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The Dry Matter Consumption of Sheep on Natural Grazing in the Transvaal.

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ONE of the major problems with which the sheep and cattle industry of the summer rainfall areas is continually confronted, is the tremendous loss in weight of animals during the winter months. This progressive decline in weight becomes even more complicated, when it is realized that the prevailing phosphorus deficiency of the pasture during winter is not exclusively responsible for this abnormal phenomenon of weight reduction. In fact it has been shown on numerous occasions that the administration of phosphates or phosphatic licks alone does not remedy this condition. It would, therefore, appear as if the whole question of weight loss is either due to a complex nutritional deficiency or to an inadequate food consumption which may be associated with the fibrous and highly lignified state of the winter pasture. However, these assumptions are at present mere speculations and can only be settled one way or another by a systematic analysis of the entire problem as it appears in practice. It is also clear, that whatever method of attack is employed, one common and insurmountable factor, namely, the estimation of the amount of grazing consumed per day, remains an obstacle in the ultimate and final solution of this very important economic problem. Thus to show conclusively and in a scientific manner that either protein, phosphorus, energy or the entire complex is deficient in winter grazing, it seems imperative that the amount of grazing consumed, the quantities of these elements present as well as their utilizability by the animal, should be known. On this basis alone can the magnitude of such a deficiency be determined and scientifically rectified. Other methods of establishing nutritional deficiencies, such as differences in gain in weight between supplemented and unsupplemented rations or changes in the chemical composition of the blood or tissues, merely indicate the possibility that such a deficiency exists, but neglect the basic information of total intake and utilizability without which scientific and economic supplementation of the deficient element become mere approximation.

Apparently little attention has been given to this aspect of work in the past. Recently, however, Garrigus and Rusk have measured the dry matter consumption of steers on reed canary and brome grasses. Their method consisted in determining the daily dry matter of the faeces voided and the percentage digestibility of the dry matter of these grasses. From these figures they could then calculate the dry matter consumed by their animals. Woodman and Evans on the other hand utilized the organic matter of the faeces and the percentage digestibility of the latter elements to measure the grass consumption of their sheep. We have adopted the method of Garrigus and Rusk for our work.

Experimental.

The experiment to be described was conducted at the Ermelo Experimental Station. The general conditions at this station in respect of rainfall, growth of pasture and seasonal fluctuations in protein content of the natural flora are fairly representative of the entire Transvaal. Twenty sheep belonging to a grazing flock were utilized for this work. In order to maintain the natural conditions of grazing, these sheep were not separated from the rest of the flock. At the start of each collection period, specially constructed metabolism bags, which fitted tightly round the hindquarters of the sheep, were put on to each sheep two days prior to the actual collection. This preliminary period was essential to accustom the sheep to the metabolism bags and prevent unusual restlessness. After this preliminary period the sheep did not seem to take any notice of the metabolism bags and grazed about normally. The collection period proper was then started. The metabolism bags were put on early in the morning and changed during the late afternoon. For the purpose of changing the metabolism bags a temporary camp consisting of wire netting fixed to a few poles was constructed in the corner of the existing camp. The flock was then grazed slowly towards this temporary camp, and interned. With the help of two native assistants the experimental sheep were carefully separated from the rest of the flock and the metabolism bags removed, while others were immediately put on. As soon as all the bags were changed, the wire netting constituting the temporary camp was let down and the sheep allowed to graze. The metabolism bags containing the faeces were removed to the laboratory, where the faeces were spread out and allowed to sun-dry. The daily sun-dried faeces were then carefully weighed and 10 per cent. aliquots taken and stored in air-tight fruit jars. Total dry matter was then determined on a representative sample of the entire 10 days' aliquot. During the 10 days' collection period representative grazing was cut by following the grazing sheep. This grass was utilized for the metabolism studies and the determination of the digestibility of the dry matter. From the daily dry matter of the faeces and the digestibility of the dry matter the dry matter consumption was calculated.

Collection periods were so arranged as to take place during the different seasons of the year. Hence collections took place during January, April, July and October. In this way it was anticipated to obtain information on the plausibility of the assumption that sheep consume comparatively more grazing during summer than during the winter months.

Experimertal Results.

In Table I is given the percentage digestibility of the dry matter of the grazing during the different seasons of the year. It will be noted from the data presented in the above table, that there is very little variation amongst the individual digestibility figures of the same period. Consequently it is only fair to assume that the average digestibility for the different periods is also representative of the natural grazing during those seasons of the year. On this basis, therefore, the mean dry matter digestibility of each period was utilized for the ultimate calculation of the dry matter consumed from the dry matter contained in the faeces.

It is interesting to note that during July, when the grazing is dry, fibrous and highly lignified, the protein content drops as low as 3·1 per cent. During this period the digestibility of the dry matter of the grazing also reaches its lowest level, namely 43 per cent. With the first summer rains and the beginning of the growing stage in October, the protein content of the natural flora increases rapidly to approximately 9·9 per cent. There is also a corresponding increase in the percentage digestibility of the dry matter during this month. During January there is apparently very little difference in the digestibility of the dry matter in comparison with that of October. The average figures are 58 and 60 respectively. As soon as winter conditions set in and the grazing becomes dry as happens in April, there is again a decided drop in both the protein content and the digestibility of the dry matter. The average percentage digestibility of 46 per cent. corresponds closely with the figure obtained during July.

In Tables 2, 3, 4 and 5 are reproduced the results relative to the calculation of the dry matter consumption of sheep during the different seasons of the year.

Several interesting points arise from a detailed consideration of the data. Thus it will be noticed, that the average daily weight of the sheep increases or decreases according to the protein content of the pasture and the season of the year. During the middle of winter as represented by our July figures the protein content of the pasture as well as the average weight of the animals are the lowest for the year. When the nitrogen content increases from 0·49 per cent. in July to 1·44 per cent. in October, there is also a corresponding increase in weight from 28 Kgms. to 33 Kgms. In January the nitrogen content is still fairly high and averages 1·17 per cent. The average weight of the sheep is at its best during this month and averages 40 Kgms. From January onwards the grazing matures fairly fast, so much so that the nitrogen content drops to 0·73 per cent. in April. This decided drop in nitrogen also reflects on the weight of the sheep. There is consequently a noticeable drop in weight to 39 Kgms. during April.

Another interesting feature is the fact that the dry matter excretion on grazing does not seem to bear any relation to the condition, stage of growth or to the seasonal fluctuations in protein content of the pasture. During October when the first blades of green grass appear and the pasture can therefore be assumed to be in its most palatable stage, the dry matter excretion is less than in July. The average figures for the two months are 324 and 370 grams respectively. Similarly the dry matter excretion during the more advanced state of maturity in April is higher than during January. In April the daily dry matter excretion is 465 grams daily, while it is only 363 grams in January.

A point of practical importance is the apparent relationship between dry matter consumption and the live weight of the animals. In July, when the average daily weight of the sheep was 28 Kgms. the dry matter consumption was at its lowest, namely 649 grams. As these sheep increased in weight to 33 Kgms. in October, the dry matter consumption also increased to 718 grams daily. In January, when the maximum average weight was attained, it was accompanied by a maximum dry matter consumption of 907 grams. During April the average weight of the sheep fell to 39 Kgms. This decrease in weight was associated with a corresponding decrease in dry matter consumption. These figures strongly indicated that the dry matter consumption of an animal may be related to body weight, power function of weight or surface area, in the same way as the maintenance protein requirement or the basal metabolism. On this basis the dry matter consumption for the different periods of measurement was expressed per kilogram body weight and per square meter of body surface as illustrated in columns 14 and 15 of the respective tables. In the latter case the surface area was calculated from the formula of Pierce and Linas namely, $S = \cdot 121\ W^{\cdot 59}$. There is indeed very little difference between the average value for the different periods, when expressed in this manner. In July the average dry matter consumption per Kg. is 23·4 gram and 748 grms. per s.m. For October the average values are 23·7 and 823 grams. For January and April the values per Kg. are 22·7 and 22·2 and per sq. m. 840 and 823 grams respectively. The coefficient of variation never exceeds the 12 per cent. mark in any of the periods.

Kleiber concludes that as a working hypothesis the maximum food capacity of an animal can be regarded as a similar function of its weight as the basal metabolism. He further shows that the basal metabolism of different species of animals can best be related to the $\frac{3}{4}$ power function of its weight. On this basis he evolved the following general equation $B = 72W^{\frac{3}{4}}$ for calculating the basal metabolism of different species of animals.

We have adopted the Kleiber equation for relating dry matter consumption to body weight. The equation now reads $DM = k\ W^{\frac{3}{4}}$ where DM equals the dry matter in grams, k the constant varying in all probability with different conditions and W the weight in kilograms.

On this basis the value of k was determined for each period from the measured dry matter consumption and the respective weights of the animals. In column 8 of the respective tables the average constant for the different periods is given. Very significant is the fact that these constants for the different periods of measurement, representing extreme pastoral conditions, are almost of the same magnitude. Thus the constant obtained under July conditions is 54, for October 57, for January 56 and for April 55. By including the above constants in the Kleiber equation, the dry matter consumption was predicted from the weights of the animals and compared with the dry matter consumption actually determined in each period. In column 10 of the tables the percentage deviation has been calculated. From these figures it will be seen that the predicted figures agree extremely well with the determined values. The average percentage deviation in the July figures is ± 9 per cent., in October $\pm 9 \cdot 8$ per cent., in January $\pm 8 \cdot 8$ per cent. and in April ± 5 per cent.

These small variations together with the fact that the constants of the individual periods are very similar, opened the possibility of utilizing a common constant, for the general prediction of the dry matter consumption of grazing sheep over the year. In this way the average of the four constants was applied to the Kleiber equation and the predicted results compared with the determined value. This formula now reads as follows $DM = 56\ W^{\frac{3}{4}}$, where DM equals dry matter in grams, and W weight in kilograms. In column 11 of the respective tables are given the predicted values of the daily dry matter consumption, according to the above formula. In column 12 these values are compared with the determined values and the percentage deviation determined. As will be seen the average percentage deviation in July is ± 11 per cent., in October $\pm 9 \cdot 5$ per cent., in January $\pm 8 \cdot 8$ per cent. and in April $\pm 5 \cdot 2$ per cent. The average deviation from all the periods is only ± 9 per cent. This deviation is extremely small when compared with such biological constants as basal metabolism and the endogenous nitrogen.

Discussion of Results.

From the results of this investigation, it is evident that while the average daily dry consumption varies with the season of the year, and consequently with the protein content of the pasture, it is extremely constant when expressed per unit of weight, per $\frac{3}{4}$ power function of the weight or per sq. meter of body surface. From these data it would further appear as if the capacity for dry matter consumption is related in the same manner as the basal metabolism, to the surface area or $\frac{3}{4}$ power function of the weight. This would mean, that there is no justification to assume that sheep eat proportionately more per unit of weight of the summer grazing than of the winter grazing. In fact it appears as if the weight of the animal is the dominating factor and not the condition of the grazing. This interpretation would, therefore, favour the argument, that the loss in weight associated with winter grazing is definitely not due to the fact that sheep consume less winter grazing but justifies the view that the winter grazing is nutritionally inferior to the summer grazing. In other words the nutritional deficiencies in the winter grazing are so great that the same quantity of winter grazing per unit of weight cannot satisfy the requirements of the animals in the same efficient manner as the summer grazing. It can therefore be regarded as an established fact, that the periodic decline in weight of animals during winter is associated with a deficiency of certain essential nutritive elements in the winter grazing.

From a scientific aspect it is interesting that the dry matter consumption under natural grazing conditions should be as closely correlated with the power function of the weight of an animal as the basal metabolism and endogenous nitrogen. The $\frac{3}{4}$ power function of the weight of an animal is in all probability a very representative measure of the protoplasmic mass, which regulates the intensity of the basal metabolism as well as the endogenous nitrogen and may equally be responsible for the regulation of the appetite of an animal or in other words its feeding capacity. It is quite possible that both the basal metabolism and the endogenous nitrogen may be lowered during the winter months. In fact a few preliminary measurements of the endogenous nitrogen under conditions similar to those of the winter grazing conditions indicate strongly that such is the case. It can therefore readily be appreciated, that the lowered intensity of the protoplasmic reactions to conserve as far as is possible its own tissues, becomes a biological necessity. This natural condition of economic conservation, through a lowering of the intensity of the protoplasmic reactions may in all probability also be extended to the appetite or food capacity of the animal and indirectly to its live-weight.

Whatever the explanation may be for this striking correlation between weight and dry matter consumption, it is nevertheless of practical importance that the dry matter consumption under grazing conditions can readily be calculated from the weight of the animals. Whether the established equation will hold true under all conditions of grazing, and which factors may influence its general applicability, is a problem of the future. However, for comparative purposes it is interesting to compare the results of Garrigus and Rusk and Woodman and Evans obtained under quite different conditions. According to our formula a 100-pound sheep would eat 981 grams of dry matter. Woodman finds that a sheep of 131 pounds would consume approximately 3·01 pounds of dry matter. On the basis of a 100 lb., such a sheep would consume 1,044 grams of dry matter. Garrigus and Rusk finds that a 600-lb. steer would consume approximately 13 lb. dry matter which is equivalent to 989 grams per 100 lb. Our calculated value of 981 grams per 100 lb. differs by 63 grams from Woodman's value and with 18 grams from the average value of Garrigus. It would therefore seem as if the relationship between dry matter consumption and weight holds good for steers as well as sheep under unrestricted conditions of natural grazing.

Summary and Conclusions.

From a study on the dry matter consumption of sheep under natural conditions of grazing, it is evident that the quantity consumed is not a factor in the loss of weight in sheep during winter. It appears from these data that the decline in weight is specifically due to a rapid depletion of nutritive elements from summer to winter grazing. It has further been shown that the dry matter consumption of sheep is correlated with the weight of the animals and that it can be predicted with success from the following equation $DM = 56W^{\frac{3}{4}}$, where DM equals dry matter in grams and W weight in Kilograms.

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TABLE 1.

Digestibility of Dry Matter during Different Seasons of the Year.

Animal No.	Weight.	Dry Matter Intake.	Dry Matter In Faeces.	Digestibility of Dry Matter.
	Kilogram.	Grams.	Grams.	Per cent.
JULY, 1938—0·49 PER CENT N.				
1	46	448	257	43
2	45	426	261	39
3	42	431	214	50
4	50	422	237	44
5	42	378	224	41
AVERAGE	—	—	—	43
OCTOBER, 1938—1·44 PER CENT. N.				
38247	56	611	246	60
49612	53	723	336	54
38252	44	470	194	59
38243	48	602	253	58
39292	52	622	263	58
AVERAGE	—	—	—	58
JANUARY, 1939—1·17 PER CENT. N.				
38248	32	515	211	59
49612	52	660	382	56
38252	42	573	225	61
38240	44	692	260	62
38000	45	469	171	64
AVERAGE	—	—	—	60
APRIL, 1939—0·73 PER CENT. N.				
38248	43	430	218	49
49612	46	455	240	47
38252	41	427	240	44
38240	41	454	247	46
38249	40	326	179	45
AVERAGE	—	—	—	46

TABLE 2.

Data on the Grass Consumption of Sheep under Natural Conditions of Grazing.

FIRST TEST, JULY, 1938.

Animal No.	Weight	Daily Dry Weight Faeces.	Daily Dry Weight of Grass Consumed, D.M.	Log DM.	Log W.	$W^{\frac{3}{4}}$.	Dm. = $KW^{\frac{3}{4}}$. K.	Dm. = 54 $W^{\frac{3}{4}}$.	Percentage Deviation.	DM. = 56 $W^{\frac{3}{4}}$.	Percentage Deviation.	Surface Area $S = \cdot 121\ W^{\cdot 59}$	DM. per Square Metre.	DM. per Kilo-Gram.
	Kgm.	Gram.	Gram.					Gram.		Gram.		Sq. M.	Gram.	Gram.
51689..........	26	337	951	2·7716	1·4150	11·5	51·4	622	5·2	645	9	0·827	715	22·7
51693..........	30	373	654	2·8156	1·4771	12·8	51·1	692	5·8	718	10	0·900	727	21·8
51694..........	26·5	425	746	2·8727	1·4232	11·7	63·8	631	−15·4	654	−12	0·836	892	28·2
51738..........	26·5	388	681	2·8331	1·4232	11·7	58·2	631	− 7·3	654	− 4	0·836	815	25·7
51755..........	26	406	712	2·8525	1·4150	11·5	61·9	622	−12·6	645	− 9	0·827	861	27·4
51757..........	26	343	602	2·7796	1·4150	11·5	52·3	622	3·3	645	7	0·827	728	23·2
51833..........	29	337	591	2·7716	1·4624	12·5	47·3	675	10·8	700	18	0·882	670	20·4
51863..........	28	404	709	2·8506	1·4472	12·3	58·2	666	− 6·1	682	− 4	0·864	821	25·3
51812..........	29	368	646	2·8102	1·4624	12·5	51·7	675	4·5	700	− 8	0·882	733	22·3
51840..........	32	436	765	2·8837	1·5051	13·5	56·8	726	− 5·1	753	2	0·935	818	23·9
51852..........	25·5	374	656	2·8169	1·4065	11·4	57·8	613	− 6·6	635	− 3	0·818	802	25·7
51885..........	23	248	435	2·3685	1·3617	10·3	41·4	567	30·3	588	−35	0·770	565	18·9
51904..........	26	327	574	2·7589	1·4150	11·5	49·9	622	8·3	645	12	0·827	694	22·1
51924..........	26·5	277	486	2·6866	1·4232	11·7	41·5	631	29·8	654	34	0·836	581	18·3
52079..........	32	411	721	2·8579	1·5051	13·5	53·5	726	0·7	753	4	0·935	771	22·6
52010..........	26	355	623	2·7945	1·4150	11·5	54·1	622	—	645	4	0·827	753	23·9
52025..........	30	382	670	2·8261	1·4771	12·8	52·3	692	3·3	718	7	0·900	744	22·3
52100..........	31·5	381	668	2·8248	1·4983	13·5	50·2	735	10·0	745	12	0·927	721	21·2
52082..........	30	475	833	2·9206	1·4771	12·8	65·0	692	−16·9	718	−14	0·935	891	27·8
51765..........	25·5	355	623	2·7945	1·4065	11·4	54·9	613	− 1·6	635	2	0·900	692	24·4
Average........	28	370	649	—	—	—	54	—	9	—	11	—	748	23·4
Standard Deviation..........	—	—	—	—	—	—	—	—	—	—	—	—	88	2·7
Coef. of variation	—	—	—	—	—	—	—	—	—	—	—	—	12	12

TABLE 3.

Data on the Grass Consumption of Sheep under Natural Conditions of Grazing.

SECOND TEST, OCTOBER, 1938.

Animal No.	Weight	Daily Dry Weight Faeces.	Daily Dry Weight of Grass Consumed, D.M.	Log DM.	Log W.	$W^{\frac{3}{4}}$.	Dm. = $KW^{\frac{3}{4}}$. K.	Dm. = $54 W^{\frac{3}{4}}$.	Percentage Deviation.	DM. = $56 W^{\frac{3}{4}}$.	Percentage Deviation.	Surface Area $S = \cdot 121 W^{\cdot 9}$	DM. per Square Metre.	DM. per Kilo-Gram.
	Kgm.	Gram.	Gram.					Gram.		Gram.		Sq. M.	Gram.	Gram.
52082..........	36	405	964	2·9841	1·5563	14·7	65·6	838	−13·3	823	−15	1·002	962	26·7
51738..........	34	395	940	2·9731	1·5315	14·1	66·7	803	−14·6	789	−16	0·969	970	27·6
51885..........	32	352	838	2·9232	1·5051	13·5	62·3	767	− 8·5	753	−10	0·935	896	26·2
51757..........	33	361	860	2·9345	1·5185	13·8	62·4	785	− 8·7	771	−10	0·952	903	26·1
91904..........	33·5	348	829	2·9186	1·5250	13·9	59·8	794	− 4·2	780	− 6	0·961	863	24·7
52079..........	32	334	795	2·9004	1·5051	13·5	59·1	767	− 3·5	753	− 5	0·935	850	24·8
51765..........	29	269	640	2·8062	1·4624	12·5	51·2	713	11·4	700	− 9	0·882	726	22·1
51833..........	36	251	836	2·9222	1·5563	14·7	56·9	838	—	823	2	1·002	834	23·2
51689..........	28·5	289	688	2·8376	1·4548	12·3	55·8	703	2·2	691	—	0·876	788	24·1
52100..........	37	297	707	2·8494	1·5682	14·1	47·1	855	20·9	840	19	0·995	711	19·1
51694..........	32	342	814	2·9016	1·5051	13·5	60·4	767	− 5·8	753	− 7	0·935	871	25·4
51755..........	29	317	755	2·8779	1·4624	12·5	60·3	713	− 5·7	700	− 7	0·882	856	26·0
51693..........	37·5	278	662	2·8209	1·5740	15·2	43·7	864	30·5	849	28	1·027	645	17·7
51852..........	34	322	767	2·8848	1·5315	14·1	54·5	803	4·7	789	3	0·969	792	22·6
52030..........	33·5	322	767	2·8848	1·5250	13·5	55·1	794	3·5	780	2	0·962	797	22·9
51840..........	35·5	344	819	2·9133	1·5502	14·5	56·3	829	1·2	815	− 1	0·994	824	23·1
52010..........	29	257	612	2·7868	1·4624	12·5	46·8	713	16·5	700	14	0·882	694	21·1
52025..........	375	362	838	2·9232	1·5740	15·2	55·2	864	3·1	849	1	1·027	816	22·3
Average........	33·0	324	718	—	—	—	57	—	± 9·8	—	± 9	—	823	23·7
Standard Deviation..........	—	—	—	—	—	—	—	—	—	—	—	—	88	2·7
Coef. Variation..	—	—	—	—	—	—	—	—	—	—	—	—	11	11·0

TABLE 4.

Data on the Grass Consumption of Sheep under Natural Conditions of Grazing.

THIRD TEST: JANUARY, 1939.

Animal No.	Weight	Daily Dry Weight Faeces.	Daily Dry Weight of Grass Consumed, D.M.	Log DM.	Log W.	$W^{\frac{3}{4}}$.	Dm. = $KW^{\frac{3}{4}}$. K.	Dm. = 54 $W^{\frac{3}{4}}$.	Percentage Deviation.	DM. = 56 $W^{\frac{3}{4}}$.	Percentage Deviation.	Surface Area $S=121 W^{\cdot 59}$	DM. per Square Metre.	DM. per Kilo-Gram.
	Kgm.	Gram.	Gram.					Gram.		Gram.		Sq. M.	Gram.	Gram.
51693..........	42	355	888	2·9484	1·6263	16·5	53·8	929	4·6	929	4·5	1·097	809	21·1
51694..........	43	413	1,033	3·0140	1·6335	16·8	61·5	940	— 9·0	940	- 9·0	1·114	927	24·0
51652..........	38	336	840	2·9243	1·5798	15·3	54·9	857	2·0	857	2·0	1·038	809	22·1
51738..........	41	421	953	2·9791	1·6128	16·2	58·7	907	4·8	907	— 4·8	1·082	881	23·2
51757..........	37·5	322	805	2·9058	1·5740	15·2	52·9	849	5·5	849	5·5	1·027	784	21·5
51765..........	33·5	367	918	2·9628	1·5250	13·9	66·0	780	4·1	780	4·1	0·962	954	27·4
51833..........	43	382	955	2·9800	1·6335	16·8	56·8	940	— 1·6	940	— 1·6	1·114	857	22·2
51840..........	41	393	983	2·9926	1·6128	16·2	60·7	907	— 7·7	907	— 7·7	1·082	909	24·0
51852..........	40	371	928	2·9657	1·6021	15·9	58·4	891	4·0	891	4·0	1·067	870	23·2
51885..........	41	444	1,010	3·0043	1·6128	16·2	62·3	907	— 9·2	907	— 9·2	1·082	933	24·6
51904..........	42·5	408	1,020	3·0086	1·6284	16·6	61·5	932	— 8·6	932	— 3·2	1·114	916	24·0
51923..........	37	307	768	2·8854	1·5682	15·0	51·2	840	9·3	840	9·3	0·995	772	20·7
52010..........	40	261	653	2·8149	1·6021	15·9	41·1	891	36·4	891	34·6	1·067	612	16·3
52030..........	41	399	998	2·991	1·6128	16·2	61·6	907	-- 9·1	907	— 9·1	1·082	922	24·3
52079..........	36	286	715	2·8543	1·5563	14·7	48·6	823	15·1	823	15·1	1·002	714	20·0
52082..........	42·5	341	853	2·9309	1·6281	16·6	51·4	932	9·2	932	9·2	1·114	766	20·0
Average........	40	363	907	—	—	—	56	—	8·8	—	8·8	—	840	22·4
Standard Deviation..........	—	—	—	—	—	—	—	—	—	—	—	—	94	2·5
Coef. Variation..	—	—	—	—	—	—	—	—	—	—	—	—	11	11

TABLE 5.

Data on the Grass Consumption of Sheep under Natural Conditions of Grazing.

FOURTH TEST: APRIL, 1939.

Animal No.	Weight	Daily Dry Weight Faeces.	Daily Dry Weight of Grass Consumed, D.M.	Log DM.	Log W.	$W^{\frac{3}{4}}$.	Dm. = $KW^{\frac{3}{4}}$. K.	Dm. = 54 $W^{\frac{3}{4}}$.	Percentage Deviation.	DM. = 56 $W^{\frac{3}{4}}$.	Percentage Deviation.	Surface Area $S = \cdot 121\ W^{\cdot 59}$	DM. per Square Metre.	DM. per Kilo-Gram.
	Kgm.	Gram.	Gram.					Gram.		Gram.		Sq. M.	Gram.	Gram.
51652..........	39	461	854	2·9309	1·5911	15·6	55·9	859	+ 0·6	874	+ 2·2	1·051	840	21·9
51689..........	33·6	347	643	2·8082	1·5263	13·9	46·0	767	+19·2	781	21·4	0·962	668	19·1
51693..........	41	450	833	2·9206	1·6128	16·2	51·4	891	+ 6·9	907	+ 8·8	1·082	770	20·3
51694..........	47	484	896	2·9523	1·5682	15·0	59·7	825	− 7·9	840	− 6·2	1·019	879	24·2
51738..........	37	485	898	2·9533	1·5682	15·0	59·8	825	− 8·1	840	− 6·2	1·019	881	24·3
51741..........	38·2	443	820	2·9138	1·5821	15·4	53·4	845	+ 3·0	861	+ 5·0	1·038	790	21·5
51757..........	36	452	837	2·9227	1·5563	14·7	56·9	810	− 3·2	823	− 1·6	1·002	835	23·3
51761..........	39·5	522	967	2·9854	1·5966	15·8	61·4	867	−10·3	882	− 8·7	1·059	913	24·5
51765..........	34	454	841	2·9248	1·5315	14·1	59·7	775	− 7·8	789	+ 6·1	0·969	868	24·7
51812..........	33	402	744	2·8716	1·5185	13·8	53·9	757	+ 1·7	771	+ 3·6	0·952	782	22·5
51833..........	41	497	920	2·9638	1·6128	16·2	56·7	891	− 3·2	907	− 1·4	1·082	850	22·4
51840..........	41	491	909	2·9586	1·6128	16·2	56·1	891	− 1·0	907	− 0·0	1·082	840	22·2
51852..........	41	506	937	2·9717	1·6128	16·2	57·8	891	− 4·9	907	− 3·2	1·082	866	22·9
51885..........	36	433	802	2·9042	1·5563	14·7	54·5	810	+ 1·0	823	+ 2·6	1·002	800	22·3
51923..........	37	431	798	2·9020	1·5682	15·0	53·2	825	+ 3·4	840	+ 5·2	1·019	783	21·6
52009..........	43	493	913	2·9605	1·6335	16·8	54·3	924	+ 1·2	940	2·9	1·114	820	21·2
52010..........	40	450	833	2·9206	1·6021	15·9	52·4	875	+ 5·0	891	+ 7·3	1·067	781	20·8
52030..........	40	453	839	2·9238	1·6021	15·9	52·7	875	+ 4·2	891	+ 6·9	1·067	786	21·0
52079..........	43	496	919	2·9633	1·6335	16·8	54·7	924	+ 0·5	940	+ 2·2	1·114	825	21·4
52082..........	46	549	1,017	3·0052	1·6628	17·7	57·4	972	− 4·4	989	− 2·8	1·158	878	22·1
Average........	39	465	861	—	—	—	55	—	4·9	—	5·2	—	823	22·2
Standard Deviation..........	—	—	—	—	—	—	—	—	—	—	—	—	55	1·5
Coef. Variation..	—	—	—	—	—	—	—	—	—	—	—	—	7	7