


Dr. Gunn  


HILL FARMING RESEARCH ORGANISATION

ANNUAL REPORT for the Academic Year 1961-62

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Headquarters

48 Palmerston Place, Edinburgh, 12.

Research Farms

Glensaugh, Laurencekirk, Kincardineshire.

Lephinmore, Strathlachlan, Argyllshire.

Sourhope, Yetholm, Kelso, Roxburghshire.

INTRODUCTION

During the past year the work of the Organisation has continued to develop, but limitations imposed by lack of laboratory facilities are both restricting and frustrating. It is hoped that arrangements made with the Nature Conservancy will in future permit the chemical analyses involved in work on muirburn and allied subjects to be carried out more expeditiously and over a wider field. A comprehensive programme on the effects of muirburn and on the fertility trends in hill soils is being developed in conjunction with the Macaulay Institute and the Nature Conservancy.

A major decision taken during the year has been to reorganise the staff into three instead of two departments as hitherto. The new department of Agronomy has only come into active function at the end of the year and will be concerned with developing an agronomic programme based on an ecological conception. It will cover both animal and pasture agronomy and is intended to conduct investigations on a much more critical basis than the ad hoc trials hitherto conducted, most of which have been difficult to interpret.

In the year 1961-62, the following staff changes took place:-

Department of Animal Studies

Appointments - Mr. W. M. Henderson - A.E.O. as from 2.10.61.  
S.D.A.

Mr. A. J. Macdonald - A.E.O. as from 2.10.61.  
S.D.A., N.D.A.

Mr. A. J. F. Russel - S.O. as from 1.1.62.  
B.Sc.(Hons.), M.Agr.Sc.

Mr. E. G. Johnstone - A.E.O. as from 2.4.62.  
S.D.A.

Mr. W. N. M. Foster - S.S.O. as from 6.8.62.  
B.A.(Agric.), M.A., D.Phil., B.V.M. & S., M.R.C.V.S.

Promotion - Mr. A. E. Cameron - A.E.O. to E.O. as from 1.10.62.  
S.D.A., S.D.D.

Resignations - Mr. R. E. A. McVicar - A.E.O. as from 31.3.62.  
B.Sc.(Agric.).

Mr. J. F. Robinson - P.S.O. as from 30.9.62.  
B.Sc.(Agric.).

Department of Botanical Studies

Appointments - Mr. G. F. Legge - A.E.O. as from 22.1.62.  
B.Sc.(Agric.).

Mr. A. D. McKay - S.S.O. as from 1.9.62.  
B.Sc.(Agric.)(Hons.).

Promotions - Mr. J. King - S.S.O. to P.S.O. as from 1.4.62.  
B.Sc.(Agr.), Ph.D.

Mr. I. A. Nicholson - S.S.O. to P.S.O. as from 1.4.62.  
B.Sc.(Agr.), M.Sc.

Resignation - Mr. M. M. Boyd - A.E.O. as from 23.11.61.  
B.Sc.(Agric.)(Hons.).

Research Farms

Appointment - Mr. A. L. Fairlie - Officer-in-Charge, Glensaugh,  
B.Sc.(Agric.) as from 24.8.62.

Promotion - Mr. R. H. Armstrong - Farm Manager to Officer-in-  
Charge, Sourhope, as  
from 1.8.62.  
B.Sc.(Agric.), M.Sc., Ph.D., A.R.I.C.

Resignation - Mr. R. R. Shepherd - Officer-in-Charge, Glensaugh,  
as from 18.8.62.  
B.Sc.(Agric.), Dip. Agric.

ANIMAL STUDIES

Subject of Research	Workers Concerned	Report
A. <u>NUTRITION</u>		
1. Supplementary feeding of hill ewes.	J. F. Robinson D. C. Currie J. N. Peart R. R. Shepherd	<p><u>Sourhope and Lephinmore</u> The pre-lambing feeding trials on the hill ceased at Sourhope in 1961, but are being continued at Lephinmore. The results on the two farms, over six years, have been summarised and published. They show that:</p> <p>(a) In practice a feeding policy must be flexible and be adjusted according to seasonal need.</p> <p>(b) Shorter periods of feeding (according to season), say 2 to 3 weeks, may be worthwhile.</p> <p>In single-bearing ewes for example, it would seem that birth weight of the lamb is less important than adequate fitness in the ewe from the standpoint of ensuring ease of parturition and development of udder.</p> <p>Post-lambing supplementation may repay closer investigation in seasons when spring growth is retarded, as in 1956 or 1958.</p> <p>(c) On hazardous ground like Lephinmore (where lambs are subject to drowning) lambing under closer control in a hill or inbye enclosure (on safer ground) is a desirable complement to pre-lambing supplementation.</p> <p>(d) Advantages may be derived from reverting to the old custom of wintering, managing and lambing gimmers in isolation from the older ages of ewes. Through their inexperience and timidity, gimmers appear to be handicapped in grazing in competition with older ewes. They also suffer greater loss of body weight in wintering.</p> <p><u>Lephinmore, 1962</u> Supplementary feeding with cubed concentrates was continued on the Mid-hill and Low-end hirsels in 1962. Feeding started on both hirsels on March 5th and continued on Mid-hill until April 13th, when the ewes were brought inbye for lambing, and on Low-end during lambing until April 30th. The weather in late winter and early spring 1962 was the worst for many years, probably since 1951. At weaning, 86% of lambs on Mid-hill and 71% on Low-end indicate a considerable saving of lambs.</p> <p>In/</p>

ANIMAL STUDIES

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Report

1. Supplementary  
feeding of  
hill ewes.  
(contd.)

In assessing the results, some allowance must be made for dry weather at lambing time - cold rainy weather might have altered the picture adversely.

Without feeding it is estimated, from past experience, that the lamb crop on Low-end would not have exceeded 50% (or less if weather had been adverse).

Glensaugh The investigation of protein levels in pre-lambing concentrate supplements continued in 1961-62. In marked contrast to the previous year, seasonal temperatures were lower, while blood levels of urea declined gradually over the period of feeding (mid-February to early April).

In 1962, there were comparisons between groups of sheep receiving supplements containing 17% and 7% respectively of digestible crude protein, and between the group receiving the supplement containing 7% of digestible crude protein and another group which received no supplement.

(a) Supplements containing 17% and 7% digestible crude protein At lambing, single and twin born lambs from the high protein group were 0.5 lb. heavier but there were no significant differences in lamb survival. The high protein group ewes were about 3 lb. heavier pre-lambing. There were no differences in fleece weights. Single born lambs in the high protein group were 2 to 3 lb. heavier at marking and weaning.

(b) Supplement containing 7% digestible crude protein against the "unfed" In the unfed group, lighter weights of ewes, by 9 lb. pre-lambing and lighter birth weights of lambs, by 1.0 lb. in singles and 0.4 lb. in twins, contributed to the poor lamb crop of only 73% at lamb marking. In the supplemented group, there were 124% of lambs at marking. There were only small differences in the marking and weaning weights of lambs.

2. Ewe hogg  
wintering.

R. G. Gunn

✓ (a) Hairneylaw, Sourhope Production recording of the three age groups of North and South Country Cheviots in these studies has continued.

Weaning percentages for 1962 were as follows:-

S.C.C./

Subject of Research

Workers Concerned

Report

2. Ewe hogg  
wintering  
(cont.)

	S.C.C.			N.C.C.		
	H.P.	M.P.	L.P.	H.P.	M.P.	L.P.
<u>Born 1956</u>						
5th lamb crop	67	86	78	133	163	140
<u>Born 1957</u>						
4th lamb crop	122	88	100	90	120	91
5th " "	75	75	89	90	100	82
<u>Born 1958</u>						
3rd lamb crop	92	67		107	93	
4th " "	83	75		107	93	

(H.P. = High Plane: M.P. = Medium Plane: L.P. = Low Plane)

With a harder winter and spring than in 1961, the trend for relatively lower production with age in the H.P. reared groups was less striking, particularly in the 1957 born age group. In the 1956 born age group, however, it was still present in this, their last, productive year on the hill. The average weaning percentages of this age group over their five productive years were as follows,

	H.P.	1956		L.P.	1957		Hill.
		M.P.	L.P.		H.P.	M.P.	
S.C.C.	63	72	62	87	72	78	
N.C.C.	100	105	96	85	107	89	

showing the advantage of M.P. or maintenance rearing over both H.P. and L.P. in terms of life time lamb production in both breeds. Breaking this down into early and late production gives average weaning percentages for the first three lamb crops and the last two lamb crops of:-

	S.C.C.			N.C.C.		
	H.P.	M.P.	L.P.	H.P.	M.P.	L.P.
First 3 lamb crops	58	59	56	87	88	67
Last 2 lamb crops	71	94	75	121	138	140
Not/	80	67	67	82	106	91
	100	81	94	90	110	86

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2. Ewe hogg  
wintering  
(contd.)

Not only was relative production greater in the poorer wintered groups in their later years but this was accompanied by a greater ewe survival rate in the L.P. than in the other two treatment groups.

		1956			1957		Hill
		H.P.	M.P.	L.P.	H.P.	M.P.	
Percentage survival to 6½ years.	S.C.C.	56	50	73	73	78	80
	N.C.C.	82	73	100	83	75	92

The stress of greater production in their earlier years, coupled with possibly lower physiological efficiency in later years through earlier maturity, may account for this poorer survival in the H.P. and M.P. groups.

To follow the survivors of this age group in their post-drafting life, they have been transferred to Glensaugh where they will be treated as an inbye flock. A sixth lamb crop will be taken and their management designed for a minimum of twin births in order to study the incidence of dystocia under the higher standards of winter nutrition likely to be met on low ground farms, as affected by possible residual differences in skeletal size and, particularly, pelvis size resulting from hogg wintering treatment.

✓ (b) Schil, Sourhope In the light of trends appearing in the Hairneylaw experiment, this study was started in 1961 and was designed to examine the effects of rearing treatment on growth to maturity, longevity, and long term productivity of Blackface ewes under hill conditions. The basic rearing treatment was one of nine months duration, from 3 - 12 months of age. One group of approximately 25 ewe lambs received high plane rearing throughout this period, in improved grass fields from 3 - 6 months and in the sheep house from 6 - 12 months. A second group of 25 remained on the hill throughout as a control. A third group of 25 received high plane rearing in fields from 3 - 6 months and then returned to the hill over the winter, while a fourth group of 25 remained on the hill until 6 months and then received high plane rearing in the sheep house over the winter. There were, thus, high-high, high-low, low-high and low-low treatments. The effects of these treatments on body growth and development as depicted by live weight and live measurements, on wool growth as depicted/

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2. Ewe hogg  
wintering  
(contd.)

depicted by sample patches, and on dentition development as depicted by permanent incisor eruption, are now being studied. These criteria will be used to describe growth to maturity from 12 months onwards. Lamb production and ewe survival will be the criteria used to describe the effects of treatment on longevity and efficient long term productivity, the contention being that rapid growth in young life leads to earlier maturity and may be negatively correlated with efficient production towards the end of the ewe's hill life. Live weight changes in the four groups over the treatment period were:-

	<u>3 months</u>	<u>6 months</u>	<u>12 months</u>
Low-Low	47.7	68.0	58.8
High-Low	48.0	72.4	59.4
High-High	47.6	74.6	92.6
Low-High	47.6	65.8	87.0

High plane rearing from 3 - 6 months, although making little difference in live weight compared with hill rearing (due to a good season for the latter), did permit considerably more skeletal growth. In general, the high plane reared animals were larger, stronger built hoggs and had the appearance of sheep a year older. A cine record of the various groups has been taken at intervals during their first 15 months of life.

The onset of first oestrus was recorded by the use of vasectomised tups on the High-High and Low-High groups. The tups were introduced on 1st November and removed on 8th January. All the H-H but only 50% of the L-H ewe lambs exhibited oestrus during this time. It is suggested that the figure would have been even lower in the L-L group and that these results indicate a fore-shortening of the growing period from high plane rearing commencing at 3 months. This may ultimately be accompanied by an overall earlier maturity.

3. Lamb fattening

A. J. F. Russel

Recent work has shown the importance of the constituents and of the texture of foods in determining the balance of the major fatty acids (acetic, propionic and butyric) in the process of digestion. As this may have a bearing on the efficiency of lamb fattening on hill farms, a study has been initiated in 1962. In the first instance, wether lambs on all three farms are being fed on aftermath and/



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Subject of Research	Workers Concerned	Report
3. Lamb fattening (contd.)		<p>and/or rape, with and without concentrates, and, at Lephinmore, under high rainfall conditions with and without access to shelter. In addition, a more detailed study is being made indoors at Glensaugh, involving individual feeding of 64 lambs with different concentrates and with hay in both chopped and pelleted forms. All lambs in these trials will be slaughtered for carcass appraisal.</p> <p>In future seasons it is hoped to assess, by means of sheep with rumen fistulae, the effects of variations in the diet on the fatty acid composition of the rumen liquor.</p>
4. Effect of urea as a supplement to roughage for pregnant ewes.	J. N. Peart	<p>The object of this study at Sourhope, involving cast-for-age Cheviot ewes individually fed indoors from January to April 1962, was to investigate the effect of urea on the intake and utilisation of poor quality hay, which might be compared with hill herbage in winter, and to compare urea with fish meal.</p> <p><u>Treatments</u> (8 ewes per group)</p> <p>Group 1 - Poor quality hay <u>ad lib.</u></p> <p>Group 2 - " " " " " plus <math>2\frac{1}{4}</math> oz. molasses and <math>\frac{1}{4}</math> oz. urea per head per day.</p> <p>Group 3 - Poor quality hay <u>ad lib.</u> plus <math>2\frac{1}{4}</math> oz. molasses per head per day.</p> <p>Group 4 - Poor quality hay <u>ad lib.</u> plus 1 oz. maize meal and 1 oz. fish meal per head per day.</p> <p>The hay (3.1% est. dig. crude protein) was chopped to minimise selectivity.</p> <p><u>Results</u></p> <p>The mean weight of all four groups of ewes when the experiment started on January 25th was 108 lb. When weighings ceased pre-lambing, on April 12th, the mean weights of ewes in Groups 2, 3 and 4 respectively had increased to 121 lb. The/</p>

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4. Effect of urea as a supplement to roughage for pregnant ewes (contd.)

The corresponding weight of ewes in Group 1 was 115 lb.

The intake of hay in all four groups rose to a peak about 6 weeks before lambing, but after maintaining this level for 3 weeks, the intake declined slightly.

Intake of Hay per Ewe and  
Birthweights of Single-born Lambs

<u>Group</u>	<u>Daily Intake</u>	<u>Peak</u>	<u>Total Intake</u>	<u>Birth</u>
	<u>25th Jan. - 12th Apr.</u>	<u>Intake</u>	<u>25th Jan. - 12th Apr.</u>	<u>Weights</u>
	lb.	lb.	lb.	lb.
1	2.18	2.48	152.8	9.6
2	2.34	2.82	164.1	9.9
3	2.35	2.70	164.9	8.7
4	2.56	3.00	179.2	9.1

The records suggest that increased intake of hay in Groups 2, 3 and 4 was insufficient to provoke responses by way of increased birth weight or improved survival of lambs. The hay, though apparently poor in quality, was obviously an adequate ration when fed ad lib.

B. PHYSIOLOGY

1. Dystocia

R. G. Gunn

Observations on difficult births Detailed records have now been taken on all three farms for five successive years, and the data are being examined and prepared for analysis. Future work on this subject will depend on the results obtained.

An attempt to create dystocia artificially is being made with Cheviot draft ewes from the Hairneylaw hogg wintering studies and is described in the report on this work.

Complementary to the analysis of dystocia records is the study of lamb head size. Heritability is being examined, as are breed and sex relationships. It is also planned to examine the relationship between head size of dystocia lambs and the pelvic measurements of their dams.

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2. Effect of lamb removal on lactation of twin-bearing ewes.	A. J. F. Russel	<p>An experiment was undertaken at Glensaugh in April 1962 to determine the effect of the time of removal of one lamb on the lactation of twin-bearing ewes, as measured by the growth rate of the remaining (twin/singled) lamb. The member of each twin pair to be removed and the time of separation (intervals of three days from birth to three weeks) were randomly determined. The lambs removed were subsequently used in an artificial rearing study.</p> <p>Final analyses are not yet complete but preliminary results indicate that the early removal of one twin resulted in the growth curve of its sib following that of the single-born control lambs. Lambs whose sibs were removed at the older ages did not attain the weaning weights of single-born lambs, but several of those whose sibs were removed at intermediate intervals had steeper growth curves and greater weaning weights than the control singles.</p>
C. <u>DENTITION INVESTIGATIONS</u>	J. F. Robinson, R. G. Gunn, in association with Dr. E. J. Butler (A.D.R.A.)	<p>Investigations at Glensaugh in 1960 and 1961 indicated the need for phosphorus supplementation when the ewes are changed from hill to inbye pasture for lambing and during lactation. Unfortunately, mineral supplementation on the hill during lactation, on an experimental basis, proved impracticable. In 1962, therefore, the ewes were kept on inbye pasture until May 20th in order to facilitate continuation of mineral supplementation for the first 6 - 8 weeks of lactation when the drain is greatest.</p> <p>The experiment, starting in 1961-62, involves three groups, each of 20 gimmers, submitted to different treatments. All three groups receive the same husbandry management and the same concentrate mixture from which mineral additives are excluded, before and after lambing. One group receives no mineral supplement while the other two groups are dosed on alternate days with phosphorus (13 grams mono-sodium phosphate) and calcium (12 grams calcium carbonate) respectively. In order to assess the influence on blood minerals of the change to inbye pasture at lambing, a fourth group of 20 gimmers is confined to the hill. All four groups are blood-sampled periodically at the same times.</p> <p>In 1962 the depression in blood levels of phosphorus during May was much less marked than in the two previous years. Moreover, the phosphorus levels varied only slightly/</p>

ANIMAL STUDIES

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C. <u>DENTITION INVESTIGATIONS</u> (contd.)		<p data-bbox="989 270 1672 296">slightly between the four treatment groups.</p> <p data-bbox="989 334 2327 394">The only response in general performance to dosing with phosphorus and calcium was an improvement of 4 - 5 lb. in the body weight of ewes between May and August.</p> <p data-bbox="1066 429 2028 455">Blood levels of calcium and magnesium are not yet available.</p> <p data-bbox="984 492 2377 840"><u>Dentition photography</u> For closer examination of the dentition in the Cairn mineral feeding experiment at Glensaugh, close-up photography of the permanent incisors has been employed. Photographs are taken at a standard distance by means of an attached distance piece and standard illumination is provided by electronic flash. In this way, a permanent record of dental development and breakdown is being collected. Measurements of the central pair of incisors and of the gap which tends to appear between them with age have been made at a standard magnification. From observations on general appearance of the teeth at an early age, and later in life, it is hoped to extend this technique for examination of the relationship between early and late appearance and possibly to recognise potentially premature broken mouthed sheep before they become so.</p> <p data-bbox="984 878 2344 1064">Pregnant and lactating ewes were sent at monthly intervals from Glensaugh and Sourhope to the Rowett Institute, who in turn provided the Manchester University Dental School with material so that a study could be made of dental development from the earliest stage in the foetus. Oestrus in the ewes concerned was successfully synchronised so that the ewes sent each 4 weeks were at a similar stage of pregnancy or lactation.</p>
D. <u>BREEDING</u> 1. Lanark, Newton Stewart and Lewis type Blackface, Glensaugh	J. F. Robinson R. R. Shepherd	<p data-bbox="984 1147 2339 1208">As noted in last year's report, the inter-comparison of the general performance of the Blackface strains has now ceased and the results are being analysed.</p> <p data-bbox="984 1245 2377 1371">These strain ewes have been retained for detailed investigation of certain fleece characteristics by Dr. Doney. The same ewes are also being used in a collaborative investigation with the Rowett Institute of responses to periodical injections of selenium, notably in connection with the "broken mouth" condition.</p>

ANIMAL STUDIES

Subject of Research	Workers Concerned	Report
1. Lanark, Newton Stewart and Lewis type Blackface, Glensaugh (contd.)	J. N. Peart, collaborating with G. B. Young and A. F. Purser (A.B.R.O.)	Top-crossing of the native Lanark type ewes by Newton Stewart rams at Sourhope and by Newton Stewart, Swaledale and Lewis rams at Lephinmore ceased in autumn 1961. The performance of the different crosses when bred to common Lanark type rams will now be observed over the whole life cycle.
2. Genetic selection for milk yield.	J. N. Peart, collaborating with G. B. Young and A. F. Purser (A.B.R.O.)	This study was continued in 1961-62 and, as in previous years, no differences were evident in lamb growth rates between sire groups. Daughter-dam correlations are now being obtained, however, which suggest that the maternal effect is greater than that of the sire. If this is so, differences due to selection can only be expected from ewes which have been born since selection started, and it is still too early for the selection programme to become fully effective.
3. Inbreeding of Blackface sheep (Glensaugh).	J. M. Doney	Matings as described previously were continued. The first inbred ewes were mated as gimmers. Results, similar to those in previous years, are now being analysed. A paper was presented at the 1962 British Society of Animal Production meeting.
E. <u>WOOL</u>		
1. Factors affecting wool growth	J. M. Doney	This work is continuing at Lephinmore as described in previous reports. A further paper has been submitted to the Journal of Agricultural Science.
2. The adaptive value of the fleece.	J. M. Doney	The first phase as described in the last report has been completed and the results accepted for publication in the Journal of Agricultural Science. A method for measuring the <u>in vivo</u> thermal insulation of the fleece was developed and described. An <u>in vitro</u> method for similar studies is being developed. A wider variety of fleece types, including Merino and Soay are being obtained.
3. Efficiency of wool production.	J. M. Doney	These observations are continuing as described in <b>last year's report.</b>
4./		

ANIMAL STUDIES

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4. Effect of pre- and post-natal nutrition on fleece development.	J. M. Doney	The first stage of this experiment has been concluded and the fleece samples taken at intervals during 12 months are being analysed. Samples of foetal skin taken at fortnightly intervals from ewes provided for the Manchester Dental College are now being processed by A.B.R.O. (Mr. Carter).
5. Effect of post-clipping exposure.	J. M. Doney 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. Sampling to record wool regrowth six weeks later showed no significant difference between treatments.  At shearing in 1962, the same shearing treatments were applied and the average fleece weights of the sheep sheared by hand was 0.6 lb. greater than that of the machine sheared sheep. This difference was significant.
<b>F. <u>MANAGEMENT</u></b>		
Controlled grazing (Park Law), Sourhope.	J. N. Peart	In 1962, the separation of the "controlled grazing" area into six paddocks by means of the New Zealand type electric fence has facilitated the control and intensification of grazing. This has been reflected throughout the year in consistently heavier ewes under "controlled" than under "free" grazing. In consequence of a heavier incidence of twins and of heavier lambs at weaning, the "control" ewes also had the advantage in lamb production.  Weaning weights of lambs under "controlled" and "free" grazing were lower than in the previous year. Seasonal effects and an outbreak of pustular dermatitis may have been responsible. Increasing stock numbers may also have contributed. On Park Law as a whole, the stock of 164 ewes and 48 hogs (0.87 acres per sheep) in 1961-62 represents an increase of 57% on the stocking when the experiment started in 1954-55.
<b>G. <u>OTHER STUDIES</u></b>		
The sheep of St. Kilda	In collaboration with the Nature Conservancy and The Royal Veterinary College, London.	The first paper on this work is being prepared for publication. This is a lengthy introductory paper covering all aspects of the work. Future papers will be more specific and will cover individual aspects in greater detail as the information is forthcoming.  Only/

ANIMAL STUDIES

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The sheep of  
St. Kilda (contd.)

Only one member of staff (Mr. Gunn) has visited St. Kilda this year. This was during July, a time when the type of work carried out during previous visits was not possible. The visit was therefore purely observational, based largely on the study of social and grazing behaviour. Very distinct individual grazing rakes were observed, the flock pattern being made up of a series of overlapping individual rakes. It is possible to describe the basic grazing unit as a micro-flock, consisting of a ewe and lamb or at most a ewe, yearling and lamb. Tup behaviour was slightly different, the basic unit being the "school", ranging from two to fifteen tups. This had a remarkably distinct grazing rake but with the individual animal of less importance than was the case with the ewe; tups tending to move from "school" to "school" without upsetting the actual movement pattern of these units.



BOTANICAL STUDIES

Subject of Research	Workers Concerned	Report
<b>A. <u>ECOLOGY</u></b>		
1. Phytosociological studies	J. King	<p>An account of the vegetation of the upper Bowmont Valley region in the Cheviots has been published (J. Ecol., <u>50</u>, 2). Additional data from a survey of the Southern Uplands and the Central Highlands have been incorporated into an account of the forest zone grasslands written in collaboration with Mr. I. A. Nicholson, as a contribution to a book on the Vegetation of Scotland to be published under the editorship of Professor Burnett, Newcastle.</p> <p>These data are also being used as the basis for a study of a technique of ordination of vegetation in relation to environmental gradients. Further plant sociological studies are in preparation with the object of characterising vegetation and associated environmental factors more precisely and objectively than existing methods have so far allowed.</p>
2. Autecological studies		
(a) <i>Calluna vulgaris</i>	R. F. Hunter Miss S. A. Grant G. F. Legge	<p>The Finella grazing and burning experiment and the heather defoliation trial at Glensaugh are being continued in the investigation of the effects of frequency, season and intensity of defoliation, on the botanical composition of the heather community and on the growth habit and yield of the heather plant.</p>
(b) Manorial response of hill grasses	J. King A. D. McKay	<p>A factorial experiment is being established to study the effect of levels of soil base status, phosphate and nitrogen levels on the development of plant communities. The site has been cultivated and sown and the full range of treatments will be applied in spring 1963.</p>
(c) Phenology and growth characteristics of hill grasses	R. F. Hunter Miss S. A. Grant G. F. Legge	<p>The study of the relative performances of nine hill grass species grown in a spaced plant trial sited at Glensaugh was continued. Data were collected on yield, periodicity of growth, winter greenness and response to different cutting regimes. The species being studied are <u><i>Holcus lanatus</i></u>, <u><i>H. mollis</i></u>, <u><i>Festuca rubra</i></u>, <u><i>F. ovina</i></u>, <u><i>Agrostis tenuis</i></u>, <u><i>A. canina</i></u>, <u><i>Anthoxanthum odoratum</i></u>, <u><i>Deschampsia flexuosa</i></u> and <u><i>Nardus stricta</i></u>. Large differences in yield were found among the species, the higher yielding species being those which would be expected to occur with greater frequency in mull soils while the lower yielders/</p>



BOTANICAL STUDIES

Subject of Research

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(c) Phenology and growth characteristics of hill grasses (contd.)

yielders occur more frequently in the plant communities associated with mor soils. Differences were also found in winter greenness. There were significant differences among species and treatments (different cutting dates) and also a significant interaction between species and treatments. In 1962, the plants were allocated to treatments so that the effect of the previous season's treatments on productivity could be assessed. In all cases cutting in October depressed the following season's growth compared with uncut plants, but the degree of depression varied. The smallest depression in yield was a 33% reduction (Holcus mollis) and the largest was 75% (Holcus lanatus). Cutting at other times of the year, e.g. August and September, had a smaller effect. Further development of this work is at present under consideration.

(d) White clover and rhizobium studies.

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

The results of the survey of the effectiveness of indigenous rhizobium populations have been written up and submitted for publication in Plant and Soil. In addition, a study of the errors involved in sampling and testing rhizobium populations has been made and the results are at present being analysed. Following the results of the rhizobium survey two field experiments are in preparation. One of these is intended to investigate the influence on the mean effectiveness of indigenous rhizobium populations of increasing the soil base and phosphate content. In another experiment it is hoped to correlate the mean effectiveness of rhizobium populations with clover yields. This would enable an assessment to be made of the agronomic significance of varying levels of rhizobium effectiveness as measured in the laboratory.

Morphological variation in relation to soil base status or to an associated factor has been found to occur in indigenous white clover populations, collected from the Sourhope area, although the range of variation is much smaller than the differences between indigenous and cultivated wild white types. These data have been written up and submitted to Plant and Soil for publication.

A further experiment is now in preparation to measure the yield and other characteristics of indigenous and cultivated clovers growing in swards with grass and subjected to various intensities of defoliation.

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3. Effect of  
altitude on  
plant growth.

R. F. Hunter  
Miss S. A. Grant

Thirty-four sites have been established within 8 altitudinal transects, at approximately 250 ft. intervals of altitude ranging from 500 ft. to 2,250 ft. Each site is level and all have a southern aspect. A site comprises 4 boxes, 16 in. cube, sunk to soil level, lined with polythene and individually drained. Two boxes contain one soil mix, the remaining 2 another soil mix, and each box is planted with tillers of the same 9 genotypes of S23 ryegrass. The tillers were planted on 28th April, counted on 9th May and 29th May, cut throughout June and July at the same physiological stage, cut again in August, and cut for the last time in late September or early October. The dry weight of each plant is measured at cutting and the number of tillers counted from the June-July cuts.

Minimum and maximum thermometers are inserted in the rear boxes of 4 transects and these are read weekly. In 1963 it is hoped to put soil moisture tensiometers in the front boxes of these transects. At 2 transects rainfall is measured at high and low elevations.

This year the effect of altitude on the growth and development of the grasses has been marked. The analysis of the data is complex and the data are voluminous, but Dr. Sampford of the A.R.C. Unit of Statistics at Aberdeen has programmed the Elliot computer for the analysis and will carry it out.

4. Sheep behaviour

R. F. Hunter  
G. E. Davies

Since May 1960, the home range or territorial behaviour of the Blackface sheep on the Schil heft at Sourhope has been studied and the result of this work was reported at the British Ecological Society's symposium on grazing at Bangor in April 1962.

In May 1962, a further interest developed in this study as ewe hogs from this heft which had been over-wintered inside in feed lots were returned to the heft. As the feed lots had been on different levels of nutrition to study the effect of plane of nutrition on the subsequent performance of the sheep when returned to the hill, it was of interest to see whether these lots stayed together as a social group adopting a home range, or whether the members of the group dispersed at random among the different home ranges composing the heft. If they stayed together there would obviously arise a confounded treatment x home range interaction/

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## 4. Sheep behaviour

interaction which would partially, if not largely, invalidate the experimental design and make a valid test of the treatment effects impossible. The data have not yet been fully collated but a provisional "look-see" indicates that the behaviour of the sheep has rendered invalid the experimental design.

If a detailed study of the data confirms the impression, the next step should be to study the value of other experimental procedures. The procedure suggested in this type of work is to pen sheep in groups, each group comprising members representing all feeding treatments. This is possible by individual feeding. Thus, penning the sheep together might create a social group but as the members of that group would have had different nutritional treatments, the formation of the social group would increase the precision of the experiment should the members of the group adopt the same home range within the pasture.

B. MUIRBURN

## 1. Burning rotation

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

Observations are being maintained on the long-term effects of muirburn on heather and Molinia communities. On the heather plots the rotations, which were originally planned as 0, (i.e. unburned control) 5, 10 and 15 years intervals between burning have been altered to 0, 5 and 10 years, the 15 years rotation being replaced by culling and removing all the crop every 5 years. It was felt that omitting the 15 year rotation and substituting a 5 year total removal of crop, representing the maximum loss of minerals possible, would give an interesting comparison with the effects of burning.

The 5 year burning and the removal of crop treatments were carried out at Glensaugh in spring 1962 but the rainfall at Lephinmore necessitated the postponement of these treatments until spring 1963, when the Sourhope 5 year treatments will also be due.

Visits were made to the 30 sites where heather regeneration over a wide range of conditions is being studied.

In addition to the muirburn experiment on Molinia, a pot experiment was carried out to confirm an earlier pot experiment which indicated that the difference/

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1. Burning rotation

difference between the flowering intensity on burnt versus non-burnt Molinia in the season of burning may be due to the insulating effect of Molinia litter. A number of Molinia turves were potted and given the following treatments:-

- A - Free standing - no litter.
- B - Sunk into the ground - no litter.
- C - Sunk into the ground plus a covering of litter.

The numbers of flowering and non-flowering tillers per plot were as follows:-

Pot No.	Flowering tillers as a percentage of the total tillers		
	Treatments		
	A	B	C
1) 1960	8.3		3.2
2) 1st	6.6		5.8
3) Expt.	19.1		5.5
4) 1962	5.5	11.2	5.4
5) 2nd	25.1	21.8	14.4
6) Expt.	7.9	1.5	3.9
7)	11.1	5.4	0
Av.	12.1	10.0	5.5

Temperature records showed that pots A and B had a wider amplitude in diurnal temperature range than pots C, i.e. the pots were cooler by night and warmer by day.

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2. Chemical aspects	R. F. Hunter I. A. Nicholson G. E. Davies	<p>This year a co-operative study on the chemical aspects of muirburn has commenced with the Nature Conservancy and the Macaulay Institute. Aspects being investigated are:-</p> <ul style="list-style-type: none"> <li>(a) Nutrient input from rain.</li> <li>(b) Magnitude of the nutrient found within the system.</li> <li>(c) Solubility of plant nutrients in ash.</li> <li>(d) The weight of mineral nutrients removed from the pasture by the sale of livestock.</li> </ul>
C. <u>NUTRIENT INTAKE OF HILL SHEEP</u>		
1. The annual cycle of nutrient intake.	J. Eadie J. S. Black A. Currie	<p>This work, which began in January 1961, continues, digestibilities being estimated by the lignin-ratio technique.</p> <p>It has been found possible to use oesophageally fistulated sheep in the field and these are now in regular use in collecting the necessary "as grazed" samples.</p> <p>Any conclusions reached from the first year's results can only be tentative at this stage as they are calculated on the assumption that the lignin is indigestible. This assumption is now being checked in <u>in vivo</u> digestibility trials. The results are encouraging in that they give reasonably good agreement with the animal performance records of the sheep concerned. It would appear that in hill pasture conditions energy intake levels during the first few weeks of lactation are likely to be of greater importance in their effect on animal performance than the energy deficiencies recorded during the latter stages of pregnancy.</p>
2. Digestibility trials on hill herbage	J. Eadie J. S. Black A. Currie	<p>Objects:-</p> <ul style="list-style-type: none"> <li>(1) To measure the partial digestibility of lignin in order to increase the accuracy of digestibility estimates using the lignin-ratio technique.</li> <li>(2) To assess the prospects of deriving satisfactory relationships between herbage digestibility and faeces N contents.</li> <li>(3)/</li> </ul>

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2. Digestibility trials  
on hill herbage.

(3) To study Owen's "dissolved faecal fraction" (Nature, Vol. 192, No. 4797 (1961)) method of estimating intake under hill pasture conditions.

(4) To gain information on the digestibility of hill pasture types and to acquire material of known digestibility for use as standards in "in vitro" estimations.

This series of trials was started earlier this summer. It is recognised that it is impossible to cut and feed in crates material identical to that eaten on the hill. However, by pretrimming, and feeding as far as possible material grown during the previous 4 - 6 weeks, an attempt is being made to minimise this difficulty. The low yields and the unevenness of the terrain render the collection of material laborious and time-consuming and since it is difficult to obtain really uniform areas of any size, it has so far only been possible to acquire enough herbage for 2 crates per determination.

Up to the present time 12 batches of herbage have been cut and it is hoped to obtain another 9 - 10 during the winter.

3. The digestibility  
of hill pasture  
species.

J. S. Black  
J. Eadie  
A. Currie

Object:-

To obtain information on the digestibility of hill pasture species, using the "in vitro" digestibility technique developed at the Grassland Research Institute.

Two experiments have been established during the summer. The first experiment is designed to investigate the variations in digestibility of 5 species under 3 management treatments during the growing season. The second experiment is concerned with rates of D.M. loss and digestibility decline of herbage of these species conserved in situ and sampled during the winter period.

The species involved are:- H. mollis, F. rubra, A. tenuis and D. flexuosa and for comparative purposes L. perenne is included in each experiment.

The/



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3. The digestibility of hill pasture species.		<p>The individual plots in these experiments are aggregations of spaced plants.</p> <p>The winter experiment will be sampled this autumn and during the coming winter. The treatments of the summer experiment start next spring.</p>
D. <u>SOIL MOISTURE AND RUN-OFF STUDIES</u>		
1. The agronomic significance of water in peat soils and its control.	<p>I. A. Nicholson I. S. Paterson, in collaboration with R. A. Robertson (Macaulay Institute).</p>	<p>This experiment, laid down in 1957 at Birkhill and designed as an exploratory approach to ecological problems associated with water in peat soils, was due to be terminated in 1962. As the rate of change, particularly with regard to the response of a grass sward to different water treatments, has increased in the last two years it has been decided to continue a part of the experiment until autumn 1963.</p> <p>Three recording thermographs were installed on the site in 1961 and the effect of soil moisture status on soil temperature at different depths is being studied.</p> <p>The first of a series of papers on this work is currently in preparation.</p> <p>Since January 1959 continuous meteorological and run-off data have been collected for a catchment area of 17 acres. The first three years of this period were devoted to the calibration of the area and this has now been satisfactorily completed. The second phase of the study is currently being prepared, involving the establishment and calibration of seven "micro-catchments" within the larger area for the 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 forms of utilisation.</p> <p>It is hoped to begin calibration of the seven "micro-catchments" on 1st January 1963 and if no unforeseen difficulties arise the experimental treatments will be established on them in 1966. The treatments will involve a series of intensities of utilisation ranging from management by burning to various forms of relatively intensive management of improved grass swards.</p>
2. The effect of surface treatments on the nature of run-off from a peat catchment.	<p>I. A. Nicholson I. S. Paterson, in collaboration with R. A. Robertson (Macaulay Institute).</p>	

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3. Autecological studies in relation to soil water regime.	J. A. Rogers I. A. Nicholson	<p>These studies were designed as an extension of the Birkhill work but on a more critical basis. The principal requirement for such an approach was an apparatus enabling soil water levels to be varied and controlled in fairly large containers of soil. Much of the year was devoted to the construction of this apparatus at Glensaugh, but it was completed in time to permit a preliminary assessment of the response of several herbage species to different water regimes in two soil types and at two levels of fertility. The grasses were grown from seed but future studies will be carried out with clonal material of both indigenous plants and of improved <b>herbage</b> varieties.</p>
E. <u>HILL PASTURE IMPROVEMENT</u>		
1. The use of herbicides on hill pastures.	R. F. Hunter G. E. Davies	<p>Dalapon used as a sward pre-treatment to oversowing has been tested on a number of different plant communities at Sourhope with varying success. During the last two years other chemicals, diquat and paraquat, have also been tried and of these paraquat is probably the more effective, but work to date shows it to be inferior to dalapon especially in the suppression of <u>Nardus</u> and <u>Molinia</u>.</p> <p>Because of low rainfall in the district and the thick turf encountered on most of the sites it has become clear that for seed establishment chemical spray action must be supplemented by some form of cultivation. Future work will entail combining these herbicides with a suitable implement, necessitating the minimum possible amount of cultivation, as well as testing new herbicides.</p>
2. Bracken control	G. E. Davies	<p>Experiments carried out over the last three years at Sourhope using "Weedone Brackontrol" have confirmed the conclusions of other workers that the results obtained so far are too variable for this chemical to be recommended as a satisfactory method of control. Trials started in 1961 with Amino triazole show more promise.</p> <p>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 data collected and analysed so far show no treatment differences, mainly because/</p>



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2. Bracken control		because of large variabilities encountered from year to year. Because of this, different recording techniques, as well as the whole future of the experiment have been discussed with the A.R.C. Statistics Unit at Aberdeen.
3. Fasset improvement scheme.	R. F. Hunter J. King J. N. Peart	This study, in which the effect of top dressing a hill pasture with lime and phosphate on the performance of the stock, continues.
4. A comparison of phosphatic manures.	R. F. Hunter	The comparison of basic slag, superphosphate and ground mineral phosphate in their respective abilities to promote the growth of wild white clover and hill grasses continues.
5. Lephinmore improvement study.	I. A. Nicholson D. C. Currie I. S. Paterson	The purpose of this study is twofold:  (i) To study the effects of integrating existing knowledge into an ecologically sound form of hill pasture husbandry.  (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 a series of enclosures, each of approximately 100 acres. Considerable success has been achieved with 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. This enclosure will be partially improved in 1963 by surface techniques. 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 input to the system.