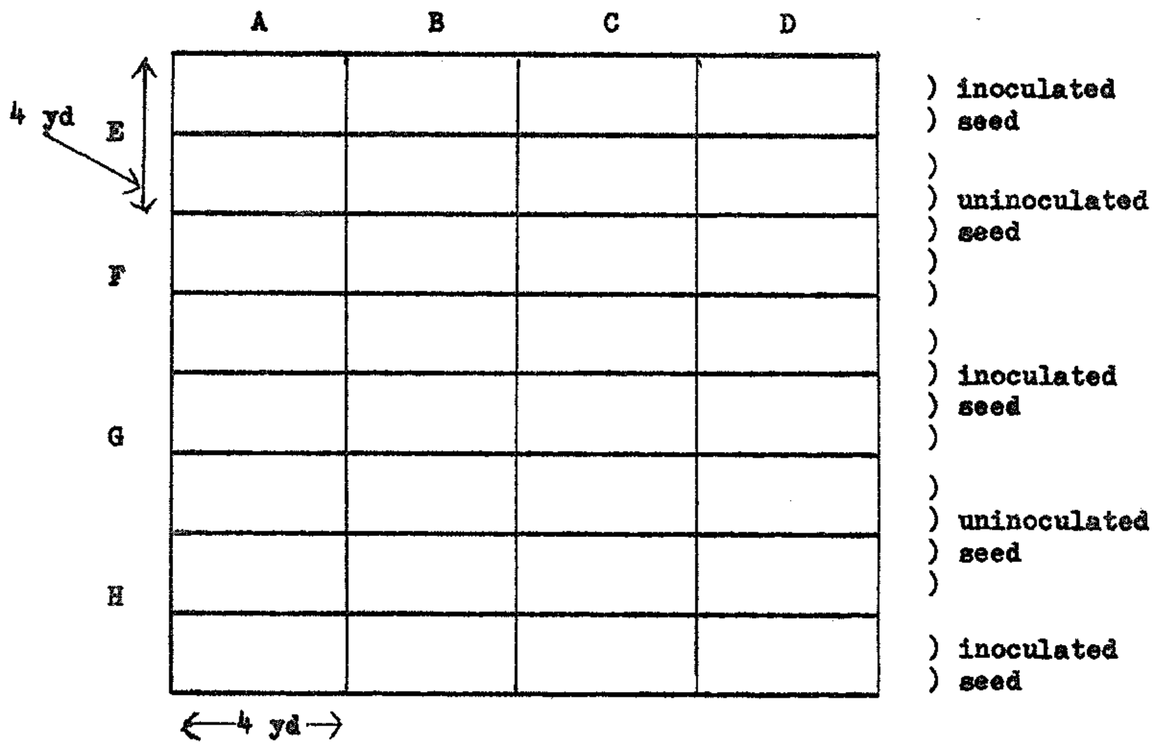
FIELD EXPERIMENTS

Using seed inoculated by Parker's method two experiments were initiated - one on peat under whitegrass at Fitzroy and the other on a sandy peat reseeded to Yorkshire fog out of diddle-dee ground at Roy Cove. The experiments were laid out with the factors of inoculation, lime and phosphate as the primary components using Kent wild white clover at 2 lb/acre as the legume. A simple layout was devised so that assessments of establishment of white clover on the subplots could be made by farm staff about one year after the experiments were laid down.

LAYOUT

A plot of 16 yd square was subdivided into 16 plots 2 yd square with ground limestone at four rates applied in one direction and phosphate (triple supers) applied at right angles, also at 4 rates.

Inoculated and uninoculated seed was then sown on half each of these subplots to give 32 possible combinations of lime, phosphate and inoculation factors.



A - 15 lb ground limestone equivalent to 10 cwt per acre
B - 30 " " " " " 20 " " "
C - 60 " " " " " 40 " " "
D - 0 " " " " " 0 " " "

E - 2 lb Triple-supers equivalent to 50 units P_2O_5 per acre
F - 4 " " " " " 100 " " " "
G - 6 " " " " " 150 " " " "
H - 0 " " " " " 0 " " " "

POT EXPERIMENTS

In addition to the two sites for this experiment, two series of pots were sown in the greenhouse using the same rates of phosphate, limestone, inoculated and uninoculated seed. One series of pots contained soil obtained from under a whitegrass community on Moody Brook and the other series soil from a "green" at Fairy Cove near Port Stanley. Within two months of sowing the establishment of inoculated white clover in both cases was clearly most successful where phosphate had been applied in conjunction with lime, even at the lower level. Soil analysis results quoted in Misc. Report No 72 of the Land Resources Division of the Directorate of Overseas Surveys (King et al 1969) point to a deficiency of phosphate in Falkland Islands soils and the results of this pot experiment are not surprising. The inoculated white clover on the phosphate treated pots was up to 6 in. high and had as many as 20 leaves three months after sowing. In the no phosphate uninoculated pots, clover germinated but developed very little even though growing under ideal climatic conditions.

WHITE CLOVER ESTABLISHMENT EXPERIMENT AT FITZROY

Plots were laid out in the horse paddock due west of the Settlement, according to the plan already described, on the afternoon of 27 November and morning of 28 November 1969. The weather was overcast and cold. A fairly strong wind blew from the East on the afternoon of 27 and from the South East on the morning of 28.

The vegetation of the paddock was dominated by white grass of fairly good type and almost forming "bogs". The other main species present were Oreob, Yorkshire Fog, Sweet Vernal, Sheeps Fescue, Rostkovia, Small Fern and Pig Vine. On most of the paddock there was an accumulation of dead leaves some 7-9 in. high but where the plots were laid out it had been burned off in March 1969 (late summer/ autumn) and was now conspicuously green. A small area within the site chosen for the experiment had missed the fire and this was burned over lightly before the plots were laid down.

The soil was deep peat throughout probably overlying clay. A 5 ft. bamboo cane could be pushed down until it was out of sight in the peat with scarcely any pressure being applied. The top 3-4 in. was a black turfy soil. Below this the peat appeared slimy and uniformly black. A soil sample was taken from the top 0-6 in. for analysis (see table for analysis report).

The site was inspected with Mr J T Clement on 4 April 1970. During the season the paddock, though nominally a horse paddock, had been used as a holding paddock and heavily grazed with sheep. Even green regrowths of whitegrass had been grazed very well and kept down to 2-4 in. No difference was noticeable between the area burned at the time the experiment was laid down in late spring and that burned the previous autumn.

The experimental plots were examined closely even though it was realised that sufficient time had scarcely elapsed since the treatments were applied for differences to be visible. A 1 ft. square quadrat was thrown 50 times at random but no clover plants were found within it. A few were seen outside the quadrat area however, and these showed considerable variation one from the other. A few large and vigorous plants some 3-4 in. in height were found but most were little more than tiny seedlings each with one or two trifoliate leaves. They were so few that it was considered unwise to dig any up to examine them for nodulation.

It was also too early to expect to see a response to the lime and phosphate applied and none was found. There seemed slight evidence of heavier grazing on the fertilized plots. Mr Clement kindly agreed to carry out an assessment of the numbers of clover plants established in March 1971 and to record his observations on degree of nodulations.

ANALYSIS OF WEIGHTS OF WILD WHITE CLOVER PLANTS FROM POT EXPERIMENT

Mean figures in grammes of plant per pot

1. Effect of Lime

	Rate cwt/acre ground limestone			
	10	20	40	0
Wt of plants per pot - means	0.228	0.104	0.188	0.056

2. Effect of Phosphate

	Rate-Units P_2O_5/acre			
	50	100	150	0
Wt of plants per pot - means	0.215	0.183	0.190	0.014

3. Effect of Inoculation

	Inoculated	Uninoculated
Wt of plants per pot - means	0.184	0.117

4. Effect of Inoculation and Liming

	Rate cwt/acre ground limestone			
	10	20	40	0
Inoculated plants	0.337	0.170	0.144	0.083
Uninoculated plants	0.119	0.088	0.235	0.044

5. Effect of Inoculation and Phosphate

	Rate-Units P_2O_5/acre			
	50	100	150	0
Inoculated plants	0.295	0.191	0.118	0.009
Uninoculated plants	0.130	0.211	0.142	0.020

6. Individual Treatment Effects

Inoculated	High Lime	High Phosphate	0.242
"	"	Low Phosphate	0.213
"	Low Lime	High Phosphate	0.530
"	"	Low Phosphate	0.719
"	No Lime	No Phosphate	0.003
"	High Lime	No Phosphate	0.012
"	High Phosphate	No Lime	0.007

Uninoculated

"	High Lime	High Phosphate	0.200
"	"	Low Phosphate	0.043
"	Low Lime	High Phosphate	0.202
"	"	Low Phosphate	0.083
"	No Lime	No Phosphate	0.003
"	High Lime	No Phosphate	0.001
"	No Lime	High Phosphate	0.032

APPENDIX 4 - GRASSLAND PRODUCTIVITY EXPERIMENT

INTRODUCTION

When considering a grass-animal complex it is necessary to understand as far as possible the basic nutritional relationship between them. Data concerning the feeding values and growth patterns of the natural and reseeded grassland of the Falklands are lacking. It was decided to initiate a simple experiment to measure these factors in relation to Cortaderia pilosa (whitegrass), some "greens" and Holcus lanatus (Yorkshire fog).

SITES

Due to the physical difficulties of experimentation in the Falklands, the number of sites was limited to four, two on each of the main islands.

All sites were chosen on the basis of rainfall distribution, one site on a high rainfall and the other on a low rainfall farm on each island. Fox Bay East (low rainfall) and Port Howard (high rainfall) were chosen on the west island and Darwin (low rainfall) and Port San Carlos (high rainfall) on the east island.

TREATMENTS

Cutting It was originally decided that monthly cuts would be made starting in November 1969 and finishing at the end of summer in May 1970. By the end of November it was evident that neither whitegrass nor the other grasses were growing and the first cut was postponed until the December/January period. It became increasingly obvious that a monthly cut was too much to expect from this low output grassland.

A programme of cuts every two months was considered to be the most that could be expected to yield measureable quantities of grass which could be harvested by cutting with hand shears.

Thus the programme was:-

Cut 1 - December/January 1969/70

Cut 2 - March 1970

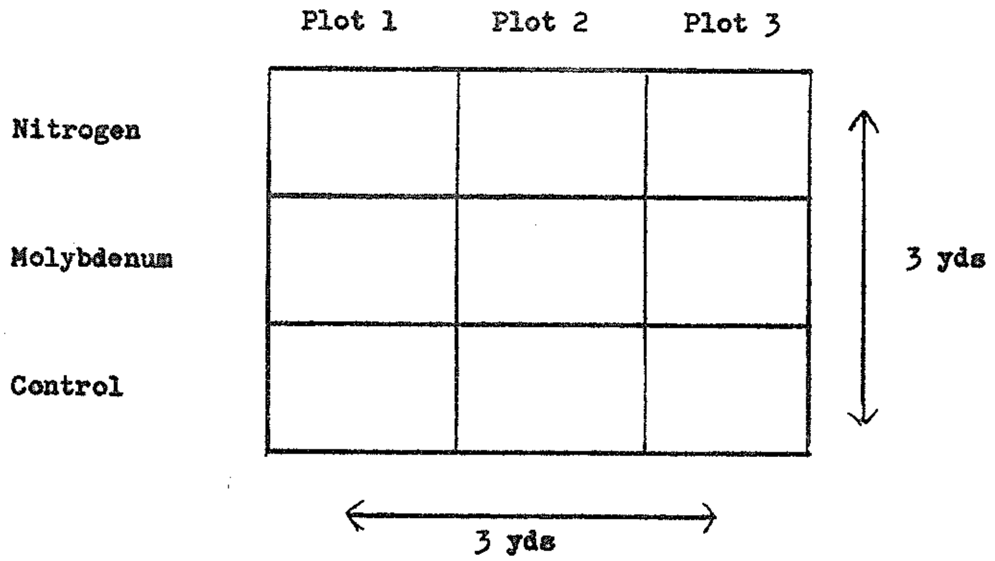
Cut 3 - May 1970

It was also decided that if there was any regrowth in March from plots already cut in December/January a further cut would be taken from these. All plots were cut over in October 1969 to remove as much dead material as possible. New green growth only was recorded. Dead material in samples was picked out and discarded before weighing and despatch for analysis.

Top Dressings Evidence from the United Kingdom and New Zealand shows that small amounts of molybdenum applied to acid soils have yielded measurable increases in grass output (Williams 1956). Admittedly these results were obtained on soils of pH5 and were peaty podsols but the possibility of a response from Falkland Islands soils could not be discounted. Part of each block on each site was cross-treated with a solution of sodium molybdate to apply the equivalent of 8 oz of the salt per acre.

To compare any increased output obtained from the molybdenum with more general means of increasing output the plots were also cross-treated with an ammonium nitrate based fertiliser at the rate of 150 units of nitrogen per acre (1 unit = 1.12 lb nitrogen).

The layout of each block of plots was as follows:-



Each block was enclosed in a sheep and goose proof cage to yield stock free results. At each farm there were three blocks of plots as follows:-

Port Howard	-	2 whitegrass and 1 "green" area
Fox Bay East	-	2 whitegrass and 1 Yorkshire fog reseed
Port San Carlos	-	2 whitegrass and 1 "green" area
Darwin	-	2 whitegrass and 1 Yorkshire fog reseed

Soil samples were taken at each site for analysis. The results are included in the Summary table of all the soils sampled. They have a high lime requirement, low to medium phosphate status and high levels of potash and magnesium.

RESULTS

All the measureable results are fully tabulated.

<u>The effect of rainfall variation</u> The mean output of whitegrass from the two high rainfall sites was 382.38 lb of dry matter per acre per cut and that from the low rainfall sites was 504.53. Thus it appears that rainfall per se had no effect on whitegrass growth on these plots. The peat soils are highly moisture retentive and it may be that factors such as surface drainage patterns are a more important factor in whitegrass growth.

<u>The effect of molybdenum</u> There was no increase in production recorded from using the element. The close agreement between the control and the molybdenum results confirms this. No significant effect on plant composition was observed.

<u>The effect of nitrogen</u> On all sites and on all grassland types there were large responses to nitrogen. This was expected but while the application improved the dry matter and protein output of the "greens" and Yorkshire fog by over 300% it increased production in the whitegrass by only 150%.

<u>Productivity</u> The dry matter output of both whitegrass and "greens" is of a low order. The whitegrass yielded an average over four cuts of less than 400 lb dry matter per acre per cut while the "greens" (admittedly not the best of their type) gave 453 lb. The Yorkshire fog on the other hand yielded over 1,100 lb of dry matter per acre for each cut and its regrowth pattern is encouraging.

Composition It is evident from the analyses that the feeding value of whitegrass is low indeed. The starch equivalent figures vary from -3.80% to +38.0% but is usually about 20% and when this figure is coupled with the high dry matter and high fibre content of the grass at all stages of growth it is quite clear that sheep cannot eat enough whitegrass to produce the necessary energy for them to remain alive.

The composition of the "greens" and the Yorkshire fog however is much better with a starch equivalent of a higher order in the 40% to 50% region. A fuller discussion of the feeding value of the herbage examined is reported in Chapter 10 together with a discussion on its mineral composition.

Acknowledgment The Team is greatly indebted to Mr N Trinder and his staff in the Nutrition Chemistry Department of the National Agricultural Advisory Service, Newcastle-upon-Tyne for carrying out the analysis of the many herbage samples from this experiment.

RESULTS OF GRASSLAND PRODUCTIVITY EXPERIMENT - 1. SUMMARY OF RESULTS BY PASTURE TYPES

CORTADERIA PILOSA (Whitegrass)

lb/Dry Matter/Acre

	Plot 1 (2 Cuts) (January and March)			Plot 2 (1 Cut) (March)			Plot 3 (1 cut) (May)		
Treatment	N	Mo	C	N	Mo	C	N	Mo	C
Sub Total - dry sites	3235.15	2659.50	2368.74	4417.37	2290.85	2609.89	3010.01	1848.24	1777.62
Sub Total - wet sites	2910.84	2830.22	2877.70	2162.81	1737.08	1601.57	1539.68	1268.67	1425.52
Total - all sites	6145.99	5489.72	5246.44	6580.18	4027.93	4211.46	4549.69	3116.91	3203.14
Mean - all sites	768.25	686.22	655.81	822.52	503.49	526.43	568.71	389.61	400.39
Effect of N & Mo Control = 100	117.15	104.64	100	156.24	95.64	100	142.03	97.31	100

	N	Mo	C
Mean of all cuts on all plots	539.87	394.83	395.66
Effect of N & Mo Control = 100	136.45	99.79	100

lb/Protein/Acre

Sub Total - dry sites	358.44	270.46	241.58	434.17	198.02	225.21	239.28	122.72	125.26
Sub Total - wet sites	336.79	301.51	279.12	208.92	156.33	124.30	98.28	81.96	87.61
Total - all sites	695.23	571.97	520.70	643.09	354.35	349.51	337.56	204.68	212.87
Mean - all sites	86.90	71.50	65.09	80.39	44.29	43.69	42.20	25.59	26.61
Effect of N & Mo Control = 100	133.51	109.85	100	184.00	101.37	100	158.59	96.17	100

	N	Mo	C
Mean of all cuts on all plots	52.37	35.35	33.85
Effect of N & Mo Control = 100	151.71	104.43	100

lb/Starch Equivalent/Acre

Sub Total - dry sites	646.05	601.18	468.25	1132.77	491.39	563.49	486.23	268.56	245.90
Sub Total - wet sites	548.63	626.93	595.28	361.54	214.76	267.03	253.98	211.06	234.58
Total - all sites	1194.68	1228.11	1063.53	1494.31	706.15	830.52	740.21	479.62	480.48
Mean - all sites	149.34	153.51	132.94	186.79	88.27	103.82	92.53	59.95	60.06
Effect of N & Mo Control = 100	112.34	115.47	100	179.92	85.02	100	154.06	99.82	100

	N	Mo	C
Mean of all cuts on all plots	107.17	75.43	74.21
Effect of N & Mo Control = 100	144.42	101.64	100

N = Nitrogen - 150 units acre in one application

Mo = 8oz/acre Sodium Molybdate

C = Control

NATURALLY IMPROVED PASTURE

lb/Dry Matter/Acre

	Plot 1 (2 cuts) (January and March '70)			Plot 2 (1 Cut) (March '70)			Plot 3 (1 Cut) (May '70)		
Treatment	N	Mo	C	N	Mo	C	N	Mo	C
Site Mean	1075.15	46.42	112.89	1016.53	697.77	633.66	400.66	185.66	160.05
Effect of N & Mo Control = 100	952.39	41.12	100	160.42	110.12	100	250.33	116.00	100

Treatment	N	Mo	C
Mean of all cuts	1246.14	464.92	453.27
Effect of N & Mo	278.89	102.57	100

lb/Protein/Acre

Site Mean	195.88	6.55	13.65	131.68	81.83	87.33	41.22	12.93	11.62
Effect of N & Mo Control = 100	1435.02	47.99	100	150.78	93.70	100	354.73	111.27	100

Treatment	N	Mo	C
Mean of all cuts	134.39	50.65	56.30
Effect of N & Mo	327.51	89.96	100

lb/Starch Equivalent/Acre

Site Mean	447.83	24.23	53.37	150.10	186.97	188.97	107.74	46.57	35.98
Effect of N & Mo Control = 100	839.10	45.40	100	79.43	98.94	100	299.44	129.43	100

Treatment	N	Mo	C
Mean of all cuts	352.83	128.88	139.16
Effect of N & Mo	253.54	92.61	100

N = Nitrogen - 150 units/acre in one application

Mo = 8oz/Sodium Molybdate/acre

C = Control

HOLCUS LANATUS (YORKSHIRE FOG)

lb/Dry Matter/Acre

	(Plot 1 (2 cuts) (January and March '70)			Plot 2 (1 cut) (March '70)			Plot 3 (1 cut) (May '70)		
Treatment	N	Mo	C	N	Mo	C	N	Mo	C
Site Mean	1782.70	640.74	654.61	1513.65	527.10	1194.51	1444.19	485.49	378.79
Effect of N & Mo Control = 100	272.33	87.88	100	126.72	44.12	100	381.26	128.17	100

Treatment	N	Mo	C
Mean of all cuts	2370.26	826.66	1113.95
Effect of N & Mo	212.76	74.21	100

lb/Protein/Acre

Site Mean	226.75	65.66	63.41	183.68	49.46	61.94	103.27	45.02	35.29
Effect of N & Mo Control = 100	357.60	103.55	100	296.55	79.85	100	292.63	127.57	100

Treatment	N	Mo	C
Mean of all cuts	256.84	80.07	80.32
Effect of N & Mo	319.77	99.69	100

lb/Starch Equivalent/Acre

Site Mean	747.14	227.83	216.38	655.91	201.15	222.95	477.63	136.94	111.00
Effect of N & Mo Control = 100	345.29	105.29	100	294.33	90.26	100	430.30	123.37	100

Treatment	N	Mo	C
Mean of all cuts	940.34	282.96	275.12
Effect of N & Mo	341.79	102.85	100

N = Nitrogen - 150 units/acre in one application

Mo = 8oz/Sodium Molybdate/acre

C = Control

RESULTS OF GRASSLAND PRODUCTIVITY EXPERIMENT - 2. INDIVIDUAL PLOT RESULTS
DARWIN

ENCLOSURE		WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	lb. DRY MATTER PER ACRE	% CRUDE PROTEIN	lb. CRUDE PROTEIN PER ACRE	% [illegible] VALUE	STARCH EQUIVALENT	LB. S.E. PER ACRE	FIBRE %	DM AS % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT %	COPPER %
PARKS																				
CORTADERIA NORTH SITE																				
PLOT 1	(N	56.6	28.8	50.88	307.30	10.9	33.496	33.60	15.70	48.25	38.5	80.22	0.22	0.96	0.09	0.08	0.09	0.10	0.040	9.30
CUT 1 -	(Mo	41.0	19.6	47.80	209.13	10.2	21.330	31.20	13.70	28.65	30.2	54.60	0.19	0.88	0.09	0.08	0.10	0.09	0.060	?
10/1/70	(C	64.2	35.9	55.92	383.05	9.9	37.920	30.20	12.70	48.65	30.2	100	0.18	0.96	0.08	0.08	0.09	0.09	0.065	9.80
PLOT 1	(N	87.8	45.8	52.16	488.69	9.1	44.480	35.80	18.50	90.41	29.9	180.32	0.27	0.90	0.09	0.08	0.04	0.10	0.040	20.00
CUT 2	(Mo	91.4	42.5	46.50	453.48	8.9	40.360	41.70	22.20	100.67	33.6	167.32	0.24	0.88	0.08	0.10	0.07	0.09	0.045	14.50
24/3/70	(C	52.7	25.4	48.20	271.02	9.1	24.660	35.80	18.50	50.14	29.9	100	*	0.82	0.08	0.07	0.05	0.09	0.030	19.00
PLOT 2	(N	250.9	123.2	49.10	1314.54	9.5	124.880	36.10	18.10	237.93	31.1	201.64	0.26	0.86	0.08	0.08	0.04	0.09	0.015	4.30
24/3/70	(Mo	153.1	76.5	49.97	816.26	8.2	66.930	40.50	22.50	183.66	31.0	125.20	0.22	0.85	0.07	0.09	0.06	0.09	0.030	4.00
	(C	115.0	61.1	55.13	651.94	8.8	57.370	38.00	20.50	133.65	30.2	100	0.21	0.78	0.08	0.08	0.05	0.09	0.025	14.30
PLOT 3	(N	176.3	70.0	39.71	746.90	7.7	57.51	35.20	17.00	126.97	31.4	150.86	0.28	0.70	0.13	0.08	0.07	0.08	0.055	3.80
MAY '70	(Mo	81.8	34.2	41.81	304.91	6.8	24.81	32.40	15.10	55.10	31.5	70.07	*	0.54	0.12	0.07	0.07	0.07	0.045	*
	(C	117.7	46.4	39.42	495.09	6.8	33.67	32.80	14.20	70.30	32.0	100	*	0.68	0.14	0.09	0.07	0.07	*	*
PLOT 1	(N	144.4	74.06	51.52 (M)	795.99	10.0	77.980	34.70 (M)	16.10 (M)	138.66	30.35 (M)	121.70								
Cuts 1 & 2	(Mo	132.4	62.1	47.15	662.61	9.55	61.690	36.45	17.95	129.32	31.9	101.31								
Aggregates & Means	(C	116.9	61.3	52.06 (M)	654.07	9.50	62.580	33.00 (M)	15.60 (M)	98.79	30.05 (M)	100								

* Insufficient material for analysis

(M) = Mean

DARWIN

ENCLOSURES		WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	LB DRY MATTER PER ACRE	% CRUDE PROTEIN	LB CRUDE PROTEIN PER ACRE	% "D" Value	STARCH EQUIV-ALENT	LB SE PER ACRE	% FIBRE	DM AS % OF CONTROL	CHLO-RIDE %	POTA-SSIUM %	SODIUM %	MAGNES-IUM %	CAL-CIUM %	PHOS-PHORUS %	COBALT ppm	COPPER ppm
PARKS																				
CORTADERIA SOUTH SITE																				
PLOT 1	(N	92.4	42.4	45.89	452.41	12.4	56.10	33.10	15.30	6[illegible]. 2	30.7	235.56	0.37	1.08	0.12	0.11	0.09	0.09	0.055	10.30
Cut 1	(MO	54.8	25.6	46.72	273.15	11.6	31.69	41.00	23.20	63.[illegible]7	30.7	142.22	0.35	1.08	0.11	0.1[illegible]	0.10	0.09	0.065	*
10/1/70	(C	35.5	18.0	50.70	192.06	10.7	20.55	35.70	18.[illegible]	35.[illegible]2	29.5	100	0.26	0.90	0.11	[illegible].09	0.08	0.10	0.060	*
PLOT 1	(N	161.1	66.9	41.53	713.82	9.9	70.67	40.20	21.50	15[illegible].47	32.2	254.37	0.33	0.82	0.12	0.09	0.04	0.09	0.040	5.00
CUT 2	(MO	106.6	43.2	40.53	460.94	8.8	40.56	43.00	24.30	11[illegible].01	32.2	164.26	0.30	0.83	0.11	0.1[illegible]	0.07	0.08	0.080	21.50
24/3/70	(C	60.4	26.3	43.54	280.62	8.0	22.45	40.10	22.10	62.02	31.0	100	0.25	0.74	0.11	0.09	0.04	0.08	0.050	22.30
PLOT 2	(N	294.2	122.3	41.57	1304.94	8.6	112.22	56.40	37.80	49[illegible].27	32.0	183.08	0.32	0.88	0.16	0.1	0.06	0.07	0.025	4.50
24/3/70	(MO	85.9	38.3	44.59	408.66	8.1	33.10	42.10	23.30	9[illegible].22	32.4	57.33	0.24	0.76	0.11	0.10	0.07	0.11	0.060	21.30
	(C	154.5	66.8	43.24	712.76	7.3	52.03	44.4	23.00	1[illegible].9[illegible]	31.7	100	0.23	0.78	0.10	0.1[illegible]	0.06	0.07	0.090	18.00
PLOT 3	(N	147.9	61.1	41.31	651.94	6.3	41.07	3[illegible].20	19.1[illegible]	12[illegible].52	33.0	315.56	0.36	0.72	0.15	0.09	.05	0.06	*	3.30
May 70	(MO	82.6	31.0	37.53	330.97	4.2	13.90	39.50	20.1[illegible]	6[illegible].52	33.4	158.26	*	0.[illegible]4	0.18	0.09	.06	0.05	*	*
	(C	52.9	19.6	37.05	209.13	3.9	8.12	31.1	12.4[illegible]	2[illegible].9[illegible]	32.2	100	*	*	*	*	*	*	*	*
PLOT 1 CUTS 1 & 2 AGGREGATE & MEANS	(N	253.5	109.3	43.71 (M)	1166.23	11.15 (M)	126.77	36.65 (M)	18.40 (M)	22[illegible].69	31.[illegible] (M)	240.72								
	(MO	161.4	68.8	43.62 (M)	734.09	10.2 (M)	72.25	42 (M)	23.75 (M)	175.38	31.[illegible] (M)	155.30								
	(C	95.9	44.3	47.12 (M)	472.68	9.35 (M)	43.00	37.9 (M)	[illegible]0.35 (M)	9[illegible]74	30.25	100						*		

* Insufficient material for analysis.

(M) Mean

DARWIN

ENCLOSURE		WET WEIGHT QR	DRY WEIGHT QR	% DRY MATTER	LB DRY MATTER PER ACRE	% CRUDE PROTEIN	LB CRUDE PROTEIN PER ACRE	% "D" VALUE	STARCH EQUIVALENT	LB SE/ACRE	FIBRE %	DM AS % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
PARKS Holcus lanatus																				
PLOT 1 CUT 1 10/1/70	N	269.9	90.8	33.64	968.84	12.0	116.26	46.7	29.4	284.84	29.8	125.41	0.68	1.22	0.18	0.14	0.15	0.10	0.060	20.80
	Mo	188.7	66.1	35.03	705.29	10.1	71.23	48.3	29.9	210.88	31.6	91.30	0.68	1.14	0.17	0.11	0.12	0.11	0.075	19.30
	C	208.9	72.4	34.66	772.51	9.3	71.84	48.6	30.5	235.62	31.2	100	0.75	1.16	0.18	0.12	0.13	0.11	0.055	20.30
PLOT 1 CUT 2 10/1/70	(N) (Mo) (C)	-Insufficient material to cut with shears																		
PLOT 2 24/3/70	N	182.1	49.1	26.96	523.90	16.6	86.97	55.7	41.1	215.32	25.2	98.59	0.98	1.76	0.24	0.17	0.21	0.10	0.040	6.00
	Mo	166.7	46.7	28.01	498.29	9.7	48.33	50.2	33.1	164.93	29.4	93.77	1.04	1.39	0.21	0.18	0.07	0.11	0.060	5.00
	C	159.1	49.8	31.30	531.37	9.1	48.35	52.6	36.4	193.42	28.0	100	1.06	1.54	0.22	0.17	0.09	0.11	0.060	5.80
PLOT 3 MAY '70	N	323.2	53.3	16.49	568.71	9.8	55.73	50.5	35.0	199.05	26.7	185.71	0.90	1.44	0.29	0.18	0.20	0.09	0.120	5.30
	Mo	298.2	37.2	12.47	396.92	8.8	34.93	49.2	32.7	129.79	28.5	129.61	0.75	1.06	0.25	0.17	0.26	0.09	0.175	4.50
	C	185.9	28.7	15.44	306.23	8.9	27.25	49.3	32.7	100.14	28.6	100	*	0.90	0.25	0.18	0.26	0.09	0.105	*

* Insufficient material for analysis

JFM

PORT HOWARD

ENCLOSURE		WET WEIGHT %	DRY WEIGHT %	% DRY MATTER	LB DRY MATTER PER ACRE	% CRUDE PROTEIN	LB CRUDE PROTEIN PER ACRE	% "D" VALUE	STARCH EQUIVALENT	LB SE/ACRE	FIBRE	DM % OF CONTROL	CHLO-RIDE %	POTAS-SIUM %	SODIUM %	MAGNE-SIUM %	CAL-CIUM %	PHOS-PHORUS %	COBALT ppm	COPPER ppm
HORSE PADDOCK CORTADERIA																				
Plot 1	N	68.5	30.0	43.80	302.01	11.8	35.64	42.40	24.00	72.48	31.6	77.34	0.30	1.04	0.11	0.16	0.06	0.14	0.060	12.80
Cut 1	Mo	71.5	32.4	45.31	345.71	11.0	38.03	39.50	19.80	84.51	32.9	89.04	0.30	0.96	0.09	0.14	0.07	0.12	0.055	15.00
29 12 69	C	75.0	36.6	48.80	390.52	8.1	31.63	31.50	12.70	49.60	32.4	100	0.24	0.76	0.07	0.13	0.05	0.11	0.120	13.00
Plot 1	N	98.9	37.1	37.1	395.86	7.7	30.48	17.10	-3.50	0	35.5	117.41	0.22	1.02	0.11	0.11	0.07	0.11	0.040	19.00
Cut 2	Mo	82.9	31.3	37.76	333.97	10.0	33.40	17.10	-3.80	0	36.0	99.05	0.35	1.22	0.14	0.13	0.08	0.14	0.030	23.30
11 3 70	C	72.6	31.6	43.53	337.17	8.8	29.67	34.00	13.90	46.90	34.6	100	0.27	1.03	0.11	0.11	0.07	0.12	0.045	*
Plot 2	N	126.7	52.3	41.28	588.04	8.4	46.88	35.90	17.70	98.77	31.3	119.41	0.20	0.98	0.10	0.11	0.07	0.12	0.040	23.80
-	Mo	106.2	42.1	39.64	449.21	9.6	43.12	17.30	-1.70	0	32.8	96.12	0.32	1.25	0.09	0.16	0.08	0.16	0.020	25.80
11 3 70	C	106.4	43.8	41.17	467.35	7.9	36.92	35.40	17.40	81.32	31.1	100	0.21	0.90	0.12	0.10	0.07	0.12	0.025	23.80
Plot 3	N	105.1	42.9	40.82	457.74	6.1	27.92	34.40	15.60	71.41	32.3	75.13	0.32	0.94	0.10	0.08	0.06	0.09	0.075	3.30
	Mo	87.0	37.4	42.99	399.06	5.6	22.35	34.80	15.90	63.45	32.5	65.50	*	0.84	0.12	0.08	0.05	0.08	*	*
May 70	C	131.8	57.1	43.32	609.26	5.8	35.34	33.70	15.20	92.61	31.9	100	0.29	0.08	0.11	0.08	0.06	0.10	0.55	3.00
Plot 1	N	167.4	67.1	40.66 (M)	697.87	9.75 (M)	66.12	29.75 (M)	10.25 (M)	72.48	33.55 (M)	95.90								
Cuts 1 & 2	No	154.4	63.7	41.53 (M)	679.68	10.5 (M)	71.43	28.05 (M)	8.00 (M)	84.51	34.45 (M)	93.40								
Aggregate	C	147.6	68.2	46.17 (M)	727.69	8.45 (M)	61.30	32.75 (M)	13.30 (M)	96.50	33.5 (M)	100								

* Insufficient material for analysis

(M) = Mean

EMT

PORT HOWARD

ENCLOSURES		WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	LB DRY MATTER PER ACRE	% CRUDE PROTEIN	LB CRUDE PROTEIN PER ACRE	% "D" VALUE	STARCH EQUIVALENT	LB SE/ ACRE	FIBRE %	D.M. % of CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
COW PADDOCK																				
CORTADERIA																				
PLOT 1 CUT 1 29/12/69	N	56.90	24.6	43.23	262.48	12.7	33.33	42.7	24.5	64.31	31.3	158.70	0.29	1.04	0.08	0.12	0.05	0.10	0.060	*
	MO	55.50	23.55	42.43	251.28	12.6	31.66	41.7	23.5	59.05	31.3	151.93	0.31	1.12	0.09	0.12	0.03	0.11	0.050	*
	C	36.30	15.50	42.70	165.39	24.8	20.84	44.8	25.0	41.35	34.1	100	0.30	1.04	0.09	0.12	0.04	0.10	*	*
PLOT 1 CUT 2 24/3/70	N	78.60	38.40	48.85	409.73	7.9	32.37	16.8	- 2.5	0	33.2	80.00	0.26	0.98	0.11	0.10	0.04	0.09	0.045	22.80
	MO	153.20	63.80	41.64	680.75	8.6	58.54	37.8	20	56.15	30.7	132.92	0.24	0.96	0.11	0.11	0.08	0.10	0.035	20.30
	C	98.10	48.0	48.93	512.16	8.3	42.51	36.9	18.3	93.73	32.1	100	0.23	0.88	0.09	0.08	0.05	0.09	0.045	28.80
PLOT 2 24/3/70	N	58.50	22.40	38.29	239.01	10.0	23.90	17.8	- 3.8	0	37.2	105.17	0.14	1.06	0.10	0.09	0.08	0.11	0.085	*
	MO	57.20	22.40	39.16	239.01	10.0	23.90	15.6	- 3.7	0	33.3	105.17	0.29	1.22	0.11	0.10	0.07	0.11	0.065	*
	C	59.00	21.30	36.10	227.27	9.5	21.59	19.1	- 0.6	0	33.9	100	0.35	1.20	0.14	0.10	0.07	0.11	0.065	*
PLOT 3 May 70	N	92.80	42.40	45.69	452.41	5.8	26.24	35.30	16.50	74.65	32.3	125.44	0.34	0.77	0.11	0.10	0.04	0.07	0.020	3.30
	MO	74.80	34.10	45.59	363.85	6.0	21.83	36.00	17.80	64.77	31.3	100.83	*	0.72	0.16	0.09	0.03	0.07	0.015	*
	C	72.80	33.80	46.43	360.65	6.0	21.64	35.50	17.20	62.03	51.5	100	*	0.75	0.15	0.09	0.03	0.07	*	*
PLOT 1 CUTS 1 & 2 AGGREGATE	N	135.50	63.00	43.54 (M)	672.21	10.30 (M)	67.70	29.75 (M)	10.87 (M)	64.31	32.25 (M)	99.21								
	MO	208.70	87.35	42.035 (M)	932.03	10.6 (M)	90.20	39.75 (M)	21.75 (M)	195.20	31.0 (M)	137.56								
	C	134.40	63.50	45.815	677.55	10.45	63.35	40.85	21.65	135.08	33.1	100								

* Insufficient material for analysis

(M) = Mean

DRP

PORT HOWARD

ENCLOSURE	WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	LB DRY MATTER PER ACRE	% CRUDE PROTEIN	LB CRUDE PROTEIN PER ACRE	% "D" VALUE	STARCH EQUIVALENT	SE/ACRE	FIBRE %	DM % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
HORSE PADDOCK NATURALLY IMPROVED GREEN mostly (N	146.2	46.5	31.81	496.16	18.30	90.80	65.70	52.50	260.48	22.8	219.86	0.63	1.92	0.09	0.24	0.28	0.12	0.060	18.00
Agrostis. Plot 1 (Mo	26.0	8.7	33.46	92.83	14.10	13.09	66.00	52.20	48. 46	23.9	44.14	0.52	1.68	0.09	0.20	0.23	0.11	*	*
Cut 1 29/12/69 (C	59.6	21.15	35.49	225.67	12.10	27.30	62.70	47.30	106.74	26.7	100	0.54	1.24	0.10	0.20	0.19	0.12	0.085	*
Plot 1 Cut 2	Insufficient material to cut with shears																		
(N	224.4	56.2	25.04	599.65	13.80	82.75	20.20	5.60	33.58	25.1	149.47	0.28	0.63	0.15	0.23	0.28	0.08	0.040	18.50
Plot 2 (Mo	192.2	49.6	25.81	529.23	10.30	54.51	21.30	6.00	31.75	26.3	131.92	0.23	1.22	0.16	0.26	0.33	0.10	0.055	26.80
11/3/70 (C	135.7	37.6	27.71	401.19	10.70	42.93	21.30	2.40	9.63	32.5	100	0.25	1.25	0.16	0.27	0.35	0.10	0.060	*
(N	235.3	60.2	25.58	642.33	8.80	56.53	40.30	25.70	165.08	25.1	220.51	0.44	0.66	0.20	0.21	0.25	0.06	0.105	4.00
Plot 3 (Mo	123.3	33.7	27.33	359.58	6.70	24.09	42.00	25.90	93.13	27.8	123.44	0.44	0.47	0.20	0.20	0.27	0.08	0.095	3.25
May '70 (C	106.7	27.3	25.59	291.29	6.00	17.48	40.30	24.70	71.95	26.8	100	*	0.52	0.19	0.22	0.24	0.06	0.110	*

* Insufficient material for analysis

PORT SAN CARLOS

ENCLOSURE	WET WEIGHT gr.	DRY WEIGHT gr	% DRY MATTER	Lb DRY MATTER PER ACRE	% CRUDE PROTEIN	Lb CRUDE PROTEIN PER ACRE	% "D" Value	STARCH EQUIVALENT	Lb SE/ACRE	% FIBRE	DMAs % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOS-PHORUS %	COB-ALT %	COPPER ppm
RIDGE CORTADERIA																			
Plot 1 Cut 1 6.1.70. N	77.5	35.4	45.68	377.72	14.5	54.77	46.00	28.10	106.14	30.9	146.28	0.25	1.04	0.11	0.08	0.13	0.08	0.060	*
MO	52.4	24.9	47.52	265.68	11.7	31.08	45.80	38.00	100.96	30.7	102.89	0.31	1.08	0.11	0.08	0.13	0.08	0.07	*
C	52.2	24.2	46.36	258.4	12.0	30.99	41.20	23.60	60.94	30.3	100	0.21	1.06	0.11	0.08	0.15	0.08	0.065	*
Plot 1 Cut 2 16.3.70. N	61.0	25.5	41.80	272.09	12.6	34.28	40.50	22.80	62.04	30.6	118.60	0.30	0.85	0.15	0.08	0.05	0.09	NA	25.50
MO	35.1	15.0	42.74	160.05	12.1	19.37	40.60	22.00	35.21	32.1	69.77	0.27	0.87	0.15	0.08	0.06	0.10	NA	26.00
C	50.2	21.5	42.83	229.41	10.5	24.09	41.40	22.70	52.08	32.2	100	0.13	0.86	0.15	0.09	0.05	0.08	NA	20.50
Plot 2 16.3.70. N	124.6	54.6	43.82	582.58	10.0	58.26	38.80	20.10	117.10	32.2	150.00	0.25	0.85	0.16	0.09	0.07	0.07	NA	18.00
MO	75.0	34.4	45.87	367.05	9.1	33.40	39.50	20.80	76.35	32.2	94.51	0.18	0.78	0.17	0.06	0.05	0.08	NA	19.30
C	81.7	36.4	44.55	388.39	9.1	35.34	39.70	20.70	80.40	32.7	100	0.18	0.78	0.15	0.08	0.05	0.07	NA	25.50
Plot 3 May '70 N	29.9	14.3	47.83	152.58	8.6	13.12	34.30	15.40	23.50	32.7	130.00	*	*	*	*	*	*	*	*
MO	29.9	14.1	47.16	150.45	7.4	11.13	31.70	13.50	20.31	31.4	128.18	*	*	*	*	*	*	*	*
C	23.6	11.0	46.60	117.37	6.5	7.63	33.20	14.80	17.37	31.6	100	*	*	*	*	*	*	*	*
Plot 1 Cuts 1 & 2 Aggregate and Means N	138.5	60.9	43.74 (M)	649.81	13.55 (M)	89.05	43.25 (M)	24.45 (M)	168.18	30.75 (M)	133.26								
MO	87.5	39.9	45.13 (M)	425.73	11.9 (M)	50.45	43.20 (M)	30.00 (M)	136.17	32.4 (M)	87.31								
C	102.4	45.7	44.60 (M)	487.62	11.25 (M)	55.08	41.30	23.15 (M)	113.02	31.25 (M)	100								

* Insufficient material for analysis
(M) Mean
NA Not available

PA

PORT SAN CARLOS

ENCLOSURE		WET WEIGHT gr	DRY WEIGHT gr	% DRY	lb Dry Matter Per Acre	% Crude Protein	lb Crude Protein Per Acre	% "D" Value	Starch Equivalent	% SE/ACRE	% FIBRE	DM AS % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
HORSE PADDOCK CORTADERIA																				
Plot 1 Cut 1 6/1/70	N	85.7	38.0	44.34	405.46	14.7	59.60	48.80	31.00	125.69	30.6	76.46	0.35	1.08	0.12	0.09	0.09	0.10	0.060	10.50
	Mo	90.6	39.9	44.04	425.73	12.3	52.36	47.00	29.40	125.16	30.3	80.28	0.34	1.16	0.12	0.10	0.13	0.11	0.060	10.00
	C	116.4	49.7	42.70	530.30	11.2	59.39	46.60	28.50	151.14	31.2	100.00	0.33	1.22	0.12	0.09	0.13	0.12	0.120	*
Plot 1 Cut 2 16/3/70	N	109.3	45.5	41.63	485.49	11.6	56.32	42.50	24.30	117.97	31.4	106.81	0.45	1.20	0.17	0.09	0.03	0.11	NA	17.30
	Mo	83.2	34.4	41.35	367.05	10.1	37.07	42.10	23.40	85.89	32.3	80.75	0.39	1.06	0.17	0.10	0.07	0.12	NA	25.00
	C	102.0	42.6	41.76	454.54	8.8	40.00	40.90	21.90	99.54	32.8	100.00	0.28	1.05	0.13	0.09	0.07	0.13	NA	27.50
Plot 2 16/3/70	N	166.3	73.4	44.14	783.18	10.2	79.88	37.80	18.60	145.67	33.1	151.03	0.30	*	*	*	*	*	*	*
	Mo	145.9	63.9	43.80	681.81	8.2	55.91	38.90	20.30	138.41	32.1	131.48	0.30	0.89	0.16	0.09	0.03	0.09	NA	18.50
	C	108.1	48.6	44.96	518.56	7.8	40.45	39.80	20.30	105.31	33.7	100.00	0.25	0.95	0.15	0.08	0.02	0.10	NA	24.00
Plot 3 May '70	N	100.8	44.7	44.35	476.95	6.5	31.00	37.00	17.70	84.42	32.6	141.01	0.29	0.72	0.18	0.10	0.06	0.07	NA	3.80
	Mo	77.3	33.3	43.08	355.31	7.5	26.65	36.60	17.60	62.53	32.8	105.05	*	0.70	0.20	0.10	0.06	0.08	NA	*
	C	72.3	31.7	43.85	338.24	6.8	23.00	37.50	18.50	62.57	32.9	100.00	*	0.66	0.20	0.11	0.06	0.07	NA	*
Plot 1 Cuts 1 & 2 Aggregate & Means	N	195.0	83.5	43.00 (M)	890.95	13.15 (M)	115.92	45.65 (M)	55.30 (M)	243.66	31.0 (M)	90.47								
	MO	173.8	74.3	42.70 (M)	792.78	11.2 (M)	89.43	44.55 (M)	52.80 (M)	211.05	31.3 (M)	80.50								
	C	218.4	92.3	42.23 (M)	984.84	10.0	99.39	43.75 (M)	50.40 (M)	250.68	31.0 (M)	100.00								

* = Insufficient material for analysis

(M) = Mean

NA = Not available

PD

PORT SAN CARLOS

ENCLOSURE	WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	lb. DRY MATTER PER ACRE	% CRUDE PROTEIN	lb. CRUDE PROTEIN PER ACRE	% 'D' Value	STARCH EQUIVALENT	LB. SE/ACRE	% FIBRE	DM AS % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
CERRO MONTE 'GREEN AREA'																			
PLOT 1 CUT 1 6/1/70 (M	77.9	18.9	24.26	201.66	23.10	46.58	62.50	51.90	104.66	18.4	-	0.92	1.32	0.23	0.31	0.21	0.20	*	*
(Mo, (C	Insufficient Material to cut with shears																		
PLOT 1 CUT 2 17/3/70 (M	662.9	136.22	20.55	1453.47	17.50	254.38	51.20	36.50	530.52	25.4	-	1.52	2.74	0.35	0.36	0.07	0.22	NA	14.30
(Mo, (C	Insufficient Material to cut with shears																		
PLOT 2 17/3/70 (M	562.1	134.34	23.90	1433.41	12.60	180.61	48.90	18.60	266.61	33.1	165.40	1.24	2.04	0.28	0.34	0.03	0.18	0.090	5.80
(Mo	331.4	81.19	24.55	866.30	12.60	109.15	52.90	39.50	342.19	23.1	99.96	1.08	2.28	0.40	0.31	0.07	0.23	0.025	11.80
(C	359.4	81.22	22.6	866.12	15.20	131.73	55.70	42.50	368.31	22.7	100	1.26	2.66	0.33	0.27	0.07	0.24	0.055	11.30
PLOT 3 MAY '70 (M	66.6	14.9	22.37	158.98	16.3	25.91	46.60	31.70	50.40	25.7	-	*	*	*	*	*	*	*	*
(Mo	4.0	1.1	27.50	11.737	15.1	1.77	*	*	-	*	-	*	*	*	*	*	*	*	*
(C	13.8	2.7	19.57	28.809	20.0	5.76	42.40	*	-	*	-	*	*	*	*	*	*	*	*
PLOT 1 CUTS 1 & 2 AGGREGATE & MEANS (M	740.8	155.12	22.405 (M)	1654.13	20.3 (M)	300.96	56.85	44.70	635.18	21.9									
(Mo) (C)	No data																		

* = Insufficient material for analysis

(M) = Mean

NA = Not available

DRP

FOX BAY EAST

ENCLOSURE		WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	lb DRY MATTER PER ACRE	% CRUDE PROTEIN	lb CRUDE PROTEIN PER ACRE	% "D" Value	STARCH EQUIVALENT	lb SE/ACRE	FIBRE %	DM AS % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
RAM PADDOCK CORTADERIA NORTH SITE																				
Plot 1 Cut 1 27/12/69	N	49.2	23.4	47.56	249.68	12.8	31.96	40.30	20.50	51.18	34.20	75.73	0.35	1.04	0.17	0.08	0.05	0.08	0.055	*
	Mo	63.4	31.25	49.29	333.44	11.2	37.35	45.30	26.80	89.36	31.90	101.13	0.32	0.94	0.08	0.11	0.05	0.11	0.060	*
	C	62.1	30.90	49.76	329.70	11.9	39.32	41.00	22.50	74.18	31.80	100.00	0.27	1.08	0.13	0.09	0.06	0.10	0.070	14.50
Plot 1 Cut 2 13/3/70	N	97.3	44.8	46.04	478.02	11.3	57.02	43.00	23.90	114.25	33.00	118.83	0.44	1.04	0.14	0.09	0.06	0.10	NA	26.00
	Mo	78.8	35.00	44.42	373.45	10.4	38.84	41.40	22.90	85.52	31.90	92.84	0.36	0.88	0.14	0.10	0.08	0.11	NA	30.00
	C	84.6	37.70	44.56	402.26	11.7	47.06	41.20	22.20	89.30	32.90	100.00	0.36	1.02	0.12	0.10	0.07	0.11	NA	28.00
Plot 2 13/3/70	N	221.4	103.3	46.66	1102.21	11.0	121.24	41.20	22.80	251.30	31.70	177.80	0.43	0.76	0.14	0.09	0.05	0.09	NA	6.00
	Mo	103.1	51.6	50.05	550.57	9.0	49.55	38.10	18.10	99.65	34.40	88.81	0.36	0.28	0.14	0.12	0.08	0.10	NA	24.50
	C	117.5	58.1	49.45	619.93	9.1	56.41	39.00	20.30	125.85	32.20	100.00	0.35	0.80	0.15	0.10	0.06	0.09	NA	21.30
Plot 3 May 70	N	158.5	66.7	42.08	711.69	8.9	63.34	32.70	13.90	98.92	32.50	161.11	0.49	0.77	0.16	0.08	0.07	0.07	0.015	5.00
	Mo	102.8	45.3	44.07	483.35	7.0	33.83	30.90	11.60	56.07	33.10	109.42	*	0.62	0.14	0.09	0.07	0.07	0.020	
	N	97.7	41.4	42.37	441.74	7.6	33.57	30.20	11.00	48.60	33.20	100.00	*	0.63	0.14	0.08	0.07	0.07	0.020	
Plot 1 Cut 1 & Cut 2 Aggregates and Means	N	146.5	68.2	46.80 (M)	727.70	12.05 (M)	88.98	41.65 (M)	22.20 (M)	165.44	33.60 (M)	99.42								
	Mo	142.2	66.25	46.86 (M)	706.89	10.8 (M)	76.19	43.35 (M)	24.85 (M)	174.88	31.90 (M)	96.57								
	C	146.7	68.6	47.16 (M)	731.96	11.8 (M)	86.38	41.10 (M)	22.35 (M)	163.48	32.35 (M)	100.00								

* Insufficient material for analysis

(M) Mean

NA Not available

JAM

FOX BAY EAST

Enclosure		Wet Weight gr	Dry Weight gr	% Dry Matter	lb Dry Matter Per Acre	% Crude Protein	Crude Protein lb/acre	% "D" Value	Starch Equiva-lent	lb SE/acre	Fibre %	D.M. as % of Control	Chlo-ride %	Potass-ium %	Sodium %	Magn-esium %	Calc-ium %	Phos-phor-us %	Cob-alt ppm	Copper ppm
Ram Paddock Cortaderia South Site																				
Plot 1 Cut 1 27.12.69	(N	43.90	20.9	47.61	223.00	12.4	27.65	38.30	20.10	44.82	31.40	99.52	0.34	0.88	0.13	0.11	0.05	0.09	0.055	*
	(Mo	52.00	26.3	50.58	280.62	11.4	31.99	37.30	19.10	53.60	31.40	125.24	0.32	0.72	0.09	0.13	0.24	0.10	0.105	14.50
	(C	41.95	21.0	50.06	234.07	9.0	20.17	38.40	20.10	45.04	31.30	100.00	0.29	0.92	0.10	0.13	0.05	0.11	0.080	*
Plot 1 Cut 2 13.3.70	(N	64.20	30.2	47.04	322.23	11.5	37.06	41.00	23.10	74.44	30.80	112.68	0.51	0.98	0.20	0.09	0.05	0.08	N A	34.50
	(Mo	55.60	25.8	46.40	275.29	10.3	28.34	42.20	24.70	68.00	31.0	96.27	0.37	0.96	0.14	0.10	0.06	0.10	N A	30.80
	(C	57.70	26.8	46.45	285.96	10.3	29.45	39.90	22.10	63.20	30.70	100.00	0.46	0.95	0.18	0.09	0.06	0.10	N A	36.00
Plot 2 13.3.70	(N	128.90	65.2	50.58	695.68	10.9	75.83	39.50	21.60	150.27	30.90	111.26	0.45	0.88	0.20	0.10	0.05	0.07	N A	25.30
	(Mo	99.80	48.3	48.4	515.36	9.4	48.44	40.10	21.90	112.86	31.30	82.42	0.37	0.88	0.16	0.10	0.04	0.09	N A	27.50
	(C	114.70	58.6	41.09	625.26	9.5	59.40	40.60	22.40	140.06	31.40	100.00	0.40	0.93	0.17	0.10	0.06	0.09	N A	27.30
Plot 3 May '70	(N	194.30	84.3	43.39	899.48	8.6	77.36	33.80	15.10	135.82	32.10	142.40	*	0.66	0.17	0.10	0.08	0.07	0.025	4.80
	(Mo	143.20	62.7	43.78	669.01	7.5	50.18	31.90	13.00	90.87	32.70	105.91	0.34	0.63	0.16	0.10	0.09	0.08	0.050	3.50
	(C	131.40	59.2	45.05	631.66	7.9	49.90	33.40	16.00	101.07	33.5	100.00	0.37	0.62	0.17	0.10	0.08	0.07	0.035	3.80
Plot 1	(N	108.10	51.10	47.33 (M)	545.23	11.95 (M)	64.71	39.65 (M)	21.60 (M)	119.26	31.1 (M)	106.90								
Cuts 1 & 2	(Mo	107.60	52.10	48.49 (M)	555.91	10.85 (M)	60.33	40.00 (M)	21.90 (M)	121.60	31.2 (M)	109.00								
Aggregates & Means	(C	99.65	47.8	48.26 (M)	510.03	9.65 (M)	49.62	39.15 (M)	21.10 (M)	108.24	31.0 (M)	100.00								

*** Insufficient material for analysis**
N A = Not available
(M) = Mean

KT

FOX BAY EAST

ENCLOSURE	WET WEIGHT gr	DRY WEIGHT gr	% DRY MATTER	lb. DRY MATTER PER AC.	% CRUDE PROTEIN	lb. CRUDE PROTEIN ACRE	% "D" VALUE	STARCH EQUIV.	lb SE/ACRE	FIBRE %	D.M. AS % OF CONTROL	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	CALCIUM %	PHOSPHORUS %	COBALT ppm	COPPER ppm
SETTLEMENT RINCON																			
(Holcus lanatus)																			
Plot1.	(M 415.45	101.85	24.52	1086.74	17.0	184.75	63.60	47,80	519.46	27.20	588.73	1.22	2.08	0.39	0.16	0.22	0.17	0.070	19.00
Cut 1.	(Mo 97.71	29.2	29.88	311.56	10.2	31.78	58.00	41.70	129.92	28.10	168.78	0.85	1.70	0.32	0.13	0.18	0.17	0.205	*
27/12/69	(C 108.5	17.3	15.94	184.59	10.9	20.12	55.50	38.70	171.44	29.00	100.00	0.88	1.48	0.37	0.12	0.16	0.14	0.105	*
Plot 1	(M 447.8	141.5	31.6	1509.81	10.1	152.49	61.60	45.70	689.98	27.40	428.79	1.64	1.66	0.58	0.25	0.41	0.18	N A	6.00
Cut 2.	(Mo 75.6	24.8	32.8	264.62	10.7	28.31	58.50	43.40	114.85	26.00	75.15	1.43	1.46	0.68	0.27	0.31	0.13	N A	11.70
3/70	(C 107.2	33.0	30.78	352.11	9.9	34.86	52.70	35.70	125.70	25.80	100.00	1.60	1.52	0.76	0.26	0.31	0.16	N A	18.30
Plot 2.	(M 735.50	234.62	31.90	2503.40	11.2	280.38	58.90	43.80	1096.49	26.00	311.58	2.00	1.75	0.76	0.28	0.25	0.12	N A	5.00
3/70	(Mo 148.80	52.1	35.01	555.91	9.1	50.59	58.50	42.70	237.37	27.30	69.19	1.56	1.47	0.61	0.25	0.26	0.13	N A	5.00
	(C 238.3	75.3	31.60	803.45	9.4	75.52	47.20	31.40	252.28	27.30	100.00	0.79	1.55	0.72	0.08	0.25	0.14	N A	5.00
Plot 3.	(M 1063.7	217.4	20.44	2319.66	6.5	150.78	47.90	32.60	756.21	26.4	513.95	1.59	1.48	0.63	0.28	0.21	0.13	0.090	6.00
	(Mo 280.3	53.8	21.49	574.05	9.6	55.11	40.50	25.10	144.09	26.5	127.19	0.93	0.92	0.36	0.21	0.24	0.13	0.132	5.80
	(C 229.7	42.3	18.42	451.34	9.6	43.33	41.90	27.00	121.86	25.7	100.00	0.92	1.04	0.38	0.21	0.25	0.14	0.130	6.00
Plot 1 Cuts 1&2 Aggregate & Means	(M 863.25	243.35	28.06 (M)	2596.55	13.5 (M)	337.24	62.60 (M)	46.75 (M)	1209.44	27.30	483.80								
	(Mo 173.31	54.0	31.34 (M)	576.18	10.45 (M)	60.09	58.25 (M)	42.55 (M)	244.77	27.05	107.36								
	(C 215.7	50.3	23.36 (M)	536.70	10.4 (M)	54.98	54.10	37.20 (M)	197.14	27.40	100.00								

* Insufficient material for analysis

(M) = Mean

N A = Not available

APPENDIX 5 - EXPERIMENTAL WORK WITH FLAIL MOWER

I. INTRODUCTION

One of the items of equipment taken out by the Team to the Falkland Islands was a flail mower. There were two reasons for the decision to import this machine. First, one member of the Team had experience of improving rough grazings in hill country in the United Kingdom with a technique based on a machine using the same cutting principle. Second, previous reports had stressed the dangers inherent in the burning of camps and the Team wished to investigate flail mowing as an alternative to burning.

A flail mower is a type of rotary cutter. A series of metal cutting blades are attached by flexible connections, often chains, to a shaft and are driven so as to revolve rapidly in a vertical plane. The blades do not have to be sharp as the action of the machine is not so much to cut as to smash off the herbage. It follows that the trash left behind the machine is torn and mangled so that it dries rapidly and is quickly reduced in bulk. It therefore differs significantly from other rotary cutters where the blades revolve in a horizontal plane. These cut off the accumulation of coarse herbage at just above ground level and sweep it to one side in its complete state where it takes a long time to break down.

The machine actually imported was a "Turbomower" manufactured by Messrs Turner Engineering Co (Coughton) Ltd, Coughton, Alcester, Warwickshire. It was designed to cut and pulverize grass and scrub growth up to 1¼ in. diameter. It had a width of cut of 5 ft. 4 in. and was capable of cutting speeds of up to 6 mph depending on conditions. We were not able to check this speed under Falkland Island conditions but found that it was possible to cut up to one acre per hour. The Turbomower can be easily and quickly fitted to the three point linkage of most tractors. The manufacturers claim that it has a relatively low power requirement. Most of the tractors available on the islands were of the Fordson Super Major and Fordson 5,000 types and these proved to be more than adequate for the machine. The Turbomower is not an expensive implement. The basic price in the United Kingdom at the time of purchase in July 1969 was £285.

II. EXPERIMENTS

1. Simple "look-see" experiments on different herbage types

It was considered that the first task should be to see quite simply how the machine, which had been developed for United Kingdom conditions, would cope with the main herbage types found in the Falkland Islands. These are whitegrass and diddle-dee camps.

Whitegrass Camp

The first operations were carried out on Moody Valley Farm near Port Stanley on 31 October 1969. The Team's driver quickly mastered the working of the machine and the main area treated was a rectangular block of approximately one acre of soft whitegrass camp on the north slope of Wireless Ridge. A strip about 8 ft. wide was left unmown through the middle of the plot. The whitegrass was not of the bog-formed type but was some 8 in. high with Oreob as the codominant species. The Turbomower made very easy work of cutting the entire herbage down to ground level. At the east end of the plot was a small area of diddle-dee some 10 in. to 14 in. high which formed an almost complete ground cover. The machine reduced this to little more than dust.

The trash was well lacerated and it was hoped that this would quickly dry out and be blown away by the wind. It certainly did dry out quickly but it lay so close to the ground that it never blew away.

Four weeks after treatment it was noted that the plot was showing up markedly from the surrounding camp by its yellowish green colour and after seven weeks the plot was quite green. Nevertheless regrowth was disappointing.

Another disappointing feature of this first experiment was that stock did not seem attracted on to the mown area to graze the green regrowths. This was considered to be an essential part of improvement through mowing. A concentration of stock would not only cause the regrowths to remain green as a result of grazing but their dung and urine would improve soil fertility. Actually the camp at Wireless Ridge was not being heavily stocked at the time of the experiment.

It was decided on the grounds of this experiment that any future turbomower plots must be sited in positions where they would have a reasonable chance of being heavily grazed. Later sites were therefore placed alongside 'greens', green valleys, or bog-formed whitegrass, in the hope that these areas would be extended, or near reseeded areas.

At Chartres on West Falkland two areas were treated with the Turbomower in late November. The first was adjacent to a green valley with a view to extending it. Here the first difficulty was experienced with the machine. The valley merged into pure whitegrass through an area where there were fairly strong bogs. When the Turbomower was set very low it was found that these whitegrass bogs were too strong for the machine to go through. It was found necessary to raise the cutting level so that the accumulation of dead herbage on the tops of the bogs was removed without attempting to cut into hard, dense hummock in the centre. Cutting height is quite quickly and easily changed on the Turbomower by adjusting the top linkage of the three point attachment to the tractor or by raising or lowering the roller at the rear of the machine. When this plot was seen again at Christmas time some four to five weeks after treatment it stood out quite clearly from the untreated whitegrass but there was little evidence of increased grazing pressure. However it was a little early to expect to see much result and the plot should be interesting to observe over the next year or so.

The object of the second experiment was different. Mr W Luxton the manager thought that no treatment of whitegrass as such would ever make it palatable and nutritious to sheep. He therefore considered that a better approach would be to try to kill the whitegrass out completely and hope that it would be replaced by better grasses. This had been achieved at Chartres on one occasion in the past when a quantity of spoilt hay had been dumped on an area of whitegrass. As the hay rotted away the original herbage was killed and completely replaced by meadow grasses and bent. On hearing that the trash after flail mowing did not blow away Mr Luxton wondered whether it might not produce the same effect as the dumped hay. Consequently an area of dense, tall whitegrass was mown experimentally and the thick swath of trash allowed to lie. Again when seen at Christmas the plot stood out clearly due to green regrowths but it was too early to assess whether the rotting down of the thick trash would kill out the whitegrass and allow other grasses to replace it. Observations over the next few years will again be interesting.

One further look-see experiment on whitegrass was established at Fox Bay East where a plot was chosen adjacent to an improved whitegrass area along a fence line where sheep congregate. Here again the futility of attempting to cut into the hearts of whitegrass bogs was demonstrated. It would be emphasized that the Team does not favour destruction of whitegrass bogs. Reference to the Section on recommendations for improving whitegrass camp (Chapter 9.11) will show that we consider bog formation to be virtually the ultimate in whitegrass improvement. On this site it was merely that in order to obtain a uniformly shaped plot part of the bog area had to be mown. It did not prove possible to inspect this area later but obviously it will repay observation over the next few years.

Diddle-dee Camp

The first work at Moody Valley had suggested that diddle-dee was readily destroyed by flail mowing. However, that was not very robust diddle-dee so it was decided to carry out the next experiment on a really tall dense stand. The Boundary Camp at Roy Cove was chosen as it contained some of the tallest, strongest diddle-dee seen anywhere on the Islands. In many places it was 2 ft. to 2 ft. 6 in. tall with strong woody trunks some ¾ in. to 1 in. in diameter. The site had the added advantage that Mr Simon Miller the manager had already experimented in other areas of the camp with a horizontal rotary mower and various extremely heavy and stoutly constructed home made crushing harrows. The diddle-dee was completely dominant in the area chosen though pig vine, Christmas bush and dwarf fern were also present. There were occasional bogs of tall fern. An area of approximately one acre was mown on 19 November 1969. In spite of its extremely tall robust growth the diddle-dee did not offer any resistance to the Turbomower. The woody branches were chopped into short lengths of 4 in. to 5 in. and the remainder of the plants reduced to almost dust. The bogs of tall fern were able to stop the machine though in practice these bogs would be left for shelter.

The plots were inspected again on 28 December and 20 March. The kill of diddle-dee was excellent. No regrowth was seen anywhere except around the fringes of some of the lower bogs which had missed the blades. The plot looked quite green from a distance but this was due to the pig vine and Christmas bush now growing vigorously in the absence of competition from the diddle-dee. Bogs of tall fern were also recovering and sending up two or three sickly fronds. Hardly any grasses were present though there were a few whitegrass bogs at the north end of the plot.

The trash was well packed down on the surface of the soil but was not showing evidence of rotting. Although dry on the surface the lower layers of trash next to the soil were quite damp. This suggests two possibilities which could be investigated further. First, the surface trash might burn off without the fire getting into the soil. Second, if seeds were broadcast before flail mowing they might germinate in this moist layer. It is possible though that the trash would be too thick to allow them to establish fully.

It seems likely however that the greatest value of flail mowing in diddle-dee of this height and density is to kill and chop as a preliminary treatment to ploughing or rotavating and reseeding. It might be argued that burning would achieve the same purpose. A fire would however be extremely difficult to control in diddle-dee of this type and it could easily spread to the soil. Further it is desirable to leave belts of diddle-dee for shelter and this is not possible with burning.

When the quality of the work of the flail mower in removing diddle-dee is compared with the other methods tried by Mr Miller it is undoubtedly superior. As already indicated the whole plant is reduced to fine trash with the woody branches chopped into short lengths. All the other methods chop or break off the main branches at the base leaving the whole branch 2 ft. to 3 ft. in length intact with side branches and leaves. These would be extremely difficult to bury with a plough and would impede rotavation.

A small amount of work on the effect of the flail mower on diddle-dee was also carried out at Chartres. A single width of the Turbomower was cut along a diddle-dee ridge. The plant community was entirely different from that at Roy Cove. The diddle-dee was in the form of low broad bogs completely separated one from the other.

The herbage in between consisted of a short dense sward dominated by smooth stalked meadow grass. The machine was set to cut very low and once again it reduced the diddle-dee to fine fragments. When inspected one month later there was no sign of recovery of the diddle-dee but the smooth stalked meadow grass due to its ability to spread by underground rhizomes had already begun to colonize the ground previously occupied by the diddle-dee bogs. Further observation will of course be necessary but it seems likely that the spread of the grass will continue until the whole area is converted into a short dense sward. Many areas of the better hard camp of the Falkland Islands has diddle-dee of this low bog type separated by narrow grassy tracts. In many cases the smooth stalked meadow grass has already invaded the bogs and its leaves can be seen rising above them. If the diddle-dee were removed mechanically the grass should take over and dominate the whole area.

2. Flail Mowing compared with Burning of Whitegrass

A comparison between flail mowing and burning was, in the end, carried out at one site only. This was on the south slope of Wireless Ridge at Moody Valley. Around the periphery of a square plot of untouched soft camp dominantly whitegrass and oreob several Turbomower widths were cut. The idea was that the central area would be burned off later and the fire would be confined to the square by the cut area surrounding it. In the event the trash in the mown part also become alight at one point so that the fire "jumped" across and quickly spread down wind. It went quite a distance before it reached a landrover track and could be beaten out. This accident emphasized the difficulty of controlling camp fires. It did not, however, spoil the experiment as adjacent flail mown and burned areas were still available for comparison.

Immediate recovery was quicker on the mown that the burned area. This was because the burn had gone in deeper than the mower. Several months later however the burned area had recovered equally well and was greener in appearance. The real assessment must be over a long term and much will depend on whether the temperature of the fire has killed out the finer grasses in the burnt plot. In the mown plot the temporary removal of competition from the dead accumulation of herbage on the whitegrass may have had a beneficial effect on the finer grasses. Only observation over a long period will give the answer.

3. Flail Mowing in conjunction with fertilizing and oversowing

Even at its best whitegrass is a coarse, fibrous unpalatable species. It is usually associated with a few better grasses such as wavy hair grass and sheep fescue. Where a high proportion of these are present flail mowing on its own may encourage them and discourage the whitegrass to produce a worthwhile improvement in the sward. In many cases however a very low proportion of these better grasses is present so that seed of better species must be introduced if a significant improvement is to be achieved.

In a series of experiments conducted in the United Kingdom (Chippindale & Davies 1962) it had been shown that when seeds were oversown in conjunction with flail moving the trash formed a mulch over the seeds creating a microclimate favourable to germination and establishment. An experiment was designed to test his technique under Falkland Islands conditions.

LAYOUT

PLOT A Flail mowing only
PLOT B Flail mowing Plus fertilizers
PLOT C Flail mowing Plus fertilizers Plus seeds
PLOT D Flail mowing Plus seeds

The experiment was laid down at two sites.

Hill Cove, Sound Ridge Camp

Moody Valley, East end of Wireless Ridge near Fairy Cove

TREATMENTS

<u>Flail Mowing</u>

The whole plot area was mown at Hill Cove on 18 November 1969 and at Fairy Cove on 3 November 1969.

<u>Seeds</u>

The following seeds mixture was sown at both sites at Hill Cove on 18 November 1969 and at Fairy Cove on 21 December 1969.

10lb Yorkshire Fog

10lb S170 Tall Fescue

4lb Sheeps Fescue

2lb Agrostis tenuis

26lb per acre

The seeds mixture was based on species which had established best in a trial laid down at Hill Cove by Young.

At Hill Cove the work was carried out in one day, the seeds being broadcast before the entire plot was flail mown. This practice is to be recommended. At Fairy Cove it was not possible to sow the seeds until some seven weeks after the plot was mown.

Fertilizers

At Hill Cove on 18 November 1969:

2 cwt Nitram (equivalent to 68 units N per acre).

3 cwt Triplesuperphosphate (equivalent to 140 units P per acre).

1 cwt Muriate of Potash (equivalent to 60 units K per acre).

At Fairy Cove over a period during the first ten days December 1969:

2 tons Ground Limestone per acre.

3 cwt Nitram (equivalent to 102 units N per acre).

9 cwt Basic slag (equivalent to 108 units P per acre).

1 cwt Muriate of Potash (equivalent to 60 units K per acre).

(Note - More than adequate quantities of seeds and fertilizers were used as the intention was to test the technique and not to find the most economical quantities of materials.)

Soils

At both sites the soil was peat. There was a 4 in. to 5 in. layer of dark turfy material on the surface with deep brown peat below.

Herbage

The original herbage at both sites was similar and typical of soft camp. Thin somewhat straggly whitegrass and oreob were the dominant species with a small proportion of wavy hair grass, fine-leaved fescues and Agrostis spp.

Weather Conditions

All the operations at Hill Cove were carried out on a cool day with wintry squalls alternating with sunny periods. A strong wind was blowing from the south west. The Fairy Cove operations were carried over an extended period of variable weather conditions. When the seed was sown 21 December 1969 it rained lightly on-and-off with a moderate wind blowing from the west.

Siting of the Plots

In order to encourage grazing stock on to the plots they were sited at Hill Cove between two reseeded areas and at Fairy Cove adjacent to a heavily stocked 'green'.

RESULTS

HILL COVE

The plots were inspected on 27 December 1969 and 20 March 1970. The whole camp was rested from grazing from 20 November for a period of about six weeks.

Effect of Flail Mowing

Mowing gave the native grasses present a chance to thrive. On 27 December wavy hair grass, fescues and Agrostis species were much more noticeable than on the untreated area outside the plots. This trend was also recorded at the later inspection.

Effect of Fertilizers

Little effect was visible on 27 December but by 20 March the fertilized area was noticeably greener than the non-fertilized strips. More important however, the swards in this area were much denser and more heavily grazed. Individual plants of whitegrass where not grazed had long broad leaves. The overall effect however was of whitegrass being kept well grazed down with intervening areas filled in by finer grasses, especially red fescue, to make a much denser sward.

Effect of Oversowing

As early as 27 December it was recorded that quite a number of seeds were germinating especially tall fescue and Yorkshire fog. Most of the seedlings were found in depressions where trash had collected between small bogs of whitegrass in the north west corner of the plot. By 20 March it was obvious that a very good establishment of grasses had been achieved especially on the fertilized section of the oversown plot. A 1 ft. square quadrat was thrown ten times at random in the oversown only plot and in the oversowing plus fertilizer plot and the seedlings counted. The results are given in the following table.

AVERAGE NUMBER OF SEEDLINGS PER SQ FOOT	
No fertilizer	Fertilizer
5.6 Yorkshire fog 0.1 Tall fescue 0.2 Agrostis	14.3 Yorkshire fog 1.3 Tall fescue

Thus there were more than twice the number of seedlings on average on the fertilized plot. Even more striking was the stage of development of the seedlings. On the no fertilizer plot they were little more than tiny seedlings with two or three short leaves. On the fertilized plot they had developed into well established plants, tall, broad-leaved and many tillered.

Overall Effect

At the time of the final inspection the flail mowing with fertilizing but no oversowing had produced a very good effect in encouraging native species to form a dense sward. It was better than the flail mowing plus oversowing plot but since there was a good take of seedlings in the latter the ultimate effect may be better. The small size of the seedlings where no fertilizers were used was disappointing. The expenditure of 20/- to 30/- per acre for seeds in conjunction with flail mowing may well be justified but an additional £4 to £5 per acre for fertilizers would probably be too expensive except for carefully selected areas

FAIRY COVE

These plots were seen frequently due to their being situated conveniently to Stanley. Unfortunately since the fertilizer and oversowing treatments were applied later than at Hill Cove their effects were later in becoming apparent so that there is less to report.

One encouraging feature was that the siting of the plots adjacent to a 'green' did encourage stock to graze them. First cattle and later sheep were attracted to the area. The whole area therefore benefitted from heavier grazing and deposits of dung and urine. The sward showed signs of becoming more dense especially on the fertilized area which showed up greener than the other plots.

The oversowing suffered on this site from being carried out some time after the flail mowing. The result was that instead of the seeds being deposited below the trash many tended to lie above it. This provided a less suitable microclimate for germination. Nevertheless by the time the Team left the Islands in April a great number of seeds had germinated particularly Yorkshire fog. If these develop into mature plants as they probably will the improvement to this area could be most impressive.

III. CONCLUSIONS

It is doubtful if the use of the flail mower can be justified in the open camp. Although it can work at the rate of one acre per hour it would take a long time to make much impression on the vast camps of the Falkland Islands. Burning is quicker and cheaper. Mowing may leave more native species than burning but further observation will be necessary to confirm this.

Its place appears to be rather in selected areas such as those adjacent to greens, green valleys and reseeds where stock will be encouraged to consolidate the improvement by grazing and improving the fertility.

Flailing can be very effective when combined with oversowing in areas where few good grass species occur naturally. Oversowing should precede mowing.

The flail mower is an excellent tool for smashing up heavy diddle-dee as preparatory treatment to ploughing and reseeding.

Flail mowing on its own is likely to be a most effective method of improving hard camp where low bogs of diddle-dee are separated by a short dense grass sward dominated by smooth stalked meadow grass. Oversowing before flailing may in this situation accelerate the colonization of the killed bogs.

POSTSCRIPT

Reports on the Hill Cove and Fairy Cove experiments written in Mid-October 1970 both say that the grass seeds have established well, especially on the fertilized areas, and are being grazed.

APPENDIX 6 - ANIMAL EXPERIMENTS

Two feeding experiments were initiated to determine the benefits that would follow a marked improvement in the diet of Falkland Islands sheep. It was hoped that these benefits would be a greater milk flow, better growth in their lambs and better wool growth in spring. Concentrates were chosen despite their cost because their use would be independent of the weather and their composition would be constant. It was known that the sheep ought to have been trained to eat concentrates during the previous summer. Nevertheless it was thought essential to try.

The first experiment (Douglas station) was designed to determine the effects when a complete diet of cereal, protein, minerals and vitamins was offered. The second (Fox Bay East) was an attempt to keep down the cost of the feed assuming it might be economic. maize only was compared with a maize/soya bean mixture. In addition proprietary blocks containing distillers solubles and urea were offered, because these would cut down the cost of distributing the feed.

In the event, the strangeness of the feed was the major problem. All the feeds except the proprietary blocks were readily eaten by some ewes. Others would not eat the concentrates. With allowances big enough to encourage shy feeders, those which relished the feed were able to eat more than was good for them and developed acidosis with varying severity. As a result they achieved no better performance than the non-feeders. The experiments, however, do provide very useful information about the performance of sheep in the Islands in the five months from October to March.

To facilitate the separation of experimental groups fencing materials for about 1¼ miles were donated by the Ministry of Overseas Development to the farms concerned.

ANIMAL EXPERIMENT I

Centre Douglas Station, East Falkland (Douglas Station Limited)

Object To observe the response to supplementary feeding of concentrates during and after lambing of

i. ewes - in terms of lamb production, body weight change, body condition score and wool growth

ii. wethers - in terms of body weight change, body condition score and wool growth.

Introduction The lack of good quality pasture in early spring is obvious to all in the Falklands. The growing of better grass for that period is desirable and it was thought important to try to assess the likely response of nursing and of dry sheep to improved nutrition. Concentrate feeding was chosen as a means of achieving this. The decision was made in the full knowledge that it would not be easy to teach the sheep to eat without running the risk of acidosis. Sufficient had to be offered daily to give all the opportunity of eating, yet if too much was put out greedy feeders would be at risk. It would have been more satisfactory to have had the sheep trained to eat concentrates in the preceding autumn. This was obviously impossible.

Materials The ewes consisted of two groups of 30 Romney stud ewes aged 3-8 years, allocated on the basis of live weight on 1 October 1969. Similarly, two groups of 30 flock wethers aged 3 years were obtained.

The pasture which the ewes grazed was reseeded (Yorkshire fog) ground with a lie-back area of diddle-dee and whitegrass. The wethers were put on to a poorer pasture of mainly whitegrass with areas of diddle-dee and short rush.

It was intended to use a vegetable protein in the concentrate mixture but this was not available for the earlier part of the feeding period. The mixtures employed and their proximate analyses are shown below

Concentrate Mixtures Used (%)

	19 October 1969 to 3 November 1969	4 November 1969 to 3 December 1969
Crushed Maize	95.0	73.0
Urea	2.4	
Extr. Linseed Cake	-	24.3
Mineral Mixture[1]	2.4	2.5
Vitamin A and D Mixture[2]	0.2	0.2
	100.0%	100.0%

% Crude Protein	16.8	17.2
% Crude Fibre	2.2	3.8
% Ether Extract	3.0	2.9
% Nitrogen-free Extract	74.7	73.0
Estimated Starch Equipment	93.3	85.0

1. Mixture of common salt (25.0%), dicalcium phosphate (58.8%), Limestone (4.6%), calcined magnesite (11.0%) plus zinc (1750 ppm) iron and manganese (700 ppm) and iodine (106 ppm) and cobalt (7 ppm)

2. Vitamin A, 5 million iu plus Vitamin D, 1 million iu per lb.

Methods

It was not possible to start concentrate feeding until 19 October 1969, two weeks after lambing started. It was then offered in V-shaped wooden troughs. Initially the quantities to be given were to be kept small and gradually increased but because of the late start, there was a tendency to offer the food more or less to appetite in order to keep feed on offer to shy feeders. The maximum to be offered was 1 lb. per head per day. However, on the 6th, 7th, 8th and 9th days of feeding up to 1½ lb. per head was put in the ewes' troughs. Feeding stopped on 3 December 1969.

The groups of ewes were grazed on the reseed which had been divided by a new fence. In order to minimise the effects of possible differences in area and in the nature of the lie-back the groups changed paddocks every 14 days. The wethers did not have their grazing areas alternated. When feeding ceased the two groups in each class of sheep were allowed to graze together.

Live weights were taken for the ewes on 1 October, the wethers on 16 October and for both on 26 November 1969 and 6 January and 25 March 1970. Body condition scores were taken simultaneously according to Jeffries (1961) method of palpating the loin. This involves a scale from 0-5, 0 being emaciated and 5 extremely fat. The date of birth of each lamb was recorded together with sex and weight within 24 hours of birth. Docking by the rubber ring method was carried out at that recording. Male lambs were left entire. The lambs were weighed at the second, third and fourth ewe and wether weighings but condition scores were taken only on the third and fourth occasions. The lambs were weaned when the experiment terminated on 25 March 1970.

Wool samples were taken by small-animal clippers from an area 5 cm x 5 cm on the left mid-side of each ewe and wether on the occasion of each weighing. Ease area was marked out on the first occasion by tattooing. Growth in successive periods could therefore be measured.

Student's t-test was used to compare fed with control animals for each factor studied.

Results

1. Feed Consumption by Ewes

Over the 46 days during which concentrates were offered, the average consumption per ewe present on 26 November 1969 was 46.8 lb. For the wethers the comparable figure was 36.7 lb.

2. Ewe numbers

Data from four ewes in the control and five in the fed group have been discarded because they were not recorded as having lambed. Three ewes in the fed group died. One death occurred before feeding started, a second two days after feeding started. Post mortem examination of the latter revealed an almost total lack of stomach contents signifying death from under-nutrition. The third case was on 6 November and was caused by pneumonia with consolidation of both main lung lobes. Information from one ewe in the fed group which failed to rear her lamb was discarded. Thus data from 21 fed and 26 control ewes were analysed.

Non-fatal acidosis due to over-eating of concentrates was observed in some individuals and undoubtedly affected thriftiness and milk supply. It occurred because of an anxiety to encourage as many sheep as possible to feed for what was realised would be a comparatively short feeding period. This led to rather more generous daily allowances than were justified in view of the occurrence of acidosis.

3. Ewe weights and weight changes

No significant difference was found between the initial weights of the ewes in the two groups. Since the ewes were pregnant at the time of first weighing and it was impracticable to weigh the ewes immediately after parturition, no comparison of weight changes to 26 November was attempted. In the succeeding period to 6 January the fed ewes put on an average 3.09 lb. more weight than the controls but this failed to reach significance (P = 0.12). None of the other differences shown below are significantly different.

Initial Weight and Average Total Body Weight
Changes of the Ewes (lb)

		Group A (control)	Group B (fed)
Initial weight		139.2	138.4
Changes	1 October to 26 November	not valid - pregnant initially	
	26 November to 6 January	+12.0	+15.0
	6 January to 25 March	+13.0	+13.3
	26 November to 25 March	+25.0	+28.4

The average number of days from the initial weighing until lambing was not significantly different, being 15 days for the control group and 14 for the fed group.

4. Ewe body condition changes

The scoring carried out at the initial weighing showed a slight non-significant difference in favour of the control group. In the ensuing period to 26 November, the fed ewes lost less condition (P = 0.09) than the control ewes but there was no significant difference during individual periods thereafter. Nevertheless this initial effect persisted and resulted in a significantly (P = 0.03) different change between first and third assessments and also (P = 0.04) over the whole period of the experiments.

Initial Ewe Body Condition Score and Subsequent Changes

		Group A (control)	Group B (fed)
Initial Score		2.3	2.1
Changes	1 October to 26 November	-0.8	-0.5
	26 November to 6 January	+0.3	+0.4
	6 January to 25 March	+0.4	+0.4
	1 October to 6 January	-0.5	-0.1
	1 October to 25 March	-0.1	+0.2

5. Fleece Weights

There was no significant difference between the fleece weights of the two groups of ewes. The overall mean was 7.8 ± 0.2 lb.

6. Lamb Numbers

The number of lambs born per ewe allocated was similar for both groups (112%). The percentages weaned were 87% for the unfed and 73% for the fed group. One male and one female lamb in the fed group were orphaned and reared on the bottle. These are recorded as losses but would have raised the weaning percentage to 80.

7. Lamb Weights and Weight Changes

No difference in birth weight was recorded between the groups. Male lambs averaged 11.0 lb. (control) and 10.8 lb. (fed) while the females were 10.0 lb. (control) and 9.4 lb. (fed). The mean birth weight for all male lambs which survived to 26 November was 10.9 ± 0.4 lb. and for females 9.7 ± 0.3 lb. The average daily liveweight gains of these lambs are laid out in tabular form below.

Average Daily Liveweight Gains of Lambs (lb.)

	Male		Female	
	Group A (control)	Group B (fed)	Group A (control)	Group B (fed)
Number	13	8	14	14
Birth to 26 November	0.59	0.49	0.56	0.50
26 November to 6 January	0.69	0.61	0.64	0.62
6 January to 25 March	0.28	0.29	0.23	0.23
Birth to 6 January	0.64	0.55	0.60	0.56

The growth rate of the control ram lambs was significantly greater ($P = 0.001$) than that of the ram lambs from the fed ewes over the period from birth to 6 January 1970. The trend is evident in each part of this period but the significance is dubious ($P = 0.14$ to 26 November and 0.20 from 26 November to 6 January). In the period from birth to 6 January 1970 the difference in growth rate of the ewe lambs almost reached significance ($P = 0.11$) but not in any other period. Ram lambs gained at an average daily rate of 0.60 ± 0.03 lb. (84 days) and ewe lambs at 0.58 ± 0.02 lb. (83 days).

8. Lamb Body Condition Scores

There was a slight but non-significant difference in the body condition score of the lambs on 6 January 1970, in favour of the control animals. No difference was observed in change of condition from then until 25 March 1970.

9. Wether Numbers

The control group finished the experiment without loss. One of the fed animals was drowned in a ditch on 28 October 1969 but it was one which had been showing signs of acidosis and it is to that cause that its death should be attributed.

10. Wether Weights and Weight Changes

There was no difference in the initial weights of the two groups. Both averaged 87.6 lb. From the table below it will be seen that the fed group did not gain as well as the control group. The difference is statistically significant (P = 0.01). In the second and third periods the position was reversed (P = 0.19 and 0.08 respectively). When the whole period of the experiment is considered, there was no difference between the average gains of the two groups.

Average Liveweight Gains of Wethers (lb.)

	Group D (control)	Group C (fed)
Number	30	29
16 October to 26 November	10.5	7.3
26 November to 6 January	10.6	11.7
6 January to 25 March	2.0	3.7
16 October to 25 March	23.0	22.7

11. Wether Body Condition Scores

The mean initial score for both groups was 2.0, that is in lean store condition. There were no differences between the groups in their subsequent changes. In the period to 26 November the mean increase was 0.1 units; from 26 November to 6 January it was 0.4 units; and from 6 January to 25 March there was virtually no change.

12. Wether Fleece Weights

There was no difference between the fleece weights of the control group (8.8 lb.) and the fed group (8.9 lb.). The overall mean was 8.8 ± 0.2 lb.

13. Wool Sample Weights

With the exception of the period from 16 October 1969 to 26 November 1969 there were no significant differences between the fed and unfed animals in weight of wool grown, either in the ewe or wether groups. During that period growth was at a very low level. The ewes responded to feeding (P = 0.05) but wool growth was depressed in the fed wethers (P = 0.001).

The proportion of the year's growth estimated from the data to have taken place in different parts of the year is shown in the following table. In it the winter growth has been estimated by deducting the March 1970 cut from the October 1969 cut.

Estimated Percentage Wool Growth in Different Periods of the Year

Nominal Period	Actual Dates	Ewes Control	Ewes Fed	Wethers Control	Wethers Fed	Period as % of Year
Shearing to Dipping	6 Jan-25 March	38.5	35.9	34.0	35.5	21.4
Dipping to Lambing	"25 Mar-18 Oct"	42.9	44.3	41.2	41.7	56.7
Lambing to Marking	18 Oct-26 Nov	3.8	4.6	9.7	7.9	10.7
Marking to Shearing	26 Nov-6 Jan	14.8	15.2	15.1	14.9	11.2
		100.0	100.0	100.0	100.0	100.0

This is the pattern one would expect.

Discussion

When the trial was proposed it was hoped that there might be more uniform appetite for concentrates and also that feeding might start in early October. Neither hope was fulfilled. The attempt to keep the feed supply at a fairly high level in order to obtain maximum benefit for the maximum number of sheep resulted in poorer performance from the fed sheep because of the effects of acidosis. Nevertheless, the results from the control groups do give an indication of the kind of performance that can be obtained from stud ewes on improved pasture and from wethers on medium quality camp in a very cold spring and in a dry summer.

The ewes seemed to respond to this method of feeding (as opposed to food) by having a reduced milk supply leading to poorer growth in their lambs. They then tended to have better body condition than the controls. Total fleece weight was not affected by treatment. The mortality figures suggest that acidosis was a cause of loss and may have been a complicating factor where other difficulties existed.

The wethers received a temporary check in liveweight gain during the feeding period but subsequently made up the difference. Feeding did not affect body condition score or total fleece weight. The acidosis experienced seemed to affect the growth rate of the wool during the feeding period.

Summary

Of the two groups of 30 ewes one was fed a concentrate mixture for 46 days commencing 5 days after the mean date of lambing, and consumed an average of 47 lb. of feed per head. Similarly, one of two groups of wethers was fed during the same period and ate an average of 37 lb. Acidosis was experienced in both the fed groups. This resulted in reducing milk supply in the ewes and therefore slightly poorer growth rate in the lambs. The fed wethers also grew more poorly but subsequently made up the difference. Average fleece weights were not affected by the treatment. The average fleece weights were ewes, 7.8 lb. and wethers, 8.8 lb. The mean daily liveweight gain of the lambs was rams, 0.60 lb. and ewes 0.58 lb. per day over 84 days. Some 35-40% of annual wool growth is estimated to take place in January, February and March.

Acknowledgment

Dr J M Doney of the Hill Farming Research Organisation kindly provided the data on wool sample weights.

ANIMAL EXPERIMENT 2

Centre Fox Bay East, West Falkland (Packe Bros.)

Object To ascertain whether energy or energy and protein are factors limiting the productivity of lactating ewes.

Introduction The ewes were unaccustomed to hand feeding and so were exposed to the same risks as in the first experiment.

Materials and Methods The ewes consisted of four groups of 30 stud Romney cross ewes in lamb to horned Polwarth rams. At the initial weighing on 18 October the ewes were in varying stages of pregnancy at an average weight of 98.2 lb. with no significant differences between the four groups. Their body condition scores were also similar, averaging 2.2.

The grazings consisted of three whitegrass paddocks and one which had a considerable proportion of ground which had been reseeded with Yorkshire fog in the preceding autumn. To minimise the effects of this difference the four groups were rotated round the four paddocks, remaining in each for seven days. Hay to appetite was offered in the reseeded area until grass growth was adequate because there was insufficient roughage on it.

The foods used were:

1. Crushed Maize
2. Crushed Maize, 97½% plus Urea 2½% initially and Crushed Maize 75% plus Linseed meal 25% subsequently
3. Proprietary Distillers Solubles blocks (including urea) to appetite
4. No supplement.

These were first offered on 20 October by putting a little of the food in each ewe's mouth. Thereafter the sheep were herded to the wooden troughs or to the blocks daily. As in experiment 1, the rate of increase in food allocated was faster than desirable to try to encourage shy feeders. Feeding terminated on 4 December.

Ewe liveweights and body condition scores (Jefferies, 1961) were taken on 8 December, 15 January, 14 February and 31 March. Lamb weights were also recorded on these dates and their body condition scores on all but the first date. At birth the lambs were weighed and tagged, but due to an oversight the dates of birth were not recorded.

The data were examined by analysis of variance for each criterion.

Results The ewes would not eat the proprietary blocks although they were given every encouragement to do so. Information from that group was therefore combined with that from the control group.

Three ewes died in the period 10-18 November in the maize only group. Acidosis was almost certainly involved. In addition there was visual evidence of digestive upset. As a result, the amounts of food offered to them was often reduced and then slowly built up again. Average consumption in that group was 0.76 lb. per head per day whereas 1 lb. was the planned allowance. Although there was some evidence of slight digestive disturbance in some of the maize plus protein fed animals there were no deaths in that group and feed allowances could be maintained. Consumption averaged 0.90 lb. per head per day. Nevertheless, acidosis was experienced on the mixed diet in the Douglas Station experiment.

Because of deaths and incomplete data, figures pertaining to 28 ewes in the mixed diet group, 27 in the maize only group and 58 in the control groups were analysed. In no period was there a significant difference in body-weight change or change in body condition score except that from 8 December to 14 February the maize only group put on 0.1 units of condition whereas the mixed diet group lost 0.1 units and the controls lost 0.2 units ($P < 0.05$). Fleece weights did not differ significantly. The average was 8.8 lb.

The number of lambs reared and their growth rate was most disappointing. Three factors were involved in this. The first was the acidosis which occurred in the maize only group. This can be seen in the table.

Numbers of Ewes and Lambs Reared

	Controls	Maize & Protein	Maize only
No. of ewes allocated	60	30	30
" " " with complete data	58	28	27
" " " births recorded	36	24	24
" " lambs reared to 31/3/70	33	16	12
" " " " , % ewes allocated	55	53	40
" " " " , % ewes with complete data	57	57	44

The other two factors reducing productivity were the unusual length of the winter and the limiting of the ewes to a fixed area of ground during the feeding period. In a normal year the area allocated would have been more than adequate. In 1970 it led to a marked dietary restriction on the ewes and hence on the growth of their lambs. Because of lack of birth dates growth rates could only be calculated after 8 December.

Lamb Daily Growth Rate

8/12/69 to 15/1/70	0.35 lb.
15/1 to 14/2	0.15 lb.
14/2 to 31/3	0.19 lb.

There were no differences between the groups. Weaning took place on 14 February.

Body condition scoring of the lambs suggested that they were losing condition in the period 15/1 to 14/2/70. From 14/2 to 31/3 the control groups showed no change but the fed groups were improving. The implication of this is not clear. It is possible that the control lambs were suffering a greater post-weaning check but the liveweight data does not support this conclusion.

Conclusions

The objective of determining whether cereal alone would improve the productivity of ewes when compared with a mixed diet was not satisfactorily achieved. There is a suggestion that the mixed diet was advantageous. The proprietary distillers solubles blocks with urea proved unpalatable to the sheep. (Ewes which were fed in 1969 are reported to have eaten the blocks readily in 1970.)

APPENDIX 7 SOIL ANALYSIS RESULTS

	CAMP AND REFERENCE	pH	Phosphorus ppm	Phosphorus Index	Potassium ppm	Potassium Index	Magnesium ppm	Magnesium Index	Cobalt ppm	Copper ppm	Organic Matter per cent
EAST FALKLAND											
Darwin/Goose Green	Bodie Wether Camp	5.4	1.7	[illegible]	25[illegible]	3	190	4	0.16	0.80	20.1
	Parks - Yorkshire fog	4.4	5.9	2	250	3	495	6	0.34	1.30	27.8
	Parks - Cortaderia North side	4.4	[illegible].1	2	355	4	285	5	0.18	1.70	29.3
	Parks - Cortaderia South side	4.3	7.[illegible]	2	1[illegible]7	2	241	4	0.3[illegible]	1.60	[illegible]
Fitzroy	Horse Paddock - Clover expt	4.2	20.0	3	2[illegible]	2	2[illegible]	5	0.17	2.20	72.4
	Low Ground Hogg Camp	4.2	5.6	1	355	4	40[illegible]	6	0.26	1.60	29.1
Bluff Cove	Little Wether Ground Hogg Camp	4.3	3.7	1	437	3	[illegible]51	4	0.34	1.50	24.1
Port San Carlos	Horse Paddock	4.9	11.0	3	130	2	250	4	0.35	1.10	77.1
	Cerro Monte	4.5	2.3	1	243	3	318	5	0.37	1.20	61.5
	Ridge	4.1	1.5	0	73	1	125	3	0.17	0.90	51.7
Port Louis	Hogg Camp	4.6	3.2	1	310	3	335	6	0.37	1.20	24.3
Green Patch	Marking Pen	4.6	2.9	1	250	3	145	2	0.17	1.40	23.9
Rincon Grande	Big Rincon	4.9	1.5	0	480	4	360	6	0.11	not available	36.0
	Average East Falkland	4.5	5.4	2	254	3	286	5	0.25	1.43	41.3
	Range East Falkland	4.1 to 5.4	1.5 to 20.0	0 to 3	73 to 480	1 to 4	125 to 495	2 to 6	0.11 to 0.37	0.80 to 2.20	20.1 to 77.1
WEST FALKLAND											
Fox Bay East	Ram Paddock - Cortaderia S	4.9	1.9	0	115	2	175	3	0.09	1.10	20.0
	Ram Paddock - Cortaderia N	4.8	2.0	0	137	2	153	3	0.11	1.20	38.8
	Settlement Rincon - Yorkshire Fog	5.0	3.9	1	300	4	495	6	0.15	1.60	15.6
Chartres	Lower Black Hill Camp - Hillsides	4.3	4.0	1	290	3	298	5	0.40	1.40	17.2
	do - Valley bottoms	4.3	4.5	1	251	3	159	3	1.20	1.20	18.4
	do - Hilltops	4.3	4.0	1	305	3	283	5	0.21	1.40	15.9
	Lower Hogg Ground	3.9	3.4	1	178	2	260	5	0.08	2.00	23.6
Port Howard	Horse Paddock - Cortaderia	4.9	10.0	2	155	2	282	5	0.19	1.00	57.3
	Horse Paddock - Naturally improved	5.2	3.5	1	238	3	242	4	0.38	1.90	13.9
	Cow Paddock	4.1	4.2	1	130	2	219	4	0.21	0.80	64.1
	Peat Banks - bottom	4.3	4.7	1	375	4	433	6	0.15	0.80	36.2
	Peat Banks - top	4.2	12.0	3	460	4	338	5	0.11	0.70	69.0
	Peat Banks - Green valley at old settlement	4.0	14.0	3	194	2	448	6	0.21	0.90	47.6
Hill Cove	Sound Ridge Camp - Turbomower Expt No Fert	4.0	9.5	2	200	2	298	5	0.22	1.10	58.0
	do - do Fert	4.1	23.0	4	305	3	343	5	0.21	1.30	59.9
	do - Fog Point	4.5	4.2	1	345	3	413	6	0.49	1.60	13.4
	do - Peat End	4.2	2.3	1	159	2	202	4	0.35	1.00	47.7
Roy Cove	Dunbar Hogg Camp	4.8	2.0	0	123	2	265	5	2.40	1.20	26.0
	Head's Clover Expt	5.2	3.1	1	360	4	525	6	0.40	1.20	21.7
	East Rincon Ridge	4.5	2.7	1	300	3	472	6	0.37	1.20	24.4
	Big Rincon Hogg Camp	4.7	3.5	1	290	3	410	6	0.21	1.40	24.7
	Average West Falkland	4.5	5.0*	1*	249*	3*	320	5	0.39	1.24	34.2
	Range West Falkland	3.9 to 5.2	1.9 to 10.0*	0 to [illegible]*	123 to 460*	2 to 4*	153 to 525	3 to 6	0.09 to >2.40	0.70 to 2.00	13.5 to 69.0
ISLANDS											
Weddell	Loop Head Ewe Camp (1)	4.4	23.0	4	218	3	355	6	0.26	1.30	15.4
	do (2)	4.2	33.0	4	243	3	500	6	0.15	1.10	35.1
New Island	South End Hogg Camp	4.[illegible]	4.4	1	237	3	581	6	0.41	1.30	11.4
Sedge Island	Garden Soil	4.[illegible]	23.0	4	335	3	712	7	0.06	1.10	56.1
	Average Islands	4.5	20.13**	3**	233**	3**	537	6	0.22	1.20	29.5
	Range Islands	4.2 to 4.[illegible]	4.4 to 33.0	1 to 4	218 to 243**	3**	355 to 712	6 to 7	0.06 to 0.41	1.10 to 1.30	11.4 to 56.1
	Average All Samples	4.5	6.[illegible]***	2***	249***	3***	351	5	0.32	1.29	36.1
	Range All Samples	3.9 to 5.[illegible]	1.5 to 33.0***	[illegible] to [illegible]***	73 to 430***	1 to 4***	125 to 712	2 to 7	0.06 to 2.40	0.70 to 2.20	11.4 to 77.1

* Hill Cove Sound Ridge Camp Turbomower Expt Fertilizer sample omitted because P & K fertilizers recently applied.

** Sedge Island Garden Soil omitted because manures have been applied heavily.

*** Hill Cove Sound Ridge Camp Turbomower Expt Fertilizer and Sedge Island Garden Soil omitted.

COMMENTS ON SOIL ANALYSIS RESULTS

The results are arranged in three groups, East Falkland, West Falkland and the small Islands, but it must be stressed that no attempt was made to take representative samples of soil types or even to cover the areas adequately from the geographical point of view. Rather, the samples were taken randomly at sites of experiments and trials, or where individual advisory problems arose. Nevertheless, a reasonable cover was achieved and the results are grouped in this way to add to their interest, especially in the Colony itself.

SOIL ACIDITY

The soils are uniformily acid as indicated by their average pH status of 4.5. There is remarkably little variation from this average figure. To make such soils suitable for arable cropping would involve the application of enormous quantities of lime - around 5-6 tons ground limestone per acre. For grassland, however, a more modest initial dressing of 2-3 tons ground limestone per acre would be expected under United Kingdom conditions to improve grassland in a number of important, if not immediately spectacular ways. Rotting away of the peaty "mat" for instance would be encouraged. Less acid soil conditions would accelerate the release of other plant nutrients and with improvement in fertility better grass and other plants begin to invade the sward. An invisible but extremely important improvement would be an increase of the calcium present in the herbage. The impact of this on the diet of the sheep does not require amplification here.

PHOSPHORUS

Most of the samples have phosphorus index values of 1 or 2. In several parts of the United Kingdom, upland peaty soils of phosphorus index 2 have proved to be very responsive to applied phosphate fertilizers when measured in terms of increased yields of grass. It would be remarkable if some such response were not also obtained in the Falkland Islands though proper trial work would be necessary to confirm this. Phosphorus has other effects on grassland. Establishment of grass and clover seedlings is assisted by ample phosphate in the soil. In a pot experiment described elsewhere in the report phosphorus was quite as important as lime in the establishment of white clover. The application of phosphorus to soil can result in an increased content of the nutrient in herbage with consequent benefits in animal growth and development.

POTASSIUM

Almost all the samples are adequately supplied with potassium.

MAGNESIUM

All the samples are well supplied.

COBALT

All the values are low and some are very low. Many are below the level generally associated with deficiency in sheep by United Kingdom standards.

COPPER

All samples are low in copper.

APPENDIX 8. HERBAGE ANALYSIS RESULTS OF SAMPLES NOT INCLUDED IN THE GRASSLAND PRODUCTIVITY EXPERIMENT REPORT

SITE, MATERIAL AND DATE OF SAMPLING	DRY MATTER %	CRUDE PROTEIN %	CRUDE FIBRE % (TCA)	ASH %	"D" VALUE %	STARCH EQUIVALENT	CALCIUM %	PHOSPHORUS %	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	COBALT ppm	SILICA %	COPPER ppm
Speedwell Island Dec 1969 Leaves and leaf bases of Poa flabellata (Tussac)	Not available	11.5	34.1	4.1	42.3	22.5	0.07	0.27	1.06	1.68	0.32	0.10	0.105	0.5	4.00
Hill Cove Dec 1969 Cortaderia pilosa (Whitegrass) 5 weeks regrowth of green leaves	52.8	11.1	30.9	4.6	40.6	22.7	0.22	0.13	0.35	1.04	0.11	0.09	0.065	0.3	7.80
Hill Cove Dec 1969 Whitegrass - white or dead material	72.7	5.8	34.2	4.2	30.0	10.2	0.10	0.06	0.12	0.24	0.06	0.09	0.130	1.3	29.00
Port Louis Hogg Camp Feb 1970 Johnson's Rincon. Selected green grass - not whitegrass	36.3	13.6	28.6	6.9	44.2	27.6	0.20	0.15	0.63	1.00	0.12	0.20	0.040	2.9	11.00
Port Howard Feb 1970 Bottom peat bank White Rock Selected grass - no whitegrass	40.9	8.8	30.7	6.4	39.5	21.7	0.08	0.09	0.32	0.67	0.08	0.09	0.055	2.9	10.00
Port Howard Feb 1970 Top peat bank White Rock Selected green material - no whitegrass	50.7	19.2	22.6	8.0	43.1	30.0	0.20	0.26	1.02	1.20	0.18	0.29	0.185	2.8	14.30
Port Howard Feb 1970 Peat Banks. Green Valley. Old Settlement - Selected material. No whitegrass	24.4	8.9	30.9	4.1	38.6	20.7	0.08	0.15	0.18	0.74	0.09	0.11	0.065	1.3	15.50
Goose Green grass - Feb 1970 for cobalt	Not available	7.4	30.4	6.1	35.6	18.0	0.07	0.08	0.23	0.84	0.11	0.09	0.030	4.0	29.80
Hill Cove. Mar 1970 Baccharis magellanica (Christmas Bush)	43.8	7.6	14.7	4.5	53.7	45.2	0.09	0.13	0.45	1.48	0.36	0.25	0.025	0.7	7.30
Hill Cove. Mar 1970 Chiliotrichum diffusum (Fachine)	44.3	9.8	30.6	3.8	40.1	22.4	0.12	0.17	0.29	1.10	0.20	0.24	0.040	0.4	7.80
Hill Cove. Mar 1970 Empetrum rubrum (Diddle-Dee)	51.6	5.3	25.6	2.8	38.1	23.3	0.20	0.08	0.15	0.34	0.09	0.15	0.015	0.5	6.00
Hill Cove. Mar 1970 Senecio condicans (Sea cabbage)	15.1	5.7	16.5	22.6	65.7	56.1	0.19	0.20	2.10	1.64	1.40	0.25	0.100 mean of paper duplicates.	14.8	15.80

/Hill Cove. Sound Ridge

APPENDIX 8. HERBAGE ANALYSIS RESULTS OF SAMPLES NOT INCLUDED IN THE GRASSLAND PRODUCTIVITY EXPERIMENT REPORT

SITE, MATERIAL AND DATE OF SAMPLING	DRY MATTER %	CRUDE PROTEIN %	CRUDE FIBRE % (TCA)	ASH %	"D" VALUE %	STARCH EQUIVALENT %	CALCIUM %	PHOSPHORUS %	CHLORIDE %	POTASSIUM %	SODIUM %	MAGNESIUM %	COBALT ppm	SILICA %	COPPER ppm
Hill Cove - Sound Ridge - no fertilizer Mar 1970	48.1	7.4	31.9	5.1	34.7	16.2	0.05	0.10	0.26	0.96	0.09	0.09	0.020	3.1	3.30
Hill Cove - Sound Ridge Fog Point Mar 1970	40.3	11.8	25.4	14.2	51.7	37.0	0.26	0.30	1.30	1.88	0.27	0.22	0.060	8.4	5.00
Hill Cove - Sound Ridge Expt. Fertilizer Mar 1970	42.2	8.1	32.0	4.2	39.0	20.4	0.04	0.16	0.28	0.92	0.10	0.08	0.020	2.1	4.00
Roy Cove - Hierochloe redolans (Cinnamon grass) Mar 1970	32.2	10.9	28.7	6.3	60.8	44.2	0.06	0.09	*	1.24	0.33	0.10	0.060	3.4	*
Hill Cove - Sound Ridge Peat End Mar 1970	20.0	13.0	23.9	12.2	53.6	39.7	0.29	0.28	1.03	1.76	0.25	0.24	0.110	6.7	25.30
Roy Cove Gunnera magellanica (Pig Vine) Mar 1970	25.8	16.1	18.0	5.2	46.6	36.2	0.32	0.12	*	0.76	0.70	0.41	0.215	0.5	*
Roy Cove - Dunbar Hogg Camp - Selected material - no whitegrass Mar 1970	27.6	13.7	24.2	6.9	55.2	41.2	0.22	0.14	1.09	1.56	0.43	0.14	0.180	19.00	19.00
New Island. South End Hogg Camp - for Cobalt Mar 1970	29.4	12.6	23.0	11.8	43.2	29.9	0.20	0.27	1.11	1.20	0.57	0.27	0.165	6.3	53.50
Roy Cove. Outer Hogg Camp Big Rincon Mar 1970	46.6	8.8	33.6	9.5	38.9	19.4	0.07	0.10	0.27	0.57	0.17	0.10	0.060	37.7	27.30
Weddell Island. Loop Head Ewe Camp - for Cobalt Mar 1970	34.7	11.7	29.6	8.3	43.1	25.9	0.11	0.21	0.60	1.28	0.15	0.13	0.065	5.1	16.80
Chartres. Lower Black Hill Mar 1970	45.6	13.3	25.4	9.3	60.0	45.3	0.21	0.19	1.41	2.60	0.19	0.24	0.070	3.4	6.50
Chartres. Hogg Ground Mar 1970	51.6	8.0	30.0	6.0	37.8	20.4	0.05	0.08	0.28	0.84	0.09	0.10	0.035	3.6	3.00
Chartres. Gaultheria antartica (Tea-berry) Mar 1970	40.0	5.3	19.2	4.2	36.9	25.8	0.44	0.07	0.34	0.56	0.16	0.23	0.085	1.4	21.30
Fitzroy. Lower ground. Ewe and wether hogget camp Mar 1970	43.7	9.5	32.6	7.1	36.4	17.5	0.08	0.11	0.43	1.00	0.11	0.10	0.045	4.8	3.80
Fitzroy Clover Expt. Apr 1970	39.1	8.0	32.1	4.1	46.2	21.6	0.06	0.14	0.45	1.02	0.19	0.11	0.045	1.8	3.80
Bluff Cove - Hogg Camp (Little wether ground) Apr 1970	43.5	9.6	30.5	5.2	44.8	27.1	0.10	0.11	0.35	1.00	0.13	0.12	0.085	2.8	4.50

ORGANIC MATTER

There is a considerable range in organic matter content of the samples but all are high. They give an indication of the relative peatiness of soils from the different areas. The lower organic matter average for West Falkland and the small Islands probably relects a higher proportion of hard camp compared with East Falkland.

The slight differences between the group averages in some nutrients are not likely to be significant. The average for phosphorus in the smaller Islands appears high but the number of samples is so small that no significance may be attached to this.

At the present prices it is difficult to justify the general use of lime or fertilizers of any kind in the Falkland Islands. A case might be made out for the use of phosphates for certain special purposes. Further trial work is required but profitable responses on "greens", green valleys, and reseeded areas are likely. This aspect is discussed in greater detail elsewhere in the report.

APPENDIX 9. LETTER ANNOUNCING AVAILABILITY OF THE LABORATORY SERVICES

Agricultural Advisory Team
Veterinary Laboratory
Stanley

29 October 1969

Laboratory Services

The fitting out of the veterinary diagnostic laboratory has now been completed and Mr Williams the technician is happy that all the techniques are now working satisfactorily. We will be glad to show the Laboratory to any farm managers visiting Stanley.

The main purpose of the laboratory and post mortem centre is to examine freshly dead carcasses and carry out bacteriological examinations on diseased organs, including carrying out total worm counts on stomach and intestinal contents and identifying of worms found. We are also prepared to do worm egg counts on fresh sheep, cattle, or horse dung. Blood samples for calcium, phosphate and copper estimations can be examined by arrangement only, the reason being that specially prepared bottles are necessary for biochemical work.

The laboratory is situated at the extreme end of the East wing or older part of the King Edward Memorial Hospital. We will accept delivery of fresh carcasses or specimens there at anytime, or will if warned meet the aircraft and collect them ourselves. The Air Service are going out of their way to help us by special collections of properly sealed freshly dead carcasses, however they request that you notify us and not the Air Service when you have material for collection.

Because of their bulk adult sheep carcasses should be skinned if time permits. All carcasses should be enclosed if possible in a plastic bag tied at the neck. The Air Service cannot be expected to carry leaking parcels or decomposing carcasses. Sheep dead for over about 24 hours are not suitable for bacteriological examination.

Dung samples for worm egg examination should be fresh, number at least 6, from the suspected paddock or batch of sheep. They should be wrapped separately and all enclosed in an outer plastic bag.

Each parcel should include the following particulars:-

1. Name of Sender. Name of farm.

2. Class and age of sheep affected.

3. Brief note of symptoms seen or condition suspected, and number of recent deaths in the batch.

You can contact us by telephone or radio. Our laboratory telephone number is Stanley 87, our evening number is Stanley 378, you can also expect the person on listening watch to relay to us a radio message request for a special carcass pick up by plane up to 7 p m Stanley time and up to approximately 9 a m in the morning Stanley time. Weather permitting the Air Service would normally pick up on the next flight.

C T McCrea

APPENDIX 10. LETTER GIVING THE TEAMS VIEWS ON THE CONTROL OF KEDS.

Agricultural Advisory Team

STANLEY

2nd April 1970

THE CONTROL OF KEDS

Introduction

In view of the current interest in this topic, the Team was invited to express its views. It was considered best to commit these to paper.

It is accepted that no scheme of eradication is foolproof, ie that breakdowns may occur, nevertheless the more important the problem is to the country concerned, the greater the effort required. To ensure speedy eradication the regulations need to be stringent, and penalties for breakdowns and breaches of regulations need to be harsh.

The Team puts forward for consideration three alternative schemes involving differing degrees of pressure on the ked problem. The first is believed to give the greatest likelihood of success in the shortest period of time and to be least likely to result in breakdown. It is formulated on the basis that eradication implies maximum effort from the whole community. The second starts from the current position and would affect only those presently acknowledging the presence of keds on their farms. It suffers from the danger that an extremely low level of infestation occurring sporadically over the Colony could mean retaining the dipping regulations for a prolonged period with a consequent lessening of determination to eliminate the pest. The third alternative is based on the premise that the penalty for failure to eliminate keds from a farm is loss of profit and that this is sufficient incentive to continue dipping. It would involve removal of all legal obligations to dip except that land-linked neighbours could compel a negligent farm to undertake a programme of eradication if the stock were badly affected, or if the complainants had all completed an eradication programme.

A key factor in an eradication scheme is the appointment of an enthusiastic campaign director to maintain both the continuity and the impetus of the compaign.

SCHEME I - RAPID ERADICATION

a. Principles

To enable eradication to be carried out it is essential that the following principles be applied.

i. the basic unit for an eradication scheme must be an island, whether large or small.

ii. the necessary operations must be carried out simultaneously throughout that island.

iii. these operations must be carried out each season until an inspector or inspectors declare that he or they are satisfied that the island is free from the parasite.

iv. The operations must be carried out on all sheep on all farms including those at present exempt until the island is declared free.

v. the movement of sheep or wool from an infested to a ked-free area should be prohibited; since dogs can be mechanical carriers of keds they should be carefully examined between working an infested flock and a ked-free one.

vi. the penalties for a. failure to observe the regulations or b. the subsequent re-appearance of the parasite should be very severe.

To supplement these principles it is thought important that if an outbreak should occur later a. the penalties should apply to the farm manager and owners concerned and b. these penalties should be related to, and be used to defray, the expenses of repeating the eradication process on the other farms on the island.

b. Operations

i. Application of Insecticide should take place twice annually. The first occasion should be "off-shears" by spray, shower or plunge-bath. The second should be by plunge-dipping only and should take place as soon as possible after the season's shearing is completed, with two provisos. These are that no sheep should be dipped sooner than five weeks after it had been shorn; and that neighbours should dip their boundary camps at the same time whenever possible. Chemicals banned in the UK should not be used.

ii. Suitability of Insecticides. Any chemical should be permitted if it satisfied two conditions - the ability to kill keds rapidly following plunge-dipping; and to persist on the wool for a minimum time of ten weeks after dipping and still be effective against keds. The manufacturer's instructions regarding the initial and renewal strengths of the dip should be followed meticulously.

iii. Clean Gathering is probably the most important single factor in an eradication programme. Because of the necessity to clean-gather for plunge-digging extra labour would be advisable. The Government might consider whether certain manual workers could be temporarily released; whether members of HM Forces would be available; and whether volunteers could be obtained by broadcast appeal. While the farms would be responsible for wages and board and lodging, Government could subsidise transport to and from the farms. If there were to be a short campaign of 2-3 years to eradicate keds there would be a greater likelihood of maintaining interest in casual work in the camp for this purpose.

The Air Service might help in two ways:-

a. Flushing sheep into the open during straggling of camps by shepherds.

b. Carrying out sweeps of mountain camps after straggling and reporting by R/T sheep remaining.

iv. Annual Report. Each farm would make an annual statement to the campaign director as soon as the autumn plunge-dipping was completed. This would be that the boundary fences were in good repair and sheep-proof and would declare the manager's estimate of the percentage of ked-bearing sheep in each camp at dipping.

SCHEME II - GOOD CONTROL

Good control can be achieved by amending the present legislation to ensure double treatment with insecticide each year as in Scheme I sections b. i. and ii. No effort would be made to obtain extra labour for gathering.

The only permissible exceptions to this would be those to whom exemption was granted on the basis of a declaration of freedom from keds. The declaration would be in two parts:-

a. that the manager has diligently examined the farm's sheep through two successive seasons and that, to the best of his knowledge and belief the farm is free from keds.

b. that the boundary fences are in good repair and sheep-proof. The most satisfactory sheep-proof fencing would be woven wire fencing, with no mesh greater than 12" x 6"; of a height no less than 3'; and surmounted by a single strand of barbed wire 6" higher. The second choice would be a seven-strand fence of six plain wires surmounted by a single strand of barbed wire, the whole being nowhere less than 3'6" high. The tension in a plain wire fence should be kept high.

All managers would be obliged to submit a report as in Scheme I section b. iv. above.

SCHEME III - LIMITED COMPULSORY DIPPING

This would involve the withdrawal and replacement, or else the redrafting, of clause 11 of Chapter 40 of the Ordinances. The aim would be to remove the compulsion to dip on the basis that the profit-motive should be sufficient incentive. However, the legislation should enable neighbours whose farms had become free from keds to protect their stock from reinfestation from a negligent neighbour's stock. It is envisaged that this would mean the right of access to the infested stock for inspection by the person(s) making the complaint and by an appointed inspector, to enable them to assess freedom from keds. If eradication was not complete in 2 years a court order would be obtainable a. to enable the eradication to be carried out under the direction of an appointed inspector and b. to enable the costs of the work of the inspector and any supplementary labour he required, to be recovered from the farm in question.

SUMMARY

A scheme for the eradication of keds and two for their control have been presented. Eradication will only be achieved when the probability of any ked surviving is extremely low. The probability will be low when -

a. all farms on any island (large or small) apply insecticide simultaneously.

b. a suitable insecticide is applied at the correct strength twice yearly.

c. no straggler sheep are left in any camp after gathering.

APPENDIX 11 - EXPLANATORY NOTES IN CONNECTION WITH THE TAPEWORM ERADICATION (DOGS) ORDER 1970

HYDATID DISEASE

Supplementary explanatory notes from C T McCrea, MRCVS, Agricultural Advisory Team, in connection with the Tapeworm Eradication (Dogs) Order, 1970.

DOGS ON FARMS

The following months are the dosing months: January, April, July and October. Inspectors appointed for the purposes of the Tapeworm Eradication (Dogs) Order will find their task easier if they decide that the dogs on their farms are dosed during the first complete week in the appropriate month starting on the Monday. It should be a matter of pride on a farm, that they can get all the dogs dosed before the next farm.

Regular dosing of dogs, together with care in offal disposal, will definitely rid the Falklands of the disease in ten years, perhaps in considerably less. But, whilst hydatid cysts are still seen to be occurring in sheep or cattle lungs and livers certain additional precautions must be taken. The workers must remember that it is possible for dogs to become reinfested between dosing periods and one infested dog may contaminate both paddocks and settlement greens.

1. No more farm dogs should be kept than are necessary for working the sheep.

2. Each dog should be provided with a kennel and/or a metal chain.

3. Except when being worked or exercised dogs should be under control and not allowed to roam free.

4. To discourage dogs from becoming scavengers, they should be fed regularly, ie once a day at the time the dog is accustomed to.

5. A new dog transferred from another farm should be dosed immediately on arrival unless it has been dosed during the month preceding transfer. An additional precaution is to bath an incoming dog using carbolic soap. Remember infested dogs carry embryo tapeworm cysts on their fur.

6. Dogs should not be allowed in dwelling houses, shanties, wool sheds, the cabs of landrovers, in gardens where children play, or in kitchen gardens where vegetables are grown.

7. When dogs are kept at cookhouses, kitchen hygiene is very important; hand towels must be treated as personal property and frequently washed.

8. Kennels should be cleaned and disinfected after the dogs are dosed.

FARM KILLING PRECAUTIONS

The person in charge of each killing should ensure that dogs are kept at a safe distance until offal is safely disposed of.

Killing on slatted floors in wool sheds is risky because cyst fluid may fall between the slats. Separate mutton killing sheds and beef killing areas with concrete floors are infinitely better. A killing shed should have a window so that the door can be closed when killing is in progress. Dogs should be kept at a safe distance from the threshold and from the drain (if it is an open drain) by a dog proof fence. The area of the beef scaffold should be fenced.

Recommended methods of offal disposal are:-

1. Burning in improvised peat fired incinerators or "Tortoise" pattern stoves;

2. Retention in decomposition chambers for 28 days.

These may be either two 40 gallon oil drums or concrete pits 4 feet by 4 feet by 3 feet, preferably two in number so that they can be used in alternate months. They should have wooden covers and be situated on the line of the chute between the killing shed and the sea in order to facilitate emptying;

3. Burying in small deep pits with heavy dog proof covers (probably only suitable for outside shepherds' houses or the open camp).

MASS KILLINGS

With advance planning these need not be a bad source of infection to dogs. Conditions on different farms vary so only general recommendations can be made.

1. Since Scolaban will only kill mature tapeworms over 6 weeks of age and the winter dosing month is July, mass killings if they must be done in the winter are best timed for mid May, ie 6 or 7 weeks before the dogs are dosed in the first week of July. Periods of extreme cold should be avoided since in extreme cold the cysts live longer.

2. As few dogs as possible should be used for gathering the sheep and only picked dogs should be used and these be withdrawn as soon as possible. Carcases should be heaped in piles of about 16 unopened carcases and remain so heaped for 2 or more days to hasten dehydration and decomposition, after this they may be spread for their manure value if desired.

3. During the ensuing week all dogs should be kennelled and only exercised under supervision.

27 January 1970

Killing on slatted floors in wool sheds is risky because cyst fluid may fall between the slats. Separate mutton killing sheds and beef killing areas with concrete floors are infinitely better. A killing shed should have a window so that the door can be closed when killing is in progress. Dogs should be kept at a safe distance from the threshold and from the drain (if it is an open drain) by a dog proof fence. The area of the beef scaffold should be fenced.

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1. Burning in improvised peat fired incinerators or "Tortoise" pattern stoves;

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These may be either two 40 gallon oil drums or concrete pits 4 feet by 4 feet by 3 feet, preferably two in number so that they can be used in alternate months. They should have wooden covers and be situated on the line of the chute between the killing shed and the sea in order to facilitate emptying;

3. Burying in small deep pits with heavy dog proof covers (probably only suitable for outside shepherds' houses or the open camp).

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27 January 1970

APPENDIX 12 - COPPER AND COBALT EXPERIMENT AT PORT STEPHENS 1970

OBJECT:- To test the benefit to weaned lambs of: (a) dosing with cobalt bullet (b) injecting copper and (c) both treatments together.

	Size of group	Treatment
A.	40 lambs (half male half female)	Nil (control group)
B.	" " " " " "	Cobalt bullet
C.	" " " " " "	Copper and cobalt bullet
D.	" " " " " "	Copper

22 January 1970

The lambs (average age 10 weeks) were randomly selected and eartagged, they were also weighed and treated as above. Seven lambs in each group were blood sampled for copper analysis.

2 April 1970

All were again weighed and those previously bled for blood copper estimation were again bled.

1 July 1970

Weighing repeated.

RESULTS

The first table shows the mean weights of the 4 groups in January, April and July. It also shows the mean weight gains between these months.

Mean weights and weight gains of lambs in different treatment groups

Group	Mean Weight (lbs)			Mean Weight gain (lbs)		
	22 Jan	2 April	1 July	Jan-April	April-July	Jan-July
Control	37.63	53.35	53.87	15.72	0.52	16.24
Cobalt	37.9	53.40	53.77	15.50	0.37	15.87
Copper and Cobalt	38.35	53.07	53.67	14.72	0.60	15.32
Copper	37.90	51.74	53.28	13.84	1.54	15.38

The second table shows the copper values of the lambs in each group bled at the first 2 weighings. It also shows the mean copper levels of each treatment group and the difference between the mean blood copper figures of January and April.

Individual and Mean copper levels in mg. p.c. blood in 4 groups

CONTROL			COBALT			COPPER & COBALT			COPPER		
	Jan	April		Jan	April		Jan	April		Jan	April
Y52	0.09	0.10	R57	0.08	0.11	B2	0.08	0.08	G2	0.09	0.08
Y55	0.11	0.08	R52	0.07	0.09	B5	0.10	0.07	G5	0.10	0.10
Y57	0.11	0.08	R55	0.15	0.10	B7	0.10	0.06	G7	0.14	0.08
Y59	0.19	0.08	R59	0.07	0.10	B9	0.09	0.07	G9	0.13	0.08
Y88	0.13	0.08	R88	0.07	0.10	B39	0.10	0.07	G38	0.18	0.09
Y89	0.20	0.09	R89	0.07	0.10	B40	0.09	0.09	G39	0.12	0.10
Y90	0.09	0.09	R90	0.07	0.10	B41	0.10	0.07	G40	0.09	0.06
Group Mean	0.13	0.08	Group Mean	0.08	0.10	Group Mean	0.09	0.07	Group Mean	0.12	0.68

DISCUSSION

It will be seen from the table of blood copper levels that even at the beginning of the experiment none of the lambs were copper deficient. The majority fall within the accepted normal range 0.07-0.15 mg. p.c. blood. It is therefore not surprising that the copper group shows no advantage. The mean copper levels of 3 of the 4 groups dropped between January and April. It will also be seen that none of the 3 experimental groups show any weight gain advantage over the controls. The weights of all 4 groups remained remarkably even. The copper injected group lagged slightly behind the other groups. The copper group also had 5 fatalities in the first 10 weeks from the start of the experiment. No lambs died in the control group or the other 2 groups.

It is interesting to note that at the age of 10 weeks the ewe lambs were significantly heavier than the wether lambs, the mean difference being 2.61 lbs.

CONCLUSIONS

On this occasion no benefit resulted from any of the 3 treatments. The evidence in this experiment is against rather than for the use of copper in young sheep on the particular land they grazed in 1970. Judging by these results the control lambs put out to grazing on the hogg ground were not cobalt deficient or copper deficient at the start of the experiment. Before assuming that this piece of land does not in some years give rise to cobalt deficiency in lambs, controlled trials should be repeated, preferably on 2 further occasions.

APPENDIX 13 - ARTIFICIAL INSEMINATION IN SHEEP AT CERRO NEGRO, CHILE

The young rams selected as potential studs for A.I. are tried out in their first season on 100 ewes, the progeny of these being assessed as shearlings. At the present time three stud rams are being used as A.I. donors. With these a 60% conception rate is usual. Ewes in this part of Chile come into oestrus in March or April. The actual insemination season lasts 17 days. The veterinary surgeon attends daily during this time. Each 50 or so ewes inseminated with one ram's semen are identified with a chalk mark and turned into a paddock together. Fifteen days later a flock ram is put into this paddock to cover ewes still showing oestrus.

The mechanics of the operation are as follows. The ewes ready for insemination are picked out with the aid of teasers (vasectomised rams). One per cent of teaser rams are run with the ewes, ewes considered ready are driven into the woolshed. One area of the woolshed is specially adapted for insemination work. The extreme corner of this area is made into a room which functions as a small laboratory for the veterinary surgeon and his technical assistant. At one side of the room there is a raised platform. Here semen collections are made from the stud ram when it is brought in to serve a teaser sheep restrained in a yoke. A second inner wall has an eye-level sliding window through which the actual inseminations are performed. The ewes are brought up a ramp and one by one are backed against the sliding window, inseminated, chalk marked and then released.

The laboratory room is kept at a temperature of 70°F. The method for collecting semen is similar to cattle A.I. procedure but a smaller artificial vagina is used. Any unused semen can be stored up to 48 hours, semen is always examinated under the microscope for motility before being used. The semen is diluted 1 in 7 before use. The diluent used is sodium citrate egg yolk solution at pH 6.7. At each insemination 0.2 ml. of the diluted semen is injected through a vaginal speculum into the uterus, using a pistol type syringe. The syringe holds 25 doses.

Although the artificial inseminations at this farm were carried out by a veterinary surgeon, the technique once it is mastered is basically a simple one and there is no reason why it should not be carried out by a competent lay inseminator trained by a veterinarian experienced in sheep A.I. work.

APPENDIX 14 - SUGGESTED INVESTIGATIONAL WORK FOR AN AGRICULTURAL EXPERIMENT UNIT IN THE FALKLAND ISLANDS

Because of the lack of numerical information on production factors some of the work suggested is an assessment of the present position. In many instances comparison with variations on the topic can be tested simultaneously.

FERTILITY

Response of native swards (including greens and bog whitegrass) and sown pastures to calcium, phosphorus, potassium and nitrogen. Assessment to be made, ultimately, in terms of animal output.

GRASSLAND PRODUCTIVITY

The assessment of total and seasonal production of:-

a. Whitegrass

b. Bog whitegrass

c. 'Greens'

d. Yorkshire fog with special reference to winter production

e. Tussac

ESTABLISHMENT OF BETTER SPECIES

a. Whitegrass dominant camp. Priority should be given to the introduction of productive species into this type of camp.

b. Eroded areas

c. Re-establishment of tussac around the coast and inland.

d. Investigation of other potentially useful 'uncultivated' species such as Cotton Grass (Eriophorum vaginatum).

GRAZING PRACTICE

a. Integration of seasonal production of different vegetative types into pattern for optimum animal production.

b. Studies on recovery periods of native fine grasses in order to rationalise rotational grazing and spelling.

c. Effects of frequency and intensity of burning on dominant species and finer grasses.

d. Artificial defoliation and animal productivity.

DRAINAGE

a. Assessment of benefits of whole camp drainage in terms of animal output.

b. Methods and cost benefit of improving dangerous ditches and streams which cause high stock losses through drowning.

c. Water relationship of greens.

LEGUMES

a. The establishment of a long lived perennial legume such as wild white clover on greens, bog whitegrass and penguin grounds with special emphasis on minimum fertiliser dressings and on inoculation.

REPRODUCTION IN SHEEP

a. Assessment of conception; lambing and dry ewe percentages.

b. Effect of age on these factors.

c. Assessment of feasibility of artificial insemination.

MORTALITY IN NEWBORN LAMBS

a. Proportion of singles and of twins which are non-viable.

b. Effect of artificial shelter on lamb survival.

c. Survival rates in lambs which get to their feet after lambing.

d. Effect of birthweight on mortality in newborn lambs.

e. Effect of variation in the wool cover in the udder area on mortality in newborn lambs.

f. Assessment of benefits of herding at lambing time.

MARKING OPERATIONS

a. The relative merits of knife and rubber ring for docking lambs.

b. Measure the extent of blood loss following docking with the knife.

c. Evaluate the usefulness of a mothering pen in terms of lamb mortality after marking.

SURVIVAL AND GROWTH RATE OF YOUNG SHEEP

a. The effect of varying post-weaning pasture quality on

i. survival to dipping
ii. " " first shearing
iii. growth rate to dipping
iv. " " " first shearing

b. The effect of weight at weaning on the above factors.

c. The effect of body condition at weaning on the above factors.

d. Assessment of weight and body condition at dipping as indicators of survival and growth rate to first shearing.

e. The effect of improved nutrition from supplements or pasture in August and September on the survival of hoggets and on their lifetime productivity.

SHEEP NUTRITION

a. Intake studies of the species, amounts and quality of ingested herbage in livestock grazing the main pasture types - combined with digestibility studies of species at different stages of growth.

b. Measure the annual cyclical pattern of change in the body weight and body composition of ewes which rear lambs.

c. Compare the merits of improved ewe nutrition in September, October and early November in terms of lamb survival and growth, ewe weight and body condition changes, and ewe wool yield and quality from grazing.

- i. tussac
- ii. improved re-seeded pasture
- iii. Winter-rested unimproved pasture
- iv. supplementary feeding

d. Compare animal output from different pasture types when stocked at a constant weight of ewes per acre with large or small ewes.

e. The rate of Vitamin A and/or D in the nutrition of hoggets and ewes.

f. Assess the long term effects on the animals and on the pasture of supplementing rough pasture with urea/molasses mixtures.

WOOL OUTPUT AND QUALITY

a. Measure any relationship between wool yield and lamb survival.

b. Assess the effect of fleece type on ewe survival and lamb production.

c. Compare the outputs of ewes producing 50s-52s wool quality versus 56s-58s on both hard and soft camp in terms of

- i. weight of wool per acre, per ewe, per 100 lb bodyweight
- ii. value " " " " " " " " "
- iii. number and weight of lambs weaned per acre, per ewe, per 100 lb bodyweight.

BREEDS AND BREEDING

a. The productivities of Corriedale, Romney, Cheviot and Scottish Blackface ewes stocked at the same total liveweight per acre.

b. The physical and financial effects of breeding naturally open-faced sheep.

c. The relative merits of pure breds compared with crosses (eg the Polwarth, the Corriedale and the Romney bred pure in comparison with Polwarth x Romney and Corriedale x Romney ewes).

d. The relative merits of Merino x Romney and Merino x Cheviot compared with Corriedale x Romney ewes.

e. The practicability of the progeny testing scheme outlined in Chapter 12. How rapidly is progress made towards the stated objective?

CATTLE

Until it is decided whether a meat industry is to be developed, expenditure on cattle experimentation should not receive high priority. Nevertheless three topics are justifiable as preliminary work.

a. An analysis of calf mortality to the yearling stage.

b. The substitution rate of cattle for sheep under different pasture circumstances.

c. An assessment of the effectiveness of different kinds of fencing for cattle.

ENDOPARASITES AND ECTOPARASITES OF SHEEP AND CATTLE

a. The compilation of a complete list of species for the Falkland Island.

b. Seasonal worm counts of Abomasum, small intestines and large intestines of ewes and lambs both on open camp and paddocks.

c. Monthly larvae counts on herbage of

i. open camp

ii. greens

iii. settlement paddocks.

APPENDIX 15 - SUGGESTED LIST OF ESSENTIAL RECORDS FOR FARM MANAGEMENT PURPOSES

PHYSICAL

1 TALLIES (by camps)

Lambs - ewe, wether and ram lambs at WEANING
- " " " " " DIPPING

Hoggets - ewe, wether and ram hoggets at SHEARING

Shearling Ewes - at DIPPING
- at SHEARING

Two-Shear Ewes - at DIPPING

Ewes - at DIPPING
- at SHEARING

Wethers - at DIPPING
- at SHEARING

2 LOSSES

Classification of ewe losses into cast for age, culled for faults (specified), used for mutton and "other".

3 WOOL

Complete sale details for each bale of wool.

FINANCIAL

1 OUTPUT

Closing valuation
Stock sales
Opening valuation
Stock purchases
Produce sales - Wool
- Skins
- Hides
- Mutton
- Beef
- Others

2 FIXED COSTS

Labour - Salaries
- Regular wages and contract labour (eg peat cutting) not dependent primarily on the size of the sheep enterprise
- Casual wages
- Passages
- Social Benefit Payments

Power and Machinery - Machinery and vehicle spares
- Fuel and oil
- Machinery depreciation
- Contract hire

Sundries - Insurances
- Office expenses

3 VARIABLE COSTS

Wool handling charges - Freight
- Insurance
- Brokerage and commissions

Wool baling bands, sacks, etc
Dip, sprays and veterinary products
Contract labour for shearing and baling
Others

4 FORAGE VARIABLE COSTS

Seeds
Fertilizers
Fencing

APPENDIX 16 - DISPOSAL OF EQUIPMENT IMPORTED BY THE TEAM

The main group of equipment was housed in the Veterinary Laboratory. As described in the report, this was situated in the King Edward Memorial Hospital. Some of the equipment was used by the Medical staff during our stay. On the Team's departure it did not seem reasonable to lock the laboratory up while it could be of use to the Colony. With the agreement of the Colonial Secretary all the equipment was therefore made over to Government and signed for by the Senior Medical Officer. This arrangement was reached only on the specific understanding that any subsequent Agricultural Team or officer arriving in the Colony would receive the whole of the equipment back. The Senior Medical Officer also undertook to maintain the equipment in reasonable and working condition.

Another large item of equipment was the Turbomower. Several experiments had been done with this flail-type mower and six managers had tried it out under their own conditions. Most of the other managers also wished to see the sort of work it could do so the following arrangements were made with the Colonial Secretary. The machine was to be put in charge of the Officer i/c Agriculture. Any manager should be able to borrow it free of charge subject to his paying freight charges from and to Port Stanley. Should he be able to come to a mutual arrangement with a neighbour to pass the machine on overland he would be liable for the freight charge out and the neighbour to the freight back to Stanley. Any manager borrowing the machine must keep it in running order and undertake to repair breakages and replace spare parts for as long as they last. A box of spares would accompany the machine. The Officer i/c Agriculture should keep a record of the movement of the machine. Managers should be required to apply in writing for permission to borrow it.

A number of books and small items of equipment, mainly for wool sampling, were left in the Agriculture Department and signed for by the Assistant Colonial Secretary.

The Team's lamb weighing machine was at Fox Bay East at the time of its departure. It was agreed with the Colonial Secretary that it should be put nominally in charge of the Officer i/c Agriculture but left at Fox Bay East for the time being as Mr R Cockwell, the Manager, had further use for it. Mr Cockwell confirmed in writing that he had charge of this machine.

Finally there were two knapsack sprayers. These again were put in charge of the Officer i/c Agriculture. One of them was at Fox Bay East where Mr Cockwell had some plots to spray. It was agreed that the same arrangements should apply to this as to the lamb weigher. The other was being used by Mr P McGill, the Team's driver and it was agreed that the Officer i/c Agriculture should retrieve it from Mr McGill and keep it in store.

COMMENTS ON ADVISORY TEAM'S REPORT
....

p. 1. '...by 1898 the Colony carried 807,000 sheep'. This figure is suspect as at that period managers are believed to have tended to exaggerate their numbers of sheep.

p. 3. The Team stray outside their terms of reference and fields of expertise in painting what I believe to be an excessively gloomy picture of the future of wool production in the Falklands.

p. 4. The figures given in Table 1 in the column headed 'Wool Clip' are incorrect. As weighed into London Warehouse they should read:-

1963-4	4802
1964-5	4733
1965-6	4869
1966-7	4602
1967-8	4509
1968-9	4654

Seasonal climatic variations considerably affect total annual clips. The last three seasons listed above were below average in this respect.
The figures in Table 2 are based on those for F.I.C. farms but ignore the fact that the figures for 1963 and 1964 were calculated on a different basis from later years, giving a lower figure, and that 1963 was a bumper year for wool production for climatic reasons, automatically lowering the cost of production per lb. The rise in cost of production has not been as serious as the figures purport to show.

p. 5. 4th paragraph. 'Any visitor ... is certain to question whether it is absolutely essential ...'. This ignores the fact that the U.K. is the only practicable market for Falkland wool. To sell it anywhere else would lose the premium which it has over many years come to command here. This being so the wool has to be shipped to the U.K. and the cost of return voyages has to be paid for somehow. If outward freight were reduced in quantity ~~that on~~ produce would have to be increased, or the deficit otherwise made up. There would be no real saving in importing materials from elsewhere, even if they were available at comparable cost and of equal quality closer to hand, which is not the case.
Last paragraph. 'Is every man fully employed all the year round ...?' It would certainly cut costs if permanent gangs could be cut and more seasonal labour employed. But in the circumstances of the Falklands that is impracticable without importation of men from the mainland, with all the difficulties and dangers that would involve. There is a case for paying higher basic wages during the summer than the winter, to encourage men to take unpaid holidays during the slack season. Another possible approach is to look for more profitable ways of using labour during the winter - e.g. by tanning skins and hides.

p. 11. 2nd paragraph. Stock eat the leaves, not the bark, of native box and find them very attractive.

p. 28. Last paragraph. I agree that there is a growing body of opinion that late summer to early autumn is generally the safest period for seeding, and with that opinion. It is not true to say that farms which cultivate in the winter are committed to spring seeding.

p. 29. 4th paragraph. At Roy Cove [& Hill Cove], the two farms which have done most reseeding, depreciation charges on machinery certainly are allowed for in costing. A few years ago costs were about £1 per acre for direct seeding, £2 for seeding after rotavation and £4 after ploughing, where machinery was used intensively. Costs must have risen since but will remain in about that ratio.

p. 30. 1st paragraph. A similar effect to burning is not in fact obtained by allowing the surface to weather, however long it is left.
2nd paragraph. In my opinion the principal reason why sod-seeded Fog has not spread is that the mat between the drills, not being broken up, could not be penetrated by shed seeds.
Last paragraph. 'Most managers had pressed on with this work as quickly as allowed by their directors'. The F.I.C., Port Howard and Hill Cove managers have certainly not been refused permission to subdivide where they have wanted to.

p. 32. 4th paragraph. It is untrue to say that use of the Turbomower could be a viable alternative to burning. It would be much too expensive.
Spelling. The Team make a distinction between spelling and Rotational grazing. Surely one is a form of the other?

p. 33. Drainage. The Team seem to be unaware that the F.I.C. pioneered use of the Buffalo tractor and ditching plough at Fitzroy on an extensive scale before arrival of the Government machines, with which relatively little was done. I have seen no evidence that the results at Fitzroy came anywhere giving an economic return on the expenditure.
They seem also to be unaware that the F.I.C. used a ditching machine of the type they recommend extensively at Fox Bay West for several years, again with very disappointing results in economic terms.
I do not myself believe that mechanical treatment of ditches can generally be an economic proposition in the Falklands. Loss of sheep in ditches can be much reduced at low cost by erecting light sheep bridges at strategic points. Nor do I believe that ditches need be a major cause of loss of hoggets, if they are adequately nourished. It is usually the undernourished hogget which falls in a ditch when trying to jump it. On the other hand ditches and holes are a major cause of loss of lambs in the playful stage before weaning.

p. 34. Assessment of results of Improvements. I do not agree with the Team's pessimistic assessment of the situation. The only two farms which have reseeded extensively for a considerable period are Roy Cove and Hill Cove. Both got under way about 1959. The former produced 40% more wool in 1970 than in 1959, the latter 22% more, both without any inherent appreciable increase in recurrent costs.
They <u>have</u> done this by increasing feed available in winter and spring. My experience and observations tell me that Yorkshire Fog <u>does</u> make more growth in the bottleneck period than anything else, particularly if it has been allowed to grow rank in the previous summer, which the Team deprecates so much. I have concluded that allowing it to get well away in the December-February period of maximum growth contributes to better early grwoth the following spring by allowing the plants to store nourishment in the roots and providing shelter from dead 'waste' growth to new growth at ground level.
I have frequently observed that on rotavated camp allowing a thin stand of Fog to seed <u>does</u> rapidly achieve a better ground cover. On ploughed ground the process is much slower and less certain because a bare peat surface without trash is much less receptive to shed seed.
I understand that the Team experienced an exceptionally cold and dry spring. I am not surprised that Yorkshire Fog on exposed reseeded areas showed no growth. I know of no grass likely to have shown more.

p. 39. Chapter 7. Tussac... The Team may well be right that there is a place for tussac plantations on mainland farms. Their recommendations should be followed up. A difficulty which they do not mention is the extreme attraction of tussac for all stock, which causes cattle and horses to break down stout fences to get at it.

p. 42. Chapter 8. The Upland Goose. Some people believe that geese do good as well as harm. Whether or not that is so I am sceptical of the practicability of controlling their numbers. Poisoning has been tried in the past and failed.

p. 43. Last paragraph. The Team are apparently unaware that in the early 1900's Hill Cove imported 200 tons of lime and spread it on natural camp with no visible result; and that in 1956-7 the F.I.C. imported 80 tons of ground mineral phosphate from North Africa, which spread on natural camp had no apparent effect other than to encourage pigvine.

p. 44. Penultimate paragraph. I have seen thousands of acres rotavated on all types of camp and never experienced any trouble with wind erosion, except where sand was turned up. The surface left by the rotavator is too cloddy for this to occur.

p. 45. First paragraph. 'It is best to burn in late winter or early spring ....'. This is disputable. I personally believe that it is safer to burn in autumn, because if the fire does burn deep into peat when the camp has started to dry out in the spring, which may well be the first opportunity at that period to burn at all, it is liable to smoulder all through the summer and revive whenever conditions are right. If the same thing happens in the autumn the fire is always extinguished by winter wet.
Third paragraph. Coulter drills have not generally been found satisfactory on rotavated ground, because they block too easily. Although it does not bury the seed so effectively the Brillion roller-seeder has been found more satisfactory and combines consolidation with seeding.
Fourth and fifth paragraphs. From personal experience I am convinced that there is much less risk of failure in sowing Yorkshire Fog than any other kind of grass, because it has greater ability to survive a dry spell after germination, which can occur at any time of year. The other grasses mentioned grow well when established, but Cocksfoot is not happy in an exposed situation, the leaves showing a yellowish tinge due to wind dessication. Yorkshire Fog is protected from dessication by the hairs on its leaves, the fescues by their rolled leaves. I do not believe that any of the other grasses provide more feed during the period it is most needed than Fog. The seed of Sheep's Fescue is commercially difficult to obtain and very expensive. Yorkshire Fog seed is cheaper than any of the others, though somewhat erratically available in large quantities. This is because it is nowhere specifically sown as a crop, all seed available being cleanings from other seed.
I stillagree that it is worth while experimenting with seeds mixtures, though one is apt to find where Fog is included even as a minority element in a mixture it dominates the final sward, because of its greater ability to establish itself.

p. 46. Prepenultimate paragraph. In my experience Poa Pratensis is the best grass for withstanding foot erosion where there are heavy concentrations of sheep, but difficult to establish from seed.

p. 48. The Rotaseeder is an expensive and cumbersome machine. I have no experience of the flail mower method, but it seems likely to me to be more economic. It should be possible to fit a seed-box in front of the mower, so as to seed and flail in one operation.

p. 61. Chapter 11. I welcome the Team's rejection of subdivision as a panacea, which F.I. tax legislation has recently been trying to encourage. As stated previously I do not agree with thei. low opinion of Fog reseeds as a source of Spring feed. To adopt their recommendations for heavy grazing of these during their period of maximum growth would I believe minimise their contribution at the time it is most needed.

p. 67. The Team's advice as to wool objectives differs somewhat from that given by David Smith & Co., whose opinion evidently carrie more weight, since they buy over half the total Falkland clip.

p. 69. Imported rams have all been bred in a totally different and less harsh environment. They bring desirable qualities, but these have to be grafted on to Falkland-bred sheep without losing the latters' ability to thrive in the local environment. I believe that widespread use of imported blood by artificial insemination would be dangerous as well as very difficult to carry out with available labour; and that it is wiser as well as easier to cross the imported ram by natural mating on to a limited number of locally bred ewes, and cross only those selected offspring, which combine the imported improvements with ability to thrive, on to main stud flocks.

p. 70-71. The suggested breeding scheme is technically very attractive, but would be difficult to carry out with labour available on Falkland farms. It is not a matter of the quality of the ~~number~~ labour, but the quantity and the fact that the Falkland climate is such that all the main stock operations have to be carried out in a period of 5 months.

p. 75. I do not understand precisely what the Team are recommending. The objectives stated should be obtained by the new David Smith & Co. and registration of 'Falkland' as a Trade Mark by the F.I. Sheepowners' Association now being discussed.

p. 76. The suggestion of bonus payments for a limited number of approved sheepdogs per shepherd has merits. The S.O.A. has previously considered some form of grading of shepherds without deciding on any action.

p. 77. I think most farm managers accustomed to drafting large numbers of sheep would agree that 18' is long enough for a drafting race. If longer it requires more men to operate and delays are more likely. Also that three-way drafting gates are essential and no less accurate than 2-way in the hands of a skilled operator.

p. 78. Shearing. The Team's remarks take no account of the fact that shearing is a skill for which some men have much more natural aptitude than others. Australasian professionals must have that aptitude or they would not choose the job. Shearers in the Falklands have or lack it in varying degrees. While expert tuition is desirable, it is unrealistic to suggest that if they were better trained they would all become highly skilled.

p. 80. Counting lambs at weaning. In theory I agree that this is desirable. In practice it is incompatible with minimum stress for them at that time, the need for which they emphasise. It would involve a longer period in the pens and more disturbance.

The wool recording they recommend would again be desirable but is incompatible with the economy in labour which they elsewhere advocate.

p. 91. 2nd paragraph. The suggestion that Government should make it an offence to sell or export ked-stained wool seems to me to have little to recommend it. It would in any case be difficult to establish what exactly constitutes ked-stain.

p. 109. Agricultural Experiment Unit. The scheme proposed is very attractive, provided the Falkland Islands farming industry does not have to pay more than a moderate contribution towards the cost. I suggest that the most suitable land for the Unit to take over would be the whole of Bluff Cove in spite of its preponderance of very poor land. It runs about 3,500 sheep at present. It is conveniently near Stanley. It is at present economically non-viable as a commercial unit and ked-infestation makes it a menace to its neighbours.

p. 111. Chapter 23. The criticism concerning insufficient financial information being given to farm managers is perhaps valid in respect of F.I.C. Section Managers, though the Camp Manager is fully informed.
I also agree that the cost heading 'Materials' in cost of production figures given to managers should be broken down under several headings.
I am too ignorant of accountancy to comment usefully on the remainder of this page, but the recommendations seem well worth following up.

p. 112. 1st paragraph. It would certainly be useful if managers could visit other farms while the important yearly operations were in progress. Unfortunately local circumstances, particularly travel difficulties, make it quite impracticable.
2nd paragraph. I do not think the F.I.C. can be criticised for not encouraging and financing visits by managers on leave to places of technical interest in the U.K. It would be wrong I think to overpersuade managers who are not keen. They are after all on well-deserved holiday. The research being done at Bariloche has little relevance to the very different climatic and other circumstances of the Falklands.

p. 113. Ditching. I repeat that I do not think large scale mechanical treatment of ditches can be an economic proposition. If it were, for Government to buy machinery and hire it out would be the worst possible method, as I think experience with the Government Buffalo tractors and drainage ploughs proved.
Purchase of fertilisers. As stated previously it has already been proved to my satisfaction that spreading of lime and phosphate on natural camp brings no appreciable return. It seems to me entirely premature to envisage large scale importation of fertilisers before their economic effectiveness has been proved on a small scale. needs more work.
Importation of Stock. We have already established that a minimum of 100 sheep could be landed in the Falklands by direct shipment from New Zealand next season at a transport cost of about £80 per head, much less than by any other means. We await information as to numbers which independent farms would wish to import by this means before deciding whether to go ahead.
Farm Laboratory Facilities. There would be no point in providing these facilities on farms where there is nooone qualified to use them, there being nobody in the Falklands qualified to instruct in their use.

p. 118. RECOMMENDATION.. I disagree for reasons given previously.

p. 119. 1st RECOMMENDATION. Only concerns any future Experimental Unit which may be set up.
2nd RECOMMENDATION. Tussac has to be very well fenced to keep out horses and cattle. Most otherwise suitable rincons present insuperable difficulties in making fences stock-proof at beach ends.
3rd RECOMMENDATION. Worth trying.
4th RECOMMENDATION. Only concerns any future Experimental Unit.

p. 120. 1st RECOMMENDATION. I agree
2nd " I agree.

p. 121. 1st RECOMMENDATION. On rotavated ground the Brillion roller-seeder is more satisfactory than a coulter drill, because the latter tends to block and sow too deep.
2nd RECOMMENDATION. I think the suggested mixture worth experimenting with but should not replace straight Yorkshire Fog until proved.
3rd RECOMMENDATION. Not applicable to F.I.C.
4th RECOMMENDATION. I agree where practicable.
5th RECOMMENDATION. I agree.
6th RECOMMENDATION. I agree, where practicable.

p. 122. 1st RECOMMENDATION. I agree except as regards seeds mixture.
2nd RECOMMENDATION. I agree.
3rd RECOMMENDATION. I agree.

p. 123. 1st RECOMMENDATION. I agree.
2nd RECOMMENDATION. I agree that lambs should be weaned onto good pasture. I have found the most practicable method of doing so to put them onto hogget camps rested since the hoggets were gathered for shearing.
3rd RECOMMENDATION. I agree.

p. 124. 1st RECOMMENDATION? I agree.
2nd RECOMMENDATION. I agree.
3rd RECOMMENDATION. I agree.

p. 125. 1st RECOMMENDATION. I agree with the desirability but doubt the pra cticability on most farms.
2nd RECOMMENDATION. Steps slready taken by F.I.C. make this unnecessary. It would in any case be very dangerous if processing of Falkland wool were all in the hands of one firm.
3rd RECOMMENDATION. I agree.

p. 126. Recommendation. We have recently enquired as to the cost of this and found it would be very high. Mr A.T.Blake, to whom we are contemplating offering employment, is a qualified New Zealand shearing instructor.

p. 127. RECOMMENDATION. I should be glad to see this done, as long as the sheep farming industry did not have to pay for it. It would be very expensive and I am confident that the result would be negative.

p. 128. 1st RECOMMENDATION. I agree.
2nd RECOMMENDATION. I agree, except that I think it pointless to make sale or export of ked-stained wool an offence.

p. 129. 1st RECOMMENDATION. I agree.
2nd RECOMMENDATION. I think this unnecessary.
3rd RECOMMENDATION. I do not feel qualified to comment.

p. 130 1st RECOMMENDATION. I agree, except that aerosols are expensive and apt to be unsatisfactory in the Falklands, owing to high cost of freight and liability to leak pressure in transit.
2nd RECOMMENDATION. I agree.
3rd RECOMMENDATION. I agree.

p. 131. 1st RECOMMENDATION. I am unqualified to comment.
2nd RECOMMENDATION. I agree, provided the sheep farming industry has to pay only a modest proportion of the cost, and suggest Bluff Cove as the most suitable site.
3rd RECOMMENDATION. I agree.
4th RECOMMENDATION. I agree.

p. 132. 1st RECOMMENDATION. If a group of managers choose to form such a body it can do no harm and may do good.
2nd RECOMMENDATION. I agree.
3rd RECOMMENDATION. This could only be useful if profitable develop

development were only being prevented on some farms by lack of capital. I doubt whether this is so.

W.W.B.

25/1/71