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Studies on the Water Requirements of Farm Animals in South Africa. I.—The Effect of Intermittent Watering on Merino Sheep.

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Introduction.

In many of the more arid parts of South Africa, sheep are watered at intervals of two or three days. It is a general assumption that sheep do not require water every day but, as far as is known, no experimental work has been published showing the effect of periodic thirsting on the water and food consumption or on the general health of these animals. It was therefore decided to conduct an experiment with the object of gaining further information on this matter.

Experiment 1.

Method.

Twelve merino wethers, all between 18 months and two and a half years old and averaging 65 lb. in body weight were divided into two groups. Each group was confined in a small pen, measuring about 20 by 20 feet, on hard bare ground in the open, where they remained except during rainy weather when they were placed under cover. The only food given was poor quality grass hay containing 2 per cent. protein supplied *ad lib.* For a preliminary period of two weeks both groups were also allowed unrestricted water constantly available.

Group 1 acted as controls and were treated as described above throughout the experiment. For the first six days of the experimental period the animals in group 2 were given water every second day, for the following six days every third day and for the last twelve days they received water only every fourth day. On the days that water was given (to group 2) it was available for one hour (9 to 10 a.m.).

Result.

The average daily consumption of hay and water per sheep in each group is shown in Graph 1.

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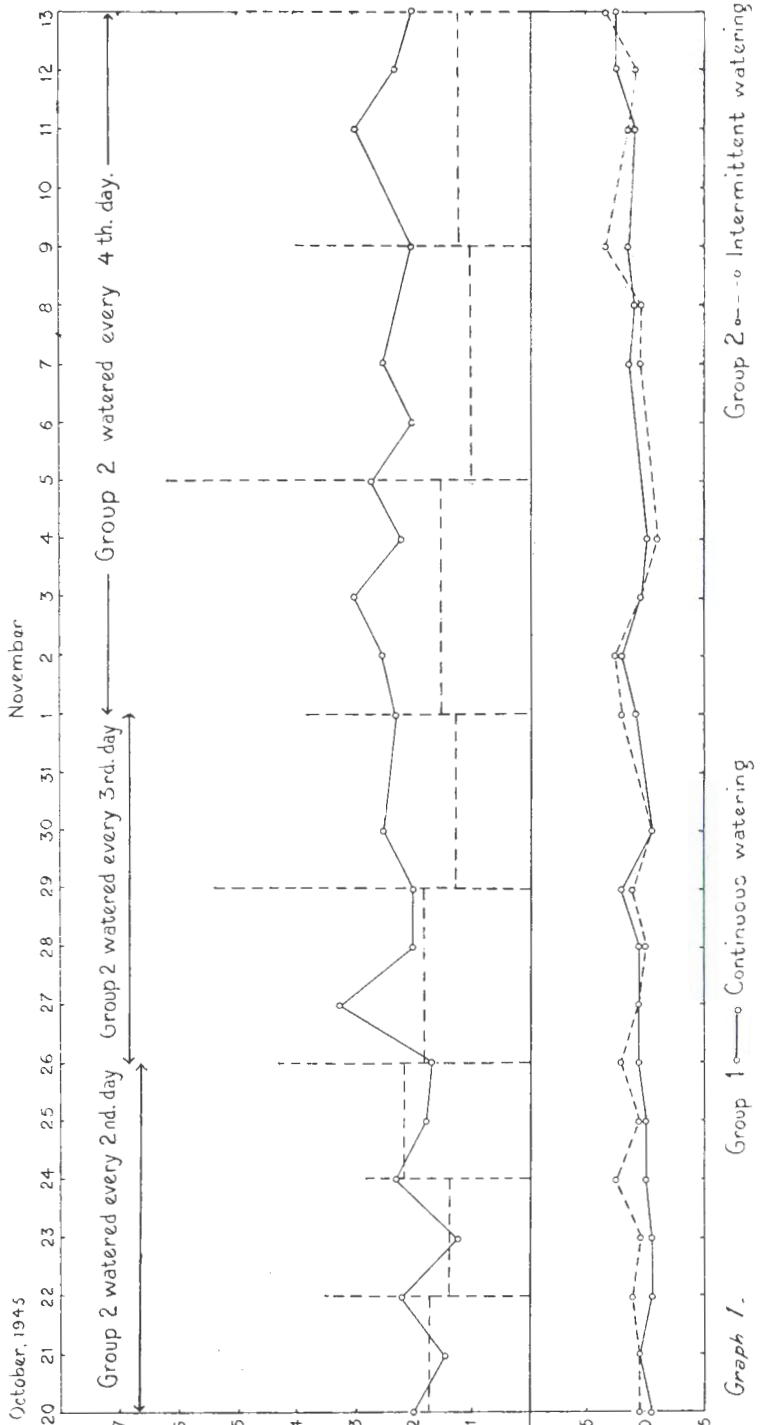
GRAPH 1.



Graph 1.

FOOTNOTE TO GRAPH 1.—The upright dotted lines represent the average water consumption per sheep in Group 2 during the hour that water was available. The horizontal dotted lines show this amount divided by the number of days since water was last available and thus indicate the average daily consumption which can be directly compared with that of the controls.

For further comparison the data are also summarized in the following table.

TABLE 1.

Interval in days between watering.....	Group 2.....	2	3	4
Average daily hay consumption per sheep (kg.).	Group 1.....	·49	·56	·62
	Group 2.....	·61	·55	·63
Average daily water consumption per sheep (litre)	Group 1.....	1·8	2·4	2·4
	Group 2.....	1·8	1·5	1·3

As the experiment was of a purely comparative nature in which the day to day reactions of two groups of animals under indentical weather conditions were to be compared, no attempt was made to correlate the results with the climatic environment. For record purposes, however, certain meteorological data for the period of the experiment are given in Appendix 1.

As will be noted from these data, the weather in general was hot and dry, the highest temperature recorded being 96·7° F. and the lowest 47·1 F. A total of 1·83 inches of rain fell on six of the 25 days.

Referring to Table 1 it will be seen that under the conditions encountered the total intake of water of the sheep in group 2, when supplied with water every alternate day, was equal to that of the controls. When the intervals between watering were extended to three or four days, however, the consumption fell to 63 per cent. and 54 per cent. of that of the controls, respectively.

TABLE 2.

Average Body Weights of Sheep (lb.).

Date.	16/10/45	23/10/45	30/10/45	6/11/45	13/11/45
Group 1.....	67	65	65	67	65
Group 2.....	65	65	64	65	55

As will be seen from the above table the animals in group 2 maintained their body weight till 6.11.45 (see Graph 1), i.e., during the whole of the periods that they received water every second day and every third day and also including one period of four days without water. During the last week of the experiment, however, they lost an average of 10 lb. per animal. As already shown, this loss cannot be attributed to decreased consumption of hay and would therefore appear to be due to dehydration and metabolic disturbances. After the completion of the experiment as reported, the animals in group 2 were again watered *ad lib.* Within seven days their average body weight equalled that of the controls (63 lb.). This rapid gain on a poor diet but with adequate water also indicates that dehydration of the body had occurred. One of the experimental animals in group 2

died on 11.11.45, the main post-mortem findings being general emaciation and anaemia, oedema of the subcutaneous tissues and lungs, hydropericard, hydrothorax, general blood stasis especially severe in the alimentary canal.

The ruminal movements of all the sheep were counted periodically and it was found that even after a period of three days without water there was no disturbance in the normal motility of the forestomachs. The faeces of both groups were also collected at intervals but no difference could be detected either in the amount or consistency.

Experiment 2.

A similar experiment to that described above was next planned, the ration in this case being lucerne hay containing 15 per cent. protein. As rainy weather had set in at the time, the sheep were placed under cover.

Method.

A further 12 merino wethers between eighteen months and two years old and averaging 61 lb. in weight were used. The animals were placed in a wood and iron shed with a concrete floor and open in the front.

For a preliminary period of two weeks all the animals were given lucerne hay and water *ad lib.* The sheep were then divided into two equal groups. Group 1 acted as controls and were treated as described above throughout the experiment. Group 2 continued to receive lucerne hay *ad lib* but were watered twice weekly only (Mondays and Fridays), i.e., on the third and fourth days alternately. On Mondays the animals in group 2 were given water at 9 a.m. and at 3 p.m., both the food and water were removed from all pens preliminary to weighing the sheep the following morning. On these days (marked M on Graph 2) therefore, food and water were available to all sheep for only six hours. On Fridays the animals in group 2 were watered at 9 a.m., and the water was available till 9 a.m. the next morning. the residual food and water were measured back at 9 a.m. daily, so that the figure shown for any particular date represents the amount consumed between 9 a.m. on that date to 9 a.m. the following morning.

Results.

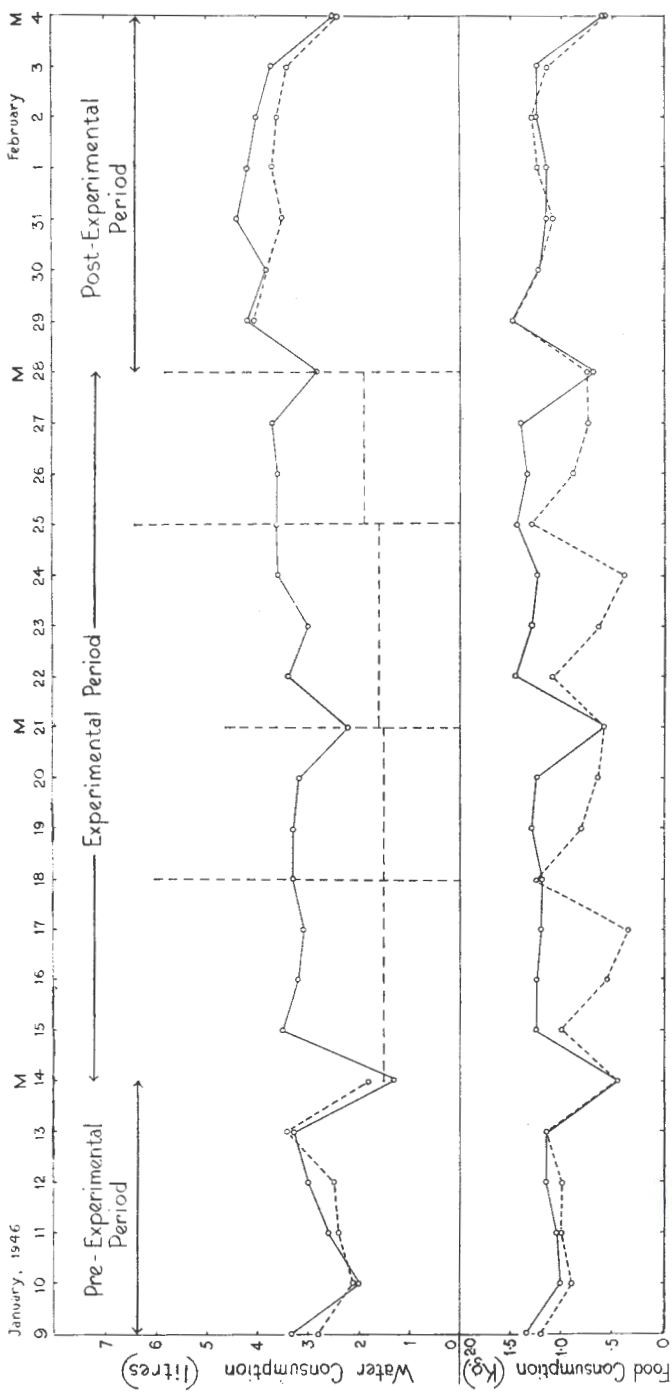
The results are shown in Graph 2, the method of presentation being the same in Graph 1.

During the whole of the experimental period the weather was almost continuously overcast with rain falling practically daily. (For meteorological data for this period see Appendix 2.)

As will be seen from Graph 2 the water consumption of group 2 was approximately half that of the controls, the average daily intake being 1·6 and 3·3 litres respectively.

After a period of two or three days without water, the sheep in group 2 each drank about four litres immediately water was offered. The distribution of the water intake of these animals while water was available is shown in Table 2, the figures being the average per sheep.

GRAPH 2.



Graph 2.

TABLE 3.

Date.	Period of Day.			Total.
	9 to 9.10 a.m.	9.10 to 3 p.m.	3 p.m. to 9 a.m.	
18/1/46.....	3·9	0·8	1·3	6·0
21/1/46.....	3·5	1·1	Removed 3 p.m.	4·6
25/1/46.....	4·1	1·3	1·0	6·4
28/1/46.....	4·2	1·6	Removed 3 p.m.	5·8

Lucerne Hay Consumption.

As will be seen from Graph 2 the intake of lucerne was markedly influenced by the availability of water. On the days that water was available the sheep in group 2 consumed virtually the same amount of lucerne as did the controls, but within the first 24 hours after the water was removed there was a significant drop in the consumption of hay. The appetite decreased progressively until water was again given. The average daily consumption of lucerne hay per sheep for the whole period was 1·21 Kg. in the control group, and 0·80 Kg. in group 2.

Body Weight.

The average weekly body weights are given in Table 3.

TABLE 3.

Days in experiment.....		0	7	14	21
Average body weight (lb.)	Gr. 1..	61	63	65	67
	Gr. 2..	61	62	62	64

Although the above figures appear to show a greater gain in the control group, statistical analysis showed that the difference between the two groups was not significant. It is reasonable to suppose, however, that the lower food intake noted in group 2 would in time be reflected in the body weight.

At the conclusion of the experiment the animals in group 2 were given water *ad lib* and showed an average increase in body weight of four pounds in the first seven days. This rapid increase probably indicates that a certain amount of dehydration had taken place during the experimental period.

CLINICAL OBSERVATIONS.

No differences could be detected in the quality of the faeces, ruminal motility or the general appearance of the animals in the two groups.

DISCUSSION.

A comparison of the amounts of water consumed by the control groups in the two experiments shows the effect of the type of food on water requirements. The animals on poor grass hay drank from 2 to 2·5 litres per day,

whereas those receiving lucerne hay took in 3 to 3·5 litres per day, despite the fact that the former sheep were exposed to the sun during a hot dry spell, while the latter were under cover during a period of high atmospheric humidity. The amount of lucerne hay eaten was double that of grass hay (averages 1·16 Kg. and 0·57 Kg. per day respectively). The water to hay ratios were 2·7 for lucerne hay and 3·9 for grass hay but these figures cannot be compared owing to the entirely different conditions under which the two experiments were conducted.

Each experiment must, therefore, be reviewed separately by comparing the reactions of the sheep whose water was curtailed with those of their controls receiving water *ad lib.* under indentical conditions.

In Experiment 1 it was seen that reduced intake of water did not affect the consumption of grass hay. In contrast to this when lucerne hay was fed, a similar restriction in water supply immediately caused a decided decrease in food intake, which was clearly shown within the first 24 hours of thirsting. This difference can in all probability be ascribed to the greater amount of water required for the excretion of protein metabolites and minerals when lucerne is fed.

It has been shown that sheep on grass hay can take in enough water when allowed to drink only every 48 hours under very hot and dry weather conditions. Exercise was, however, restricted to a minimum so that it cannot be assumed that this finding would apply to sheep on natural grazing.

Summary.

(1) On a ration of poor quality grass hay sheep were found to maintain their normal intake of water when allowed to drink for one hour only every second day.

(2) When given water at 72 and 96 hour intervals the total intake was decreased to 63 per cent. and 54 per cent. of the normal, respectively.

(3) This decreased intake of water, however, did not affect the consumption of grass hay although one animal actually died of dehydration.

(4) On the other hand the consumption of lucerne hay was markedly suppressed by lack of water even during the first 24 hours of thirsting.

(5) Sheep on lucerne hay receiving water only twice weekly still gained in body weight This gain was, however, accelerated when water was constantly available.

(6) As exercise was greatly restricted these results cannot be applied quantitatively to sheep on open grazing.

Appendix 1.

Meteorological Data for Period of Experiment 1.—*Grass Hay Ration.*

Date.	Shade Temp. ° F.		Humidity Percentage.		Solar* Radiation.	Rainfall (Inches).
	Maximum.	Minimum.	Maximum.	Minimum.		
20/10/45.....	85·0	50·0	40	29	710	—
21/10/45.....	81·7	56·0	91	29	565	—
22/10/45.....	85·1	56·7	55	8	705	—
23/10/45.....	73·1	57·1	88	60	413	—
24/10/45.....	72·7	57·9	88	46	559	—
25/10/45.....	85·3	54·3	94	35	624	—
26/10/45.....	91·8	52·3	88	22	846	—
27/10/45.....	89·7	51·7	84	7	829	—
28/10/45.....	88·6	54·2	82	19	798	—
29/10/45.....	89·5	53·3	82	24	637	·01
30/10/45.....	93·5	50·0	86	16	763	—
31/10/45.....	87·6	55·6	79	32	758	·23
1/11/45.....	74·9	53·1	87	45	698	—
2/11/45.....	81·1	47·1	95	30	725	—
3/11/45.....	89·7	47·5	85	20	671	—
4/11/45.....	96·7	50·0	69	20	585	—
5/11/45.....	90·4	53·0	84	26	644	·32
6/11/45.....	91·0	56·6	95	24	711	·06
7/11/45.....	90·0	59·1	91	23	567	—
8/11/45.....	79·6	54·0	85	46	340	·82
9/11/45.....	79·0	55·8	95	43	595	—
10/11/45.....	70·5	59·0	87	62	195	·39
11/11/45.....	81·2	58·8	95	27	650	—
12/11/45.....	82·6	55·5	70	13	746	—
13/11/45.....	77·4	54·5	86	29	600	—

* Total intensities of sun and sky radiation per day, impinging on a horizontal surface given in gram calories per square centimetre.

Appendix 2.

Meteorological Data for Period of Experiment 2.— Lucerne Hay Ration.

Date.	Shade Temp. ° F.		Humidity Percentage.		Rainfall. (Inches).
	Maximum.	Minimum.	Maximum.	Minimum.	
9/1/46	82·3	66·3	95	46	·40
10/1/46	74·0	65·0	92	67	·47
11/1/46	75·6	60·6	88	57	·01
12/1/46	81·6	62·0	83	46	—
13/1/46	86·6	61·0	92	34	—
14/1/46	84·5	60·9	90	30	—
15/1/46	82·6	69·3	72	45	·24
16/1/46	77·1	65·3	93	56	·64
17/1/46	70·6	61·6	95	67	·02
18/1/46	76·0	64·4	91	58	·01
19/1/46	78·0	62·6	93	51	—
20/1/46	81·4	62·2	83	45	·40
21/1/46	74·0	62·4	95	69	·26
22/1/46	67·2	60·3	94	73	·23
23/1/46	66·1	58·1	95	75	·26
24/1/46	73·6	58·6	95	61	—
25/1/46	80·1	62·7	95	50	·17
26/1/46	77·5	63·7	94	60	·27
27/1/46	80·2	65·0	95	56	·82
28/1/46	80·6	63·7	95	59	·01
29/1/46	76·0	65·2	95	68	·04
30/1/46	81·9	67·6	93	52	—
31/1/46	82·9	65·1	91	52	·21
1/2/46	82·1	65·2	95	51	·10
2/2/46	82·2	66·6	94	52	·18
3/2/46	76·2	67·4	94	63	·23
4/2/46	80·5	60·7	95	54	·65