THESIS

ON

THE EFFECT OF BEETS AND POTATOES UPON A FEEDING RATION

C. D. THOMPSON

T H E S I S

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by

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Presented for M. S. Degree

September, 1896.

THESIS

DIGESTION EXPERIMENT.

Object: To test the question whether the addition of mangel wurtzels or potatoes to a ration affects the digestibility of the factors of that ration.

For the experiment two cows of the college herd were selected; Halo, a grade Jersey, six months in period of lactation weighing about 750 lbs. and Milla, a grade Shorthorn, three months in period of lactation weighing about 850 lbs.

Halo was in calf about three months at the beginning of the experiment.

The basic ration was composed of wheat bran 6-1/2 lbs., corn meal 6-1/2 lbs. and clover hay 14-1/2 lbs. per 1000 lbs. live weight per day; the nutritive ratio being near the German standard for milk cows. During the time when roots or potatoes were fed the other foods were varied slightly in amounts to keep the daily amount of the dry matter consumed and the nutritive ratio nearly constant.

The corn meal was from corn of mixed varieties and quite coarsely ground. The wheat bran was such as ordinarily comes from the mills. The clover hay was very good in quality and at the beginning of the experiment it was run through an ordinary cutter and made in lengths of about one inch. The roots and potatoes were free from dirt and sliced before

feeding.

At the beginning of the experiment sufficient quantity of each of the several feeding stuffs was carefully cut to last during the entire period. The hay after being cut up was thoroughly mixed, then a handful taken from various places in the pile and these mixed together formed a sample for analysis. The corn meal was sampled by being well stirred and a small quantity taken for analysis. The bran was sampled in a similar manner. The roots were taken and sampled by means of a butter tester boring holes through the root in various directions and mixing these together for a sample. The potatoes were sampled in a similar manner.

Table I gives the chemical composition of the feeding stuffs; the figures under the ash, protein, crude fibre, fat and nitrogen free extract represent the per cent of each of the dry matter in the given material.

Table I.

	Water	Dry matter	Ash	Protein	Crude fibre	Fat	N. free extract
Bran	12.8	87.2	4.2	15.64	4.84	4.	71.17
Corn	12.2	87.8	1.31	12.13	2.2	5.2	77.71
Roots	90.5	9.5	10.2	15.21	7.	2.	65.59
Potatoes	78.	21.	6.7	12.87	2.21	.7	77.42
Hay	12.	88.	7.2	12.75	30.	4.2	38.85

The feeds were all mixed together in a tight box or manger, the hay being first moistened just enough to cause the meal to adhere it and thus prevent waste.

Particular care was taken not to feed any more each time than would be eaten up and yet enough to maintain constant weight of the animal and keep up the flow of milk.

The cows were fed and watered regularly twice each day, at 7 A. M. and 5 P. M.

The experiment in its entirety, including preliminary and intermediate periods, lasted fifty two days (from March 7th at 7 A. M. to April 28th at 7 A. M.). It was divided into three separate periods. During the first period the daily ration was composed of wheat bran 6 lbs., corn meal 6 lbs., mangle wurtzels 30 lbs. and clover hay 14 lbs. per thousand pounds of live weight per day. The first eleven days were devoted to preliminary feeding, during which time the cows were allowed to run in the yard, a record being kept of the food and water consumed and the daily weights of the cows. This was done in order that all material foreign to our work be eliminated from the animal body; and to allow the bowel contents to become normal and to gage the appetites of the animals.

At the close of period I the beets were gradually removed and the bran, corn meal and hay increased slightly so as to form a ration as nearly like the ration of the first period in amount of dry matter and chemical constitution as possible.

During the period of 13 days intervening between periods

I and II the cows became accustomed to the new ration. They were allowed to go on the yard during the daytime.

At the close of this intermediate period the test of the digestibility of the constituents of the dry matter of the ration without potatoes [illegible]. In this period the daily ration [illegible] of bran 8-[illegible] lbs., corn meal 8-1/7 lbs. and clover hay 22-[illegible] lbs. At the close of period [illegible] the ration was [illegible] changed by the addition of potatoes. It required ten days to accustom the cows to the ration after which the third period of the test began.

In this third period which was but four days in length the ration consisted of bran 6 lbs., corn meal 6 lbs., potatoes 17 lbs. and clover hay [illegible] lbs. per thousand pounds live weight [illegible].

[illegible] platform and fastened with a chain about the neck.

At the [illegible] from [illegible] of attendants both day and night, who were provided with two pails for each cow, one for collecting liquid and the other for collecting solid [illegible]. As soon as the solid [illegible] collected it was transferred to a tin can with a

tight cover and left for [illegible]. The solid excrement was weighed and recorded [illegible] the night time [illegible] was collected, which was weighed at the close of the period.

The urine was weighed each morning but allowed to remain in the can until the end of the first three days, when a sample was taken and analyzed; the same operation was repeated during the last three days. The milk was carefully weighed, a sample taken and placed in a can forming a composite sample which was analyzed at the end of three days; the same operation was repeated in the second half of the period.

The milk was [illegible] for fat in the Babcock test.

Table II shows the daily record of the feed and water consumption [illegible] during the three days preliminary feeding period of the entire experiment.

Table II
Preliminary Feeding.

Hole	Day	D.M. A.M.	D.M. P.M.	Roots	Hay	Water A.M.	Water P.M.	Weight
Harold	7	5	5	10 #	8 #	00	50.#	760
"	8	5	5	8	8	00	00.	761
"	9	5	5	10	10	00	45.	759
"	10	5	5	12	10	00	40.	760
"	11	5	5	14	10	00	37.	757
"	12	5	5	15	10	00	35.	772
"	13	5	5	15	10	00	42.	767
"	14	5	5	15	10	10	00.	768
"	15	5	5	15	10	97	94.	752
"	16	5	4.5	15	10.25	got water		771
"	17	4.5	4.5	15	10.5	in yard		772

Actual Rent during the six following years.

Date		Com.				Value		
		Pres.	Ave.	Loss	Tax	A.	Pro.	Net
March	15	4.5%	4.6%	15%	10.5%	40%	85%	774%
"	16	4.5	4.5	15	10.5	40	85	774
"	20	4.5	4.5	15	10.5	40	85	774
"	21	4.5	4.5	15	10.5	40	85	774
"	22	4.5	4.5	15	10.5	40	85	741
"	23	4.5	4.5	15	10.5	40	85	741

Intermediate period.

Date		Com.		Loss		Value		
		Pres.	Ave.	Loss	Tax	A.	Pro.	Net
March	24	4.5%	4.5%	15%	10.5%	25%	85%	754%
"	29	4.5	4.5	0	10.5	15	00	733
"	30	4.5	4.5	7	10.5	20	00	741
"	31	4.5	4.5		10.5	25	00	778
"	28	4.5	4.5		10.5	25	00	750
"	29	4.5	4.5		10.5	25	00	710
"	30	4.5	4.5		10.5	0%	00	787
"	31	4.7%	4.7%		11.	00	--	763
April	1	5.	5.		11.5	--	--	----
"	1	5.	5.		11.5	--	10	--
"	2	5.	5.		11.5	35	40	750
"	4	5.	5.		11.5	10	40	733
"	5	5.	5.		11.5	20	40	753
"	6	5.	5.		11.5	20	40	753

Actual Rent during the six following years.

Date		Com.				Value		
		Pres.	Ave.	Loss	Tax	A.	Pro.	Net
April	7	5	5		11	8%	38	733
"	8	5	5		11	35	40	747
"	11	5	5		11	20	40	733
"	12	5	5		11	40	30	710
"	13	5	5		11	1	30	744
"	14	5	5		11	10	40	740

Intermediate period.

Date	Time	Feed	Feed	Protein	Hay	Water		Total
		A.M.	P.M.			A.M.	P.M.	
April	10	5.	5.		11.	80.	40.	786.
"	14	5	5	5.5	11.	80	60	777
"	15	5	5	7.	10.75	80	60	767
"	16	4.5	4.5	10.	10.	70	40	703
"	17	4.5	4.5	12.	10.	70	60	707
"	18	4.5	4.5	14.	10.	70	80	763
"	19	4.5	4.5	14.	10.	70	80.	783
"	20	4.5	4.5	11.88	9.5	70	60	759
"	21	4.5	4.5	11.88	9.5	70	60	759
"	22	4.5	4.5	11.88	9.5	70	60	759

Actual Post during the four following days.

Date	Time	Feed	Feed	Protein	Hay	Water		Total
		A.M.	P.M.			A.M.	P.M.	
April	23	4.5	4.5	11.88	9.5	70	40	784
"	24	4.5	4.5	11.88	9.5	80	1	784
"	25	4.5	4.5	11.88	9.5	80	80	819
"	26	4.5	4.5	11.88	9.5	70	80	784
"	27							1127

Table III shows the daily record of the feed and water given daily; it also gives the daily weight for the entire experiment.

Table III

Preliminary Period.

Date	Time	Feed	Feed	Protein	Hay	Water		Total
		A.M.	P.M.			A.M.	P.M.	
March	9	3	3	11	12	60	30	378
"	9	3	3	11	12	9	50	374
"	9	3	3	14	14	00	01	805
"	10	3	3	13	14	00	55	800
"	11	3	3	15	14	97	40	803
"	12			15	14	4	43	803
"	13	3	3	15	14	14	42	842
"	14	3	3	20	14	00	01	801
"	15	3	3	20	14	03	01	843
"	16	3	3	20	14	00	00	840
"	17	3	3	20	14	00	00	845

"	24	3	4	10	10.5	4	1	003	
"	25	3	3	11	11.0	22	27	240	
"	26	3		10	10.0			240	
"	27							827	

2: Period 2. - At this time the rats were subjected to the [illegible] test. During this time no record was kept of the water received, or the weights of the animals.

[illegible] the amount of water [illegible] by [illegible]; and the period of more nearly constant of the ration.

Table IV.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17	[illegible]	[illegible]	1.20	.24	[illegible]	[illegible]	10.77
[illegible]	17	2.00	99.70	.82	1.02	2.10	.66	10.41
[illegible]	07	31.47	2.65	.93	.17	1.00	.00	5.03
May	22	[illegible]	[illegible]	[illegible]	[illegible]	7.23	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Period II.								
[illegible]	21	3.14	[illegible]	1.19	1.75	[illegible]	[illegible]	[illegible]
[illegible]	22	2.01	[illegible]	.48	1.07	[illegible]	.04	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Period III.								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	125	44.31	74.70	1.47	2.21	10.01	17.80	44.12
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17	1.45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] This table is the same as the one next above, but is calculated to a six [illegible] period to compare with periods I and II.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Peaks	150	108.00	11.40	1.17	.88	1.74	.00	7.47
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Period I.								
[illegible]	[illegible]	[illegible]	[illegible]	1.41	1.01	5.00	1.00	[illegible]
[illegible]	[illegible]	4.70	[illegible]	.55	1.73	4.51	.73	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Totals	100	[illegible]	[illegible]	7.51	8.50	[illegible]	[illegible]	[illegible]
Period II.								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Potatoes	[illegible]	47.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Totals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Potatoes	[illegible]	71.10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Totals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible] 24.71

[illegible]. In period II 24.10 lbs. and in period III 24.00 lbs.;

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] [illegible] of grain. [illegible] upon the introduction [illegible] [illegible] [illegible], [illegible] in the [illegible] [illegible].

[illegible] food [illegible], [illegible] [illegible] weighed [illegible].

[illegible] [illegible] of water [illegible] in both food and drink, the water [illegible] in [illegible], urine, and milk in each period, [illegible] not accounted for.

[illegible]

Period		Consumed in			Found [illegible] in				Not account[illegible]
[illegible]		drink	food	Total	[illegible]	urine	milk	Total	[illegible]
[illegible]	I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	II	981	17.42	[illegible].48	303.14	[illegible]	84.77	[illegible]	[illegible].50
"	III	[illegible]	[illegible]	[illegible]	[illegible]	110.44	[illegible]	[illegible]	[illegible]
[illegible]									
Period	I	[illegible]	[illegible]	[illegible]	[illegible]	64.40	[illegible]	[illegible]	[illegible]
"	II	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	III	[illegible]	[illegible].10	[illegible]	[illegible].77	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] shows that [illegible] water [illegible] in urine in period I than in period II, [illegible] in food and drink the amount [illegible] was practically the same. In period III [illegible] a great deal [illegible] in period one. [illegible] in period III than in period II, [illegible] in period I. [illegible] water [illegible] in food and drink in period III [illegible] of [illegible] periods [illegible].

While potatoes contain considerable water it seems that when substituted for [illegible] or added to the [illegible] ration there was an increased consumption of water in drink.

Table VII shows the [illegible] at the [illegible]

[illegible] of [illegible] period.

Table [illegible].

		[illegible]		Milk.
Period I	[illegible]	[illegible]		[illegible]
	" [illegible]	[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Period II	April [illegible]	743.		[illegible]
	" [illegible]	[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Period [illegible]	[illegible]	[illegible]		[illegible]
	" [illegible]	[illegible]		[illegible]
	[illegible]	[illegible]	Gain	[illegible]

[illegible] lbs. [illegible], [illegible] in weight. [illegible] This is due to a large [illegible] quantity [illegible] at the close of the period [illegible].

[illegible] m, [illegible].

[illegible] have been made, by both German and American experimenters, to [illegible] own [illegible] s [illegible] it [illegible] experi- [illegible].

The quantity, however, was very small.

All analyses, both of food and excrement, were made in duplicates, and in the tables averages of these duplicates are recorded.

Table VIII gives the percentage composition of the solid excrement, also the total pounds of each constituent.

Table VIII.

Halo Period I, Percentage composition of dung.

Water	Dry mat.	Ash	Eth. ext.	Nit.	Crude prot.	Alb. nit.	True alb.	Crude fibre	N.Free ext.
83.18	16.82	8.64	3.21	2.56	16.20	2.06	12.87	30.6	41.8[illegible]
Period II									
83.2	16.8	8.1	2.55	2.35	14.68	2.01	12.56	29.7	44.07
Period III									
82.2	17.8	7.25	3.7	2.37	14.81	1.91	11.94	29.04	45.80

Total pounds of each constituent in dung.

Period I

Weight	Water	Dry mat.	Ash	Eth. ext.	Nit.	Crude prot.	Alb. nit.	True alb.	Crude fibre	N.Free ext.
220.75	183.62	37.13	3.21	1.19	.85	5.94	.76	4.78	11.36	15.43
	Period II									
238.25	198.14	40.11	3.25	1.02	.94	5.89	.81	5.04	11.91	18.04
	Period III									
251.63	206.84	44.79	3.25	1.66	1.06	6.63	.81	5.35	13.01	20.24

Milla, Period I Percentage composition of dung.

Water	Dry mat.	Ash	Eth. ext.	Nit.	Crude prot.	Alb. nit.	True alb.	Crude fibre	N.Free ext.
84.04	15.96	8.62	3.8	2.54	15.88	2.04	12.75	27.	44.70
Period II									
83.05	16.95	8.10	2.58	2.45	15.31	2.00	12.50	29.37	44.0[illegible]
Period III									
83.61	16.39	8.06	3.7	2.72	17.00	2.14	13.37	30.75	40.[illegible]

Total pounds of each constituent in dung.

Weight	Water	Dry mat.	Ash	Eth. ext.	Nit.	Crude prot.	Alb. nat.	True alb.	Crude fibre	N.Free ext.
Milla, Period I,										
318.83	287.47	30.78	4.38	1.83	1.20	8.66	1.03	6.47	13.71	22.70
Period II										
302.75	271.43	31.32	4.16	1.38	1.26	7.86	1.03	6.42	15.07	22.91
Period III										
301.13	271.73	29.36	3.98	1.82	1.34	8.45	1.06	6.60	15.17	19.80

From this table we see, that Halo produced 17.5 lbs. more dung in period II than in period I and 30.68 lbs. more in period III than in period I. In period II she produced 2.96 lbs. more dry matter than in period I, while in period III she produced 7.06 lbs. more than in period I.

Milla produced 15.50 lbs. less dung in period II than in period I and 17.13 lbs. less in period III than in period I. In the dry matter she gave .55 lbs. more in period II than in period I and 1.42 lbs. more in period II than in period III.

Comparing one period with another it would seem as if all the functions of digestion were carried on with considerable uniformity.

The milk yield.- An accurate record was kept of the amount of milk produced. At each milking a sample was taken, and placed in a can, forming a composite sample, which was analyzed at the middle and close of each period.

Table IX gives the weight and percentage composition of the milk; also, the total pounds of each constituent.

[illegible]

Table X.

Ration	Dry matter consumed daily	Calories consumed daily	Protein consumed daily to produce 1 lb. of increase
Period I	132.14	5.00	22.55
"	[illegible]	5.35	21.47
" III	111.55	4.98	18.33
Little			
Period I	140.10	5.40	17.40
" II	114.21	5.31	17.33
" III	140.03	5.10	19.00

[illegible]

[illegible]

[illegible]

[illegible]

per cent of each diet fed.

Table VI

[illegible]	Dry matter	Ash	Crude fiber	Crude protein	Nitrogen free extract	Crude fat	M. Dig. Co.
Consumed in food	135.24	9.07	104.47	7.47	11.21	1.02	47.67
Returned in dung	64.77	5.41	56.40	3.43	10.21	.36	12.46
Pounds digested	70.47	3.66	48.07	4.04	1.00	.66	35.21
Per cents digested "	52.11	40.36	46.01	54.06	8.94	64.71	73.83
Period II							
Consumed in food	110.53	5.73	104.85	4.33	82.75	14.87	98.84
Returned in dung	40.17	3.25	51.40	1.51	32.62	5.50	10.04
Pounds digested	70.47	2.48	37.85	8.84	10.37	9.37	44.80
Per cents digested "	63.79	43.28	72.24	74.54	47.73	63.08	73.41
Period III							
Consumed in food	111.70	5.85	105.04	4.17	84.61	15.07	98.87
Returned in dung	40.70	3.15	54.54	1.60	19.93	5.38	23.84
Digested	71.00	2.70	50.50	2.71	4.27	9.79	75.03
Per cents digested "	63.59	46.47	48.07	62.91	27.02	76.19	76.41
Period I							
Consumed in food	145.80	9.18	134.05	6.88	24.31	20.06	88.1
Returned in dung	58.73	4.71	48.42	1.80	13.71	9.04	22.72
Pounds digested	87.07	4.47	85.63	4.89	10.60	11.02	65.38
Per cents digested "	59.73	47.54	51.29	73.47	39.43	57.19	77.01
Period II							
Consumed in food	144.80	7.51	136.89	6.86	29.98	19.60	81.04
Returned in dung	51.82	4.16	47.16	1.88	15.07	7.86	22.91
Pounds digested	93.48	3.35	89.13	5.04	14.92	11.74	58.48
Per cents digested "	64.55	44.60	65.29	73.28	48.75	59.90	71.83
Period III							
Consumed in food	147.90	7.87	140.03	5.80	26.45	19.94	87.84
Returned in dung	49.36	3.98	45.33	1.32	16.17	8.40	10.99
Pounds digested	98.54	3.88	94.65	3.98	11.28	11.54	66.85
Percents "	66.62	49.43	67.58	68.62	42.84	57.87	77.84

In order to determine the digestibility of any food con-

stituent, for example, protein in the ration, food, 111.84 lbs., returned in dung, 37.13 lbs., and the difference between these amounts, 74.11 lbs., is the amount digested. The pounds digested, 74.11 divided by the num-

ber of pounds consumed, 111.84, gives 66.61 which is the per cent of the dry matter digested; or, in other words is the coefficient of digestibility.

In the same period Halo consumed, in food, 15.18 lbs. protein, returned in dung 5.94 lbs. leaving 9.24 lbs. digested. 9.24, the amount digested, divided by 15.18, the amount consumed, gives 48.82 which is the per cent of the crude protein digested; or, the co-efficient of digestibility for crude p protein is 48.82.

In a similar manner the other co-efficients of digestibility are calculated.

In table XII are brought together, for farther comparison. the digestive co-efficients of the various constituents of the ration as indicated by both cows.

Table XII.

Halo

Period I	Dry matter	Ash	Organic Matter	Ether ext.	Crude fibre	Crude prot.	N.Free ext.
Period I	66.62	48.80	67.69	74.52	48.94	60.87	75.45
Period II	63.73	43.28	64.84	79.01	47.71	60.65	71.01
Period III	59.86	45.27	60.67	62.01	35.20	55.85	69.41
Milla							
Period I	65.76	47.54	66.83	63.97	53.78	60.22	72.91
Period II	65.55	44.60	65.39	79.23	49.75	59.90	71.83
Period III	66.62	49.43	67.59	63.62	42.64	59.67	77.24

This table shows, in the first place, how accurately the work of the digestive organs of one cow correspond with that of the other. For example, of the dry matter consumed in period I, Halo digested 66.62% and Milla 65.76%. Of the crude protein,

II

free

the organ matter. It also follows, since the nitrogen free extract is determined by subtracting the sum of the ether extract, crude protein, crude fibre and ash from the dry matter, that since the cows agreed in the digestion of these constituents and differed in the dry matter, they must differ, also, in the digestion of the nitrogen free extract. Hence the cows agree as to the comparative digestibility of each factor of the ration except the dry matter.

Table XIII is made up in the same manner as table XI except, that the dry matter of the beets and potatoes is assumed to be entirely digested.

Table XIII.

Halo Period I	Dry matter	Ash	Ether extract	Crude fibre	Crude protein	N. Free extract
Consumed in food	111.34#	6.37#	4.67#	22.26#	15.18#	62.37#
Amount in beets	8.55	.88	.17	.60	1.30	5.60
" without beets	102.62	5.39	4.50	21.65	13.88	57.27
Returned in dung	37.13	3.21	1.19	11.36	5.94	15.43
Pounds digested	65.56	2.18	3.31	10.29	7.94	41.48
Per cents "	63.84	40.44	73.55	47.50	57.20	73.10
Period II						
Consumed in food	110.58	5.73	4.86	22.78	14.97	62.24
Returned in dung	40.11	3.25	1.02	11.91	5.89	18.04
Pounds digested	70.46	2.48	3.84	10.87	9.08	44.20
per cents "	63.73	43.26	79.01	47.71	60.65	71.01
Period III						
Consumed in food	111.59	5.95	4.37	20.08	15.02	66.17
Amount in potatoes	14.18	.95	.09	.33	1.82	10.99
Amount without "	97.41	5.00	4.28	19.75	13.20	55.18
Returned in dung	44.79	3.25	1.66	13.51	6.63	20.24
Pounds digested	52.62	1.75	2.62	6.24	6.57	34.94
Per cents "	54.02	35.00	61.21	31.57	49.77	63.32
Milla, period I.						
Consumed in food	148.30	8.35	6.22	29.66	20.26	83.81
Amount in beets	11.40	1.17	.22	.80	1.74	7.47
Amount without"	136.90	7.18	6.20	28.86	18.52	76.34
Returned in dung	50.78	4.38	1.93	13.71	8.06	22.70
Pounds digested	86.12	2.80	4.07	15.15	10.46	53.64
Per cents "	62.96	39.00	67.83	52.49	56.47	70.26

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Amount in potatoes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Digested in [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	72.60

The dry matter, [illegible] beets and potatoes [illegible]

[illegible]

[illegible]

[illegible]

[illegible] the dry matter of beets and potatoes [illegible].

[illegible] pounds of dry matter [illegible] lbs., the dry matter of the beets consumed, gives 10?.6? pounds; and subtract from this 57.3? lbs., the dry matter in the [illegible], gives us 65.56 lbs. of dry matter [illegible]. Now dividing this amount by 10?.6? gives [illegible] the per cent digested when the dry matter of the beets is [illegible] and wholly (?) [illegible]. The Ash, the other ex[illegible], [illegible].

Table [illegible] similar [illegible] to Table III, ex[illegible] matter [illegible].

Table [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

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[illegible]

[illegible]

[illegible]

Table XV.

Halo	Weight	Water	Solids	Ash	Nitrogen
Period I	30.5#	91.2 %	8.8 %	3.0 %	1.13 %
	47.0	91.8	8.2	2.52	1.04
Period II	30.75	91.1	8.9	2.6	1.06
	30.00	91.75	8.25	2.8	1.14
Period III	59.25	94.42	5.58	1.6	.55
	57.75	94.36	5.64	1.4	.56
Total weight of each					
Period I	77.5 #	70.90#	6.54#	2.09#	.83#
Period II	60.75	55.23	5.52	1.63	.63
Period III	117.00	110.44	6.56	1.76	.65
Milla					
Period I	39.00#	91.2 %	8.8 %	2.71#	1.03#
	31.75	90.8	9.2	3.00	1.14
Period II	35.25	90.73.	9.27	3.50	1.12
	33.50	91.46	8.54	3.13	1.25
Period III	58.25	93.6	6.4	2.25	.71
	29.25	91.11	8.89	3.00	.93
Total weight of each					
Period I	70.75#	64.40#	6.35#	2.01#	.78#
Period II	68.75	62.62	6.13	2.28	.81
Period III	87.50	80.96	6.54	2.21	.69

The amount of urine in period I is a little more than in period II with both cows, and a great deal more in period III than in either period I or II. With the water contents similar conditions exist.

There is some variation in the nitrogen. Halo returned more in period I than in either period II or III, and more in period II than in period III.

Milla returned more in period II than in either period I or period III, and more in period I than in period III. In period III, when so much urine was produced, the per cent of nitrogen was very small.

Table XVI gives the weight and per cent of dry matter, the ash, and the nitrogen in the food consumed, and in the dung, urine and milk returned. It also gives the amounts and per cents of each account for.

Table XVI.

Halo	Dry matter		Ash		Nitrogen	
Period I	Pounds	%	lbs.	%	lbs.	%
Consumed in food	111.24		6.27		2.43	
Returned in dung	37.13	33.38	3.21	51.19	.95	39.09
" " urine	6.54	5.87	2.09	33.33	.83	34.15
" " milk	14.09	12.67	.73	11.64	.56	23.05
Accounted for	57.76	51.92	6.03	96.16	2.34	96.29
Period II						
Consumed in food	110.58		5.73		2.40	
Returned in dung	40.11	36.28	3.25	56.72	.94	39.17
" " urine	5.52	4.99	1.63	28.76	.68	28.33
" " milk	14.45	13.07	.78	13.63	.53	22.09
Accounted for	60.08	54.34	5.66	98.81	2.15	89.59
Period III						
Consumed in food	111.59		5.95		2.40	
Returned in dung	44.79	40.14	3.25	54.63	1.06	44.17
" " urine	6.53	5.88	1.76	29.57	.65	27.06
" " milk	15.27	13.65	.73	12.27	.56	23.33
Accounted for	66.32	59.67	5.74	96.47	2.27	94.58
Milla						
Period I						
Consumed in food	148.30		8.35		3.25	
Returned in dung	50.78	34.25	4.38	52.45	1.29	39.69
" " urine	6.35	4.29	2.01	24.07	.78	23.97
" " milk	19.51	13.15	1.26	15.04	.76	23.40
Accounted for	76.64	51.69	7.64	92.56	2.83	87.06
Period II						
Consumed in food	144.80		7.51		3.13	
Returned in dung	51.32	35.44	4.16	55.39	1.26	40.22
" " urine	6.13	4.24	2.28	30.37	.81	25.88
" " milk	19.18	13.24	.83	11.05	.72	23.00
Accounted for	76.74	52.92	7.27	96.81	2.79	89.10
Period III						
Consumed in food	147.90		7.87		3.19	
Returned in dung	49.36	33.37	3.98	50.57	1.34	42.01
" " urine	6.54	4.42	2.21	28.08	.69	21.63
" " milk	20.08	13.57	1.30	16.52	.79	24.77
Accounted for	76.76	51.36	7.49	95.17	2.82	88.41

The food during digestion undergoes a series of chemical changes. The body must be supplied with the necessary warmth and this heat comes from the food being burned in the body, and in the process of combustion the products become gaseous and are given off in considerable quantities in respiration and through the spores of the skin.

With Halo, in periods I, II and III we have accounted for of the dry matter, respectively, 51.88 %, 54.34% and 59.67%; With Milla, likewise, we have 51.68%, 53% and 53.24%. Hence we see, a great loss with no very great variation, except in that Halo gives a little more in period III than in either period I or II.

The per cent of ash and nitrogen accounted for is, for the most part, pretty uniform and is nearly all accounted for.

With each cow there is a uniform increase in the return of nitrogen in the manure in the three successive periods. With Halo it is 39.09%, 39.17% and 44.17%, with Milla 39.62%, 40.22% and 42.01% respectively.

In the urine Halo gave a constantly decrease of nitrogen in the three successive periods, 34.15%, 28.33% and 27.08% respectfively. Milla gives 33.97%, 25.88% and 21.63%.

Therefore, we conclude that when beets or potatoes are added to the basic ration, if we consider the dry matter of the beets and potatoes no more digestible than the dry matter of the basic ration, there is a greater per cent of the constituent elements of the ration digested when beets are

added than when bran, corn meal and clover hay constituted the ration, while when potatoes was added a less per cent was digested.

But if we consider the dry matter of the beets and potatoes as fully digested, then a much less per cent of the dry matter of the ration is digested when beets are added and a far less per cent when potatoes are added.