

H I L L F A R M I N G R E S E A R C H O R G A N I S A T I O N

ANNUAL REPORT for the Academic Year 1962-63

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Lepinmore, Strathlachlan, Argyllshire.

Sourhope, Yetholm, Kelso, Roxburghshire.

INTRODUCTION

The most important feature of the years work has been the confirmation of the previous conclusions that family and social relationships of sheep affect their grazing behaviour on a hill and that there is a much greater variation in the environmental conditions under which individual hill sheep graze than had been thought previously.

This work by Dr. Hunter has isolated some inherent weaknesses in former conceptions of experimental design for animals on free range pastures and to a large extent explains the conflicting and inconclusive results obtained in hill experiments conducted by both this and other organisations. It makes essential the development of a new approach.

STAFF CHANGESDepartment of Animal Studies

- Appointment - Mr. J. G. Griffiths - S.O. as from 12.11.62
B.A.(Hons.)
- Promotion - Mr. J. M. Doney - S.S.O. to P.S.O. as from 1.4.63
B.Sc., Ph.D.
- Mr. R. G. Gunn - S.O. to S.S.O. as from 1.4.63
B.Sc.(Agr.), Ph.D.
- Mr. W. F. Smith - Sen.Asst.(Sc.) to E.O.
A.I.S.T. as from 1.4.63
- Resignation - Miss P. F. Riches - A.E.O. as from 30.4.63
B.Sc.

Department of Agronomic Studies

- Promotion - Mr. J. N. Peart - S.S.O. to P.S.O. as from 1.4.63
B.Sc.(Agr.), M.Sc.

Research Farms

- Appointment - Mr. A. D. M. Smith - A.E.O., as from 9.9.63 (Sourhope)
S.D.A., N.D.A., S.D.D.
- Promotion - Mr. W. J. Hamilton - A.E.O. to E.O. as from 1.4.63
N.D.A., N.D.D. (Glensaugh)

ANIMAL STUDIESSubject of Research
and Workers Concerned

Report

A. NUTRITION1. Ewe hogg rearing
and wintering

R. G. Gunn

(a) Hairney Law, Sourhope

Production recording of the two remaining age groups of North (N.C.C.) and South Country Cheviots (S.C.C.) reared as hoggs on High plane (H.P.), Medium plane (M.P.) and Low plane (Hill) has continued. The weaning percentages were as follows:

| <u>Born 1957</u> | <u>S. C. C.</u> | | | <u>N. C. C.</u> | | |
|------------------|-----------------|-------------|-------------|-----------------|-------------|-------------|
| | <u>H.P.</u> | <u>M.P.</u> | <u>Hill</u> | <u>H.P.</u> | <u>M.P.</u> | <u>Hill</u> |
| 5th lamb crop | 75 | 75 | 89 | 90 | 100 | 82 |
| <u>Born 1958</u> | <u>Away</u> | | <u>Hill</u> | <u>Away</u> | | <u>Hill</u> |
| 4th lamb crop | 83 | | 75 | 107 | | 93 |

The 1956 born age group which were transferred to Glensaugh and treated as an inbye flock in an attempt to determine any difference in incidence of dystocia under these conditions were adversely affected by the severe winter, as were all the sheep stocks, and were merely brought into good condition for lambing by the feeding treatments imposed. Only one case of dystocia was recorded.

Weaning percentages were as follows:

| | <u>H.P.</u> | <u>M.P.</u> | <u>L.P.</u> |
|----------|-------------|-------------|-------------|
| S. C. C. | 100% | 40% | 63% |
| N. C. C. | 133% | 112% | 100% |

The 1957 born age group have also been transferred to Glensaugh where they will produce a sixth lamb crop as inbye sheep with the same objective.

(b) Schil, Sourhope

Observational work by the Botanical Studies department has indicated that the hoggs in this experiment which were wintered together in pens, formed social groups on their return to the hill. This caused a non-random distribution of treatment groups within the hill environment. Full recording will be continued on these sheep but the interpretation of the results will depend on the duration of the social groups and the extent of the differences caused by them. An extension of the experiment is planned in which the different treatments will be applied within each pen of lambs, so that any subsequent non-random distribution caused by the formation of social groups will not apply to the nutritional treatments.

Lamb/

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Report

1. Ewe hogg rearing
and wintering
(Contd.)

Lamb production in the first productive year was adversely affected by the severe winter, lamb mortality being high in all groups (26 per cent to 31 per cent). Pre tupping weights (18 months) and weaning percentages were as follows:

| <u>Pre-weaning treatment</u> | <u>Wintering treatment as hoggs</u> | <u>Weight (Nov.)</u> | <u>Weaning %</u> |
|----------------------------------|---|--------------------------|------------------|
| Low | Low | 101.8 | 63 |
| High | Low | 100.2 | 67 |
| High | High | 110.7 | 73 |
| Low | High | 107.4 | 64 |

(c) Finella, Glensaugh

As a preliminary trial to examine the concept of improved rearing during the first 6 months of life being more important and of more lasting value than expensive wintering, half the ewe lambs born as singles plus half those born as twins but reared as singles (the other twin being artificially reared) were retained with their dams on reserved hill land after marking (6 weeks). The other half were returned to the hill in the normal manner along with the rest of the flock.

Live-weights were:

| <u>Group.</u> | <u>No.</u> | <u>Marking 13/5/63</u> | <u>Weaning 14/8/63</u> |
|---------------|------------|----------------------------|----------------------------|
| Reseed | 26(8) | 23.6 | 74.9 |
| Hill | 29(10) | 23.7 | 64.0 |

Number of twins reared as singles in brackets.

At weaning, the bottom 4 or 5 were cast from each group and the remainder retained as replacements. All were then separated from their mothers and run together. All will receive identical wintering in the manner practised at Glensaugh. Their future live-weights and production performance will be closely examined.

2. Lamb fattening

A. J. F. Russel

Two aspects of the problem of fattening hill lambs have been studied, viz. (1) the development of a system of fattening lambs continuously housed from weaning, which might serve as a basis for feed-lot fattening, and (2) the development of a system of fattening lambs grazing home-grown forage crops. Preliminary investigations were initiated in Autumn 1962.

(a) Housed Lambs

Preliminary studies in the Glensaugh sheep house in 1962 confirmed the superiority of maize over barley as a base for a lamb fattening concentrate, and indicated that the pelleting of the concentrate gave a slight advantage in live-weight increase over the dry feed mix.

Hay/

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2. Lamb fattening
(Contd.)

Hay was fed in chopped and in ground and pelleted forms and although observations at different times **showed** that lambs fed pelleted hay did not ruminate, there was no difference in performance attributable to the physical form of the hay.

(b) Grazing Lambs

(i) Supplementation of Rape

In 1962 the supplementation of rape with a high energy concentrate was effective in increasing the daily live-weight gains of Blackface lambs at Glensaugh and of South Country Cheviot lambs at Sourhope. The control and supplemented groups of Blackfaces at Glensaugh gained more rapidly and were ready for slaughter sooner than the comparable groups of South Country Cheviots at Sourhope. A trial is now in progress at Sourhope to give a valid comparison of these two breeds.

There is some evidence from the preliminary studies that the feeding of high energy supplements not only increases daily live-weight gains but also allows more efficient use of the crude proteins in rape. The effect of different levels of supplementary feeding on the nitrogen balance of rape fed lambs is now being studied at Sourhope.

The 1962 trials also showed that the thyroid glands from rape fed lambs were approximately double the weight of those from lambs grazing aftermath. It is considered that this is a hypothyroidism caused by goitrogenic factors known to exist in many of the Brassica species, and an experiment is at present in progress to test this hypothesis and to assess any effect of this condition on performance.

(ii) Supplementation of Aftermath

The supplementary feeding of a high energy concentrate was also effective in increasing the daily gain of Blackface lambs grazing aftermath at Glensaugh and at Lephinmore, and of South Country Cheviot lambs on aftermath at Sourhope. As was the case with rape, the live-weight increments of the Blackfaces were superior to those of the Cheviots, but it is not yet possible to state whether a real breed difference is involved.

At Glensaugh the Blackface lambs on aftermath were initially comparable to those on rape, and at Sourhope the South Country Cheviots on aftermath were of the same genetic and environmental backgrounds as those on rape. In both breeds the lambs fattened on aftermath gained more rapidly than those on rape. This was true of the supplemented and unsupplemented treatment groups.

Comparisons/

ANIMAL STUDIESSubject of Research
and Workers Concerned

Report

2. Lamb fattening
(Contd.)

Comparisons of different classes of lambs at Glensnaugh showed that the live-weight gain of wether lambs was significantly greater than that of ewe lambs. Lambs which were heavier at weaning made more rapid gains than those which were lighter at weaning.

(iii) The Effect of Shelter

Artificial shelter was made available to half of the lambs grazing aftermath at Lephinmore where high rainfall conditions are generally experienced throughout the year. The Autumn months of 1962 were characterized by an almost total absence of wet weather in this area, and no difference in performance could be detected between the groups with and without shelter.

(c) Carcase Studies

The carcasses of the lambs used in the various fattening trials were separated into commercial cuts or joints (gigot, loin, flank and forequarters) and the weights of these joints expressed as a percentage of carcase weight. The percentage joints were then related to their commercial value in an attempt to develop an index of carcase merit which would reflect good development of high priced parts and favour those carcasses of superior conformation. Statistical analyses are not yet complete but the results to date suggest that, because of the very small variation in the proportions of the various joints, the resultant index may give very little information which is not already supplied by carcase weight. The results further suggest that this type of index may be more suitable for comparisons between breeds than within breeds.

B. PHYSIOLOGY1. DystociaR. G. Gunn and
W. N. M. Foster

Recording of cases of difficult births has continued. Preliminary tests have been made on lamb head size/live-weight relationships. These are to be extended. It is not possible to draw any sound conclusions from the limited analysis made as yet on these records.

2. Effect of lamb
removal on
lactation of
twin-bearing ewes

A. J. F. Russel.

This experiment, to determine the effect of time of removal of one lamb from a twin pair on growth rate of the remaining lamb reared on its dam as a single, was repeated in 1963. Results were generally similar to those of the previous year in that the growth rate of twin/singled lambs was approximately the same as that of natural singles. Time of separation from 3 to 21 days seemed/

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2. Effect of lamb removal on lactation of twin-bearing ewes (Contd.)

seemed to have no consistent effect on growth rate. No evidence of ill effects on the ewes was found. The experiment has terminated and the results are to be analysed.

3. Environmental studies and climate physiology

Projects within this study involve the inter-relation of ecological and physiological factors covering the evaluation of the natural and artificial climatic environments to which hill sheep are subject and the investigation of the direct and indirect ways in which the climatic environment affects the productive capacity of the animals. Three groups of experiments have been developed within this field.

- (a) The assessment of natural environments

J. G. Griffiths

The objective of this study is to measure the complexity of factors which make up the climatic environment and obtain a synthesis of these meteorological measurements into a single quantitative value. The animal responses, physiological or behavioural, can then be related to the environmental conditions and an index of climatic stress developed. Preliminary studies on micro-variations of climate have been initiated at Lephinmore, on a section of inbye land. These observations are being correlated with the grazing patterns, feed requirements and production of fattening hogs.

- (b) The effect of exposure on appetite

J. G. Griffiths

A small controlled experiment has been started at Sourhope to investigate the effects of exposure on the appetite and subsequent production of wintering ewe hogs.

- (c) Wind profiles in the fleece

J. G. Griffiths
and J. M. Doney

Preliminary studies on model sheep in a wind tunnel have shown that the airflow in the outer layers and on the surface of the fleece can be modified by changes in the external airflow. This could influence breed differences in heat loss considerably.

C. DENTITION INVESTIGATIONS

1. Mineral supplement

R. G. Gunn, in association with Dr. E. J. Butler (A.D.R.A.)

This experiment on the Cairn, Glensaugh has now completed its second season of treatment, the management, feeding and mineral dosing with calcium and/or phosphorus being similar to that described in last year's report. The severe winter necessitated more hand-feeding than in the previous year, the hill ground and even the low-ground being under deep snow for several weeks. During this time the blood phosphate levels dropped to the lowest values yet recorded in this experiment, the mean values for all groups being well below the recognised low level for the normal range. These levels were raised considerably during the last few weeks of pregnancy and were depressed/

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1. Mineral
supplement (Contd.)

depressed only slightly during May, a similar situation to 1962 and unlike that of the previous two years. Again there was little difference in the blood phosphate levels between the four groups. From before lambing until marking time, the phosphorus and calcium dosed groups overcame the loss in weight of lamb and maintained their live-weight, while the control group lost 6 lb. and the hill group lost 16 lb. Production performance was similar in all groups, due to fewer deaths and fewer twins in the hill group than in the others. A number of ewes died in the phosphorus group this will be carefully watched next year.

These ewes are now $3\frac{1}{2}$ years of age and premature dental breakdown can be expected to commence at any time from now onwards. The latest dental scoring taken on 3rd September, 1963, suggests that calcium and phosphorus dosing are both improving the state of the teeth, in particular the bite position and mobility of the teeth. Interest will now centre on this situation during the next year.

2. Dentition photography

R. G. Gunn

This is being continued on the Cairn sheep. Repeatability tests are being carried out on the accuracy of the technique.

3. Mixed grazing of
heather and grass

R. G. Gunn

To examine the effects on the dentition of rearing and maintaining ewes on the same area of heather hill with access to improved grass, 37 B.F. and 18 Cheviot ewes, all with ewe lambs, were placed on the Lochhills at marking. Access to an 11 acre field of grass was provided. At weaning the ewes were removed and the ewe lambs will remain on this area throughout their breeding lives. Dentition eruption and breakdown will be examined throughout life.

4. Inheritance of
broken mouth

R. G. Gunn

25 ewe lambs, offspring of a tup known to be broken mouthed at the two-tooth stage, have been retained from the Cairn and will be run on the Big Hill, where their dental performance will be carefully observed in comparison with that of ewe lambs from tups with sound mouths. These observations, along with others from broken mouthed matings, will be used to provide preliminary information on possible genetic influence on this character.

D. BREEDING/

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D. BREEDING1. Effects of
inbreeding

J. M. Doney

General: The field investigations, which involved the mating of four rams to groups of daughters and unrelated ewes in three consecutive seasons, have terminated. The results showed that this level of inbreeding produced lambs which were smaller at birth and had a slower growth rate than their non-inbred half sibs. Pre and early post-natal mortality rates were high in inbred lamb groups. Amongst surviving ewe hoggs, the inbreds had a lower chance of being retained in the breeding flock under normal farm selection procedures, and, at two years of age, showed a very low percentage of successful pregnancies. The lambing and mothering performance of these ewes will be followed for the rest of their normal hill life. Increased variance was associated with reduced mean in almost all characteristics of the inbred sheep.

2. Feed
Utilisation

J. M. Doney

Inbred and outbred wether lambs from the above matings were chosen for an experiment on feed utilisation. They were used to study the dependence of the observed inbreeding depression on nutritional factors and to make preliminary observations on general genetic differences in feed utilisation and partition. A standard pelleted ration was used throughout the experiment. It was found that, despite previous differences, the differences between the two groups in rate of live-weight gain and in wool production were non-significant when rations were limited to levels resulting in either a slight negative or a small positive live-weight gain. Under 'ad lib' feeding conditions however, the mean voluntary intake of the outbred lambs was about 20% greater than that of the inbreds whilst rates of live-weight gain and of wool production were about 30% greater. This suggests that the depression caused by inbreeding, already shown to be removed by suitable endocrinal supplementation, might operate mainly through differences in voluntary intake on a given feed type. Differences amongst animals in the gross efficiency of conversion of feed to production characters may also exist when sheep are fed to maximum voluntary intake. Digestibility trials showed very little variation within or between groups at low restricted feed levels but we were not able to repeat these trials at high levels.

The/

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2. Feed
Utilisation
(Contd.)

The data are being examined to try to determine a suitable statistical model to assess the differences between groups or treatments in overall feed utilisation and in the partition of intake amongst the various components of production.

E. FLEECE STUDIES1. Nutritional and
Climatic control
of wool growth

J. M. Doney

The work at Lephinmore has suggested that, under free ranging conditions on the hill the rate of wool production by Blackface sheep is reduced slightly by pregnancy and considerably by lactation. Other results from these experiments have suggested a hypothesis on the interaction between seasonal (possibly climatic) and nutritional factors in the control of wool growth. It seems that from late Spring to mid autumn the rate varies with the level of feed intake but that during winter, wool production declines to a minimum (down to 10% of peak rate) which is independent of intake at least up to maintenance level. This lack of response to variation in below-maintenance intake during winter differs from published observations in other breeds, mainly Merino and N.Z. Romney. It is suggested that genetic differences exist in the control of wool growth by response to external factors and that such differences could result from the effects of selection on wool production alone. A series of small scale experiments, designed to test the validity of different aspects of this hypothesis, are now in progress at Glensaugh and Sourhope as well as at Lephinmore.

The monthly observations on wool production by free grazing Cheviot wethers at Sourhope (annual cycle of intake - Eadie) are continuing. These results have not been analysed but the annual cycle of wool production shows a sharp drop in December to a low level which remains fairly constant till April after which there is a sharp increase to a more variable summer level.

2. Adaptive value
of the fleeceJ. M. Doney and
J. G. Griffiths

Earlier work has shown that gross criteria such as live-weight change are of little use in assessing differences in adaptation due to the fleece. Progress in the development of better methods, such as the measurement of the insulation, sensible heat loss from the skin and total heat production, has been slow. The East of Scotland College of Agriculture have now provided us with a site and with a Lister hay drier as a source of air movement, enabling us to construct a wind tunnel./

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2. Adaptive value
of the fleece
(Contd.)

tunnel. This allows a greater degree of control over the climatic stresses imposed and will therefore allow the development of a wider range of techniques for assessing variations in response to such stresses. This programme will be extended to a study of the genetic variation in other physiological aspects of climatic adaptation.

3. Fleece
development

J. M. Doney

The pre-natal nutritional limitation associated with twin pregnancy was shown to reduce the number of secondary wool fibres present at birth. Providing post-natal nutrition was adequate, the differences in all fleece characters between lambs born as singles and those born as twins had disappeared by six weeks of age. Severe post-natal restriction of feed intake during the first few weeks of life, achieved by artificial rearing, had marked effects in secondary fibre development, on total rate of wool production and on the hair shedding cycle. These effects persisted well beyond the period of nutritional limitation but had disappeared by the time the lambs were one year old. Moderate limitation (lambs reared as twins compared with those reared as singles) was intermediate in its effects.

4. Thermal insulation
of the fleece
(artificial sheep)J. M. Doney and
J. G. Griffiths

An electronically controlled guarded hot plate has been built and is undergoing preliminary calibration tests prior to installation in an artificial sheep for use in wind tunnel studies (see E3 and B3c.).

F. ANIMAL HEALTH1. An Investigation
of Lamb MortalityW. N. M. Foster
and R. G. Gunn

Heavy lamb losses between birth and marking are frequently experienced at Lephinmore and in the adjoining hill regions of Western Argyllshire.

Within the limitations imposed by hill conditions (e.g. black loss and the ravages of predators) the causes of lamb mortality over this period have been investigated.

No evidence was obtained that deaths were due to any one specific disease. A variety of factors, in the main physical, geographical and climatic contributed to the toll, but it was apparent that management can play a considerable part in reducing losses.

Thus/

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1. An Investigation
of Lamb Mortality
(Contd.)

Thus in the two hirsels lambed inbye and returned to the hill at approximately ten days of age the lamb losses, expressed as total deaths or as percentages of lambs born/ hirsels were considerably lower than the losses in the hirsels lambed on the hill. In the latter case some 50% of the loss was occasioned by drowning and black loss.

| | Born Dead | Died Birth- Marking | Missing at Marking (Black loss) | Total |
|-----------------------------------|--------------|---------------------------|---------------------------------------|-----------|
| Barnacarry (lambed on hill) | 4 (2.3) | 30 (17.0) (12 drowned) | 8 (4.6) | 42 (23.9) |
| Low End (lambed in-by) | 4 (2.6) | 3 (1.9) | 6 (3.8) | 13 (8.3) |
| Mid Hill (lambed in-by) | 9 (3.7) | 12 (4.9) | 1 (0.4) | 22 (9.0) |

Solid type represents actual mortality.

Figures in parenthesis represent % mortality on hirsels.

2. Tick Borne Diseases(a) Studies on the
aetiology of
Tick Pyaemia

W. N. M. Foster

In many tick infested areas of the north of England and Scotland this disease is of economic importance. Prophylactic measures are not yet available and whilst penicillin therapeutically is beneficial, its administration under hill conditions is often impracticable or delayed until tissue damage has occurred. Earlier work by the Animal Diseases Research Association suggests that the sheep tick (*Ixodes ricinus*) is not the vector of the staphylococci, the role of the tick probably being confined to the transmission of a predisposing condition - tick borne fever. Moreover the incidence of pyaemia is often higher on farms with a low tick infestation. This supports the contention that tick bite is not necessarily the source of infection.

An alternative portal of entry for the bacteria which has not been investigated is per os. Expressed in another way the incidence of pyaemia, irrespective of the degree of tick infestation may be an indication of the degree of sub-clinical staphylococcal mastitis (or alternatively teat contamination) in the flock.

A limited number of examinations were carried out in the early part of the year to investigate this possibility.

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(a) Studies on the
aetiology of
Tick Pyaemia
(Contd.)

(1) Blood agar plates were cultured with the incubated milk of six ewes each of which was nursing a pyaemic lamb. In five of the six cases haemolytic staphylococci were isolated. In the sixth (negative) case the lamb had developed pyaemia some four weeks previously.

(2) To obtain information on the incidence of staphylococci in ewes milk, samples were obtained from twenty-five ewes in three different flocks. The results are shown below:

Flock A (Tick Area: Yarrow Valley) 25 ewes
sampled

Haemolytic staphylococci isolated
from the milk of three ewes.

Flock B (Tick Area: Yarrow Valley) 25 ewes
sampled

Haemolytic staphylococci isolated
from milk of three ewes.

Flock C (Tick Free Area: Pentland
Hills) 25 ewes
sampled

No staphylococci found.

The results of the foregoing investigations are insufficient in number to draw any definite conclusions, but do suggest that this subject merits further detailed study.

(b) Prevention of
Tick Pyaemia

It is often claimed that tick cream smeared on the lamb at birth protects it from tick bite, and hence from tick borne disease and 'tick worry' at a susceptible phase of its life.

W. N. M. Foster

To study the validity of this claim alternate lambs on one hirsle at the Iephinmore Research Farm were smeared with tick cream at birth (68 smeared: 77 unsmeared). A tick count on eleven smeared and eleven unsmeared lambs at three weeks of age showed that tick cream had considerably reduced but not eliminated infestation with adult female ticks. However, infestation of the head region with nymphal ticks was approximately the same in both groups of lambs.

Little evidence was obtained of any prophylactic value of tick cream. Only four cases of pyaemia occurred and these were evenly distributed between the smeared and unsmeared groups.

Present results thus suggest that on this farm where the tick infestation is not exceptionally heavy little benefit is obtained by/

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(b) Prevention of
Tick Pyæmia
(Contd.)

by applying tick cream to lambs at birth. Moreover since it is known that nymphal ticks can transmit both louping ill and tick borne fever and infestation with this stage was not reduced, it is doubtful if tick cream has any prophylactic value. The low incidence of tick pyæmia in the unsmeared group would also suggest that a factor other than tick bite per se is involved in the aetiology of this disease.

3. Helminthological
Studies

W. N. M. Foster

The results of faecal egg counts at the Lephinmore and Glensaugh Research farms suggest that Helminth infestation is rarely a problem under the extensive system of hill management, and that the routine use of anthelmintics is unnecessary and uneconomic.

Helminthiasis is however a more important problem when hill lambs are run inbye for fattening and anthelmintic dosing is frequently advantageous. In order to express this advantage in economic terms a comparative anthelmintic trial, utilising control lambs (24), lambs dosed with phenothiazine (24) and lambs dosed with thiabendazole (24) is currently being carried out. Weight gain and faecal egg output in the three groups is being studied at fortnightly intervals during the fattening period, and at slaughter total intestinal worm counts will be carried out on a small representative sample of lambs from each group.

It is hoped that the statistical integration into the experiment of groups of lambs given supplementary feeding and provided with shelter will provide additional information on the value of these procedures.

G. MISCELLANEOUS

The Sheep of
St. Kilda

J. M. Doney
R. G. Gunn
W. N. M. Foster

Routine observations of population size and distribution and of social behaviour were continued during 1963 by the Soay Research Group. Drs' Gunn and Foster took part in the field study and initiated some work on the parasitological status of the sheep. With the permission of the National Trust for Scotland and the co-operation of the Army, 24 Soay sheep were brought back to form the nucleus of a research flock. After initial acclimatisation at Lephinmore these sheep were divided between the Edinburgh and London Zoos.

BOTANICAL STUDIESSubject of Research
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Report

A. ECOLOGY1. Plant SociologyJ. King
A. D. Mackay

The long term object of this work is to classify not only the vegetation but ultimately the whole ecosystem and to derive from this site-type units that might be of practical value for sheep farming, forestry and land-use classification.

During 1963 an attempt has been made to collect more quantitative data from plant communities than has been obtained in the past. Sixty five sites have been recorded and although this number will have to be increased in the future, it is hoped that it will be sufficient to allow different methods of analysis to be tried out.

2. Autecological Studies(a) *Calluna vulgaris*R. F. Hunter
S. A. Grant
G. F. Legge

The Finella grazing and burning trial continues. This trial, designed to study the effect of different intensities and seasons of grazing on regenerating heather after muirburn, commenced in 1957. Each of the six main plots (2 grazing intensities x 3 periods of grazing) is split into 4 sub-plots, burnt at two year intervals. One plot was burnt in 1957, one in 1959, one in 1961 and the last in 1963. Observations are made on the botanical composition of the sward and of the growth habit of the heather.

This experiment is accompanied by observations on the effect of simulated grazing of plants growing in boxes. An interesting observation has been made in the course of this work which is now being confirmed in case it may have been an artifact. The observation is that the current year's growth of heather differs in chemical composition among plants which have had different clipping regimes. If this observation is correct it indicates that the proportion of wood in a heather plant influences the chemical composition of the current leaf production.

(b) Phenology and growth characteristics of hill grasses

R. F. Hunter
S. A. Grant
G. F. Legge

The development of the work previously reported under this heading has been towards complementing the study of the in vitro digestibility of hill grasses already under way at Sourhope. The work, which has been begun at Glensaugh is designed to compare species and in more detail to compare the value of using single spaced plants and micro swards. The use of the former presents fewer difficulties and gives rise to much less work than the latter. If single spaced plants prove satisfactory it will allow of an extension of this field of study.

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- (b) Phenology
and growth
characteristics
of hill grasses
(Contd.)

A further development of the work on hill grasses arising out of the preliminary experiment which was reported in some detail in the last annual report, is a study of competition among these grasses. In the first instance it was decided to study competition between two of the better hill grasses which had shown contrasting reactions to the treatments administered in the preliminary trial. The first competition experiment was carried out in boxes, the two species Festuca rubra and Agrostis tenuis, being grown in a replacement series at two levels of fertility and being treated with a uniform defoliation treatment. In later experiments it is hoped to investigate the effect of different defoliation regimes on the mixtures.

- (c) White Clover
and Rhizobium

J. King and
A. D. Mackay (in
collaboration with
Dr. A. J. Holding
and Mr. M. Singer
of the Bacteriology
Department,
Edinburgh School of
Agriculture)

Previous work has shown that indigenous wild white clover populations differ morphologically from cultivated types in being much smaller and more prostrate, although as Snaydon (J. Ecol. 50 1962) has shown they may be more adapted to low soil nutrient levels. Little information exists however on the yield and nitrogen fixation of these indigenous clovers relative to cultivated types under hill conditions and experiments are being established to study this. In particular, the effects of altitude and of frequency of defoliation on the productivity of these clovers is being investigated.

Field experiments on Rhizobium populations have been confined to an attempt to correlate herbage yields with the mean effectiveness of the Rhizobium population. If successful this would permit mean Rhizobium effectiveness as measured in the laboratory to be interpreted in agronomic terms.

Greenhouse pot experiments and laboratory work on Rhizobium populations are being carried out by Dr. A. J. Holding and Mr. M. Singer and we are associated with some of this work.

3. Effect of Altitude
on Plant growth

R. F. Hunter
S. A. Grant
G. F. Legge

This study began in 1962, was continued in 1963 and the first part should be completed in 1964.

The severe winter of 1962-63 killed much of the plant material in the boxes but it was possible to find sufficient material of four genotypes out of the original nine to replant the boxes, and these were planted out as microswards. In addition to the soil temperature records, soil tensiometers have been put in the boxes comprising two transects and it is intended to use tatter flags to indicate wind speeds.

4. Sheep behaviour/

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4. Sheep behaviourR. F. Hunter
J. Eadie
G. F. Davies

Between lambing and weaning faeces samples were taken on eight dates from approximately fifty ewes on the Schill heft at Sourhope, of whom none were gimmers, and all of whom had male single lambs. The faeces samples are to be analysed for pigmentation and nitrogen. The grazing location, or home ranges, of the fifty ewes was recorded during the sampling period. The data arising from the analyses will be examined to find if there is a correlation between the ewes faeces nitrogen and/or pigmentation and lamb's rate of growth.

B. MUIRBURNR. F. Hunter
S. A. Grant
G. F. Davies

Work continues on the long-term burning rotation treatments, and recordings are up to date except in the case of the Lephinmore experiment where a late and wet spring made burning impossible for the second successive year.

The annual visits to the 30 sites where heather regeneration is being followed were again made. Botanical analysis of these sites is accompanied by measurements of heather heights in both grazed and ungrazed areas.

The long term burning experiment on *Molinia* is being continued and the results of this experiment to date plus those of the three burning and manurial experiments carried out between 1958 and 1960 and those of two *Molinia* pot experiments have been published. "The effects of muirburning *Molinia* dominant communities", *J. Brit. Grassl. Soc.*, 18: 3.

In collaboration with the Nature Conservancy, The Macaulay Institute, and the A.R.C. Radiobiological Laboratory work continues on the effect of muirburning on the fund of mineral nutrients in the soil. The data gathered to date indicates that the minerals in rainfall could be an adequate source of replenishment of the fund of mineral nutrients in the system should the fund suffer a loss through muirburning. The realisation that this possibility exists has considerably altered previous thinking on muirburn.

C. WATER IN RELATION
TO PLANT GROWTH

J. A. Rogers

The studies of the growth pattern of native hill and introduced agricultural herbage species under varying soil moisture conditions are being continued. During the growing season of/

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C. Water in Relation
to Plant Growth
(Contd.)

of 1963, five herbage species have been grown in two different soil types under eight soil-moisture regimes. These were Festuca arundinacea (Tall Fescue-S170), F. rubra (Red Fescue-S59), Phleum pratense (Timothy-S50), Lolium perenne (Perennial Ryegrass-S23) Poa trivialis (Rough-stalk Meadow-grass) and Sheep's Fescue (F. ovina). The water regimes were controlled by varying the water table levels, using a system of carefully levelled reservoirs; soil moisture tensions ranging from 0 cm. (waterlogged) to 52 cm. of mercury (0.68 atmospheres) were thus obtained.

From a preliminary examination of the data (tiller number and vertical height), the following observations may be made: all the species in the trial gave the highest results towards the wetter end of the spectrum when grown in sand, except for Poa trivialis. In peat, this 'preference' for the wet treatments was much less well marked. The central treatments yielded the highest number of tillers on Phleum, Lolium and F. ovina: F. arundinacea had a slight "preference" for the wetter treatments, but showed a marked reduction in the wettest one. F. rubra also gave a similar but rather less well defined pattern. Poa trivialis was the only species to give a higher count at the drier end. It must, however, be emphasised that these observations are only tentative as the results are not yet fully analysed.

During the course of these investigations, owing to the diurnal as well as the longer term fluctuations and the consequent difficulties in recognising the true range and temporal pattern of soil moisture tension, it was found that some means of obtaining a continuous record of this parameter was required. An instrument to perform this function has been devised, and is now in operation at Glensaugh. In order to determine the range, and if possible the frequency of high soil moisture tensions in the field, tensiometers have been set up (in co-operation with the Agronomy Department) at all three farms and at Blacklaw and Birkhill in a wide range of soil and vegetation types.

Further work is to be carried out in which different species will be subjected to varying soil moisture conditions. It is hoped to extend these investigations to a wider range of species and to make use of overhead irrigation, enabling a better control of higher tensions to be obtained.

D. HILL PASTURE
IMPROVEMENT/

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D. HILL PASTURE
IMPROVEMENT1. The use of
herbicides on
hill pasturesR. F. Hunter
G. E. Davies

Further experiments have been carried out with paraquat on a wide range of hill communities. Results have still to be analysed statistically but they indicate that on hill-vegetation paraquat has no apparent advantage except perhaps in its extremely short life when applied to the soil, so that the interval between spraying and over-sowing can be considerably reduced.

It is now generally agreed that some new method of surface sowing should be used after spray application for effective seed establishment. This year therefore an experiment was started at Sourhope in an attempt to introduce clover into a poor *Agrostis Fescue-Nardus* pasture which had previously been fertilised and sprayed and afterwards received different methods of cultivation prior to sowing. It is far too early to draw any conclusions but further work will be done on these lines on other plant communities using various rates of the herbicide as well as varying the times of spraying and sowing.

2. Bracken control

G. E. Davies

No further field work has been undertaken in testing the various bracken control herbicides. As indicated in previous reports results so far have been disappointing and it seems that the right chemical has still to be found.

The trials in collaboration with the Scottish Station of the National Institute of Agricultural Engineering, dealing with the mechanical treatment necessary to keep in check bracken already brought under control, continue. The low density of bracken however, together with the very large seasonal effect makes it very difficult to interpret results. This year it is hoped that after analysing blocks that have received treatments for the longest period in the experiment we will be able to come to a final conclusion as to the desirability of continuing this experiment for a further period.

3. A Comparison
of phosphate
manuresR. F. Hunter
G. E. Davies

The comparison of basic slag, superphosphate and ground mineral phosphate in their respective abilities to promote wild white clover continues. This trial is conducted at Sourhope and on this soil type basic slag and superphosphate have been more effective than ground mineral phosphate in the early stages of the comparison.

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Report

A. PLANT/SOIL
RELATIONSHIPS

- 1.
- The agronomic
-
- significance of water
-
- and its control in
-
- peat soils.

I. A. Nicholson,
I. S. Paterson, in
collaboration with
R. A. Robertson,
(Macaulay Institute)

This experiment, laid down in 1957 at Birkhill, Lanarkshire, was designed as an exploratory approach to the study of ecological problems associated with the water factor in peat soils. It was terminated in September 1963. More critical studies designed as an extension of this work are being continued by Dr. Rogers who remained in the botany department when the agronomy department was established.

- 2.
- The effect of surface
-
- treatments on the
-
- nature of run-off
-
- from a peat catchment

I. A. Nicholson,
I. S. Paterson, in
collaboration with
R. A. Robertson,
(Macaulay Institute)

Since January 1959 continuous meteorological and run-off data have been collected for a peat catchment of 17 acres. The first three years of the study were devoted to characterisation of the area. This has now been satisfactorily completed and the first paper has been published. The second phase of the study is currently being prepared, involving the establishment and characterisation of seven "micro-catchments" within the larger area for a study of drainage effects on run-off pattern, the investigation of water balance, nutrient balance and the nature of soil development and its ecological significance under different intensities of grazing management.

- 3.
- Study of the
-
- seasonal fluctuations
-
- in moisture status of
-
- different hill soils

I. A. Nicholson
J. A. Rogers.

During 1963 tensiometers were installed in several soil types at a number of centres to determine seasonal changes in soil moisture status. This information is required as a background for subsequent work on reseeding.

- 4.
- Response of surface
-
- seeded pasture to
-
- applied nutrients

I. A. Nicholson,
I. S. Paterson, in
collaboration with
J. Reith, (Macaulay
Institute)

Data on the nutrient requirements for successful establishment of grass and clover swards on different soil types are scattered and inadequate. Before further work on sward replacement is begun, more data on the significance of minor elements in particular are required, and a series of experiments involving treatment of sown pasture on four soil types with various combinations of major and minor elements was begun in 1963.

B. PLANT/ANIMAL
RELATIONSHIPS

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B. PLANT/ANIMAL
RELATIONSHIPS1. The annual cycle
of nutrient intakeJ. Eadie
J. S. Black
A. Currie

This project began in January 1961, and will terminate in the Spring of 1964.

The conclusions reached at this point can only be tentative pending the completion of the digestibility study programme ((2) below).

The data continue to support the contention that under the conditions of the investigation, energy intake levels during the first few weeks of lactation are likely to be more limiting to animal performance than the energy intake levels obtained during late pregnancy.

An examination of the data so far available indicates a linear relationship between the digestibility of the intake and the Dry Matter intake corrected for body size. The linearity of this relationship together with the measured rate of increase in Dry Matter intake per unit increase in digestibility suggests that the sheep under study on the hill are eating at maximum voluntary intake. It is considered premature at this point to embark on a discussion of the implications of this finding.

2. Digestibility
trials on hill
herbage.J. Eadie
J. S. Black
A. Currie

This study commenced in 1962, and up to the present time some 38 batches of hill herbage have been cut. The results of 26 digestibility trials are available.

The measurement via these trials of partial lignin digestibility (of interest in intake measurement by the lignin ratio technique) continues and also the investigation into the possibility of using Owen's "dissolved faecal fraction" method in intake measurement under hill pasture conditions.

The most important finding from this series of trials is that there seems a distinct possibility of deriving satisfactory faeces N - digestibility relationships for use in intake measurement.

The major objective is this series of trials is now the derivation of such relationships.

3. The digestibility
of hill pasture
species/

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3. The digestibility
of hill pasture
speciesJ. S. Black
J. Eadie
A. Currie

The object of this work is to obtain information on the digestibility of hill pasture species using the in vitro digestibility procedure developed at the Grassland Research Institute.

Two experiments were established during the summer of 1962. The first is designed to investigate the rate of Dry Matter loss and digestibility decline of 5 species conserved in situ and sampled at various times during the winter. Digestibility data from the first winter's investigation are now being completed and the trial has been set up again for the coming winter.

The second experiment is designed to investigate the variation in digestibility of 5 species under 3 management treatments. The first season's cutting is now almost completed and the experiment will be repeated in 1964.

The species being examined are H. mollis, F. rubra, A. tenuis and D. flexuosa. For comparative purposes L. perenne is included in each experiment.

4. Ewe reactions to
grazing management
and effect on
lamb growthJ. N. Peart in
co-operation with
Glasgow Veterinary
School

As a prelude to grazing management studies using hill grazings in conjunction with limited areas of improved pasture, a pilot study under inbye conditions was undertaken at Glensaugh in 1963.

Using ewes and lambs the treatments were; set stocking, rotational grazing and free range.

Compared with rotational grazing the lambs reared on the set stocked and free range systems made significantly greater live-weight gains.

Blood samples taken from the ewes at frequent intervals had a varied content of calcium and magnesium according to grazing treatment. The rotational grazing treatment significantly effected levels of blood calcium.

Herbage samples were analysed for mineral and nutritional content.

C. MANAGEMENT1. Lephinmore
improvement studyI. A. Nicholson
I. S. Paterson
D. C. Currie

The purpose of this study is two-fold:

1. To study the effects of integrating existing knowledge into an ecologically sound form of hill pasture husbandry.

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1. Lephinmore
improvement study
(Contd.)

ii. To provide a pasture: animal background raised to a considerably higher level of productivity than is normal on extensive hill pasture for detailed study of selected components of the system.

The technique involves the partial direct upgrading of a small proportion of each of several enclosures, the enclosure sizes being approximately 100 acres. Considerable success has been achieved in raising the grazing value of the first enclosure in which about 20% of the area has been surface treated and/or seeded. A second enclosure, adjoining the first was fenced in 1962 in preparation for the second phase of the scheme. The late completion of the forestry road retarded progress in 1963 but it is hoped that a start will be made on the improvement work this year. With the existence of two large enclosures it is intended to operate a simple form of rotational or deferred grazing by using them in conjunction with the remainder of the hill.

An essential feature of this approach is that no attempt is made to realise the full potential of the hill environment, but a sufficient level of soil and herbage improvement is aimed at to enable stocking rate to be built up to the point where vegetational trends can be intelligently controlled by suitable forms of grazing manipulation and limited fertiliser use.

Supporting information on the consequences of different grazing regimes on hill herbage is being obtained from a survey of fence line effects.

2. Controlled grazing
(Park Law -
Sourhope)

J. N. Peart

The total sheep numbers on Park Law were further increased to 200 ewes and 50 hogs in November 1962. This is one sheep to 0.73 acres and represents an increase of 85% since the experiment started in 1954-55. At this high stocking rate there are some indications of stress in the free grazed flock which are not yet apparent in the control grazed sheep.

Total output from both flocks was severely reduced in 1963 in common with other flocks on the farm and in the district following the severe and prolonged snowstorm in the winter of 1962-63.

3. Wintering of
pregnant ewes/

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3. Wintering of
pregnant ewes

J. N. Peart

During 1963 the lamb production from a group of hill wintered ewes was compared with that of a similar group wintered indoors. Although the lambing percentage of the indoor ewes was less, they produced a greater weight of lamb by weaning time.

The feeding behaviour of the ewes wintered indoors was observed with regard to the influence of age, bodyweight and frequency of feeding.

D. OTHER STUDIES

1. Effect of post
clipping exposure

J. N. Peart

In 1961, half the sheep of the Rigg heft at Sourhope were shorn bare with machine shears and the remainder shorn by hand shears to leave about $\frac{1}{2}$ " wool. Sampling to record wool regrowth six weeks later showed no significant difference. These treatments are being continued on sheep born in 1960. The hand shorn sheep produced higher average fleece weights in 1962 and 1963. Following the severe winter of 1962 - 63 there were fewer broken fleeces in the hand shorn group.

2. Genetic selection
for milk yeild

J. N. Peart in
collaboration with
G. B. Young and
A. F. Pursor
(A.B.R.O.).

As in previous years, little difference in lamb growth at 56 days of age has been found between sire groups, but differences in lamb birth weights and mortality are becoming evident.

A repeatability of 32% has been found in production from individual ewes and this with a high daughter - dam correlation suggests that under hill conditions the maternal effect is greater than that of the sire.

The study is being extended to measure the efficiency of the selection method employed by progeny testing the rams on a low ground flock.