THE RELATIVE ABILITY OF STEERS AND RABBITS TO DIGEST PASTURE HERBAGE.

by

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A Thesis

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ABSTRACT

Comparative digestibility trials with steers and rabbits fed on identical diets of pasture herbage (lawn clippings) are reported.

Rabbits were found to be somewhat more variable than steers in their ability to digest pasture herbage. The variability of the rabbit, however, is not so large as to necessitate impractically large numbers of animals to obtain reliable average results.

Evidence is presented to indicate the existence of a correlation between the ability of steers and rabbits to digest pasture herbage.

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CONTENTS

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INTRODUCTION

Feeding trials with cattle usually involve large expenditures of money, labor and time. This limits the number of trials that can be conducted. It also limits the number of individual animals which can be used in the given feeding experiment. The reliability and precision of experimental work, however, increases with the increasing number of experimental subjects employed. For these reasons a satisfactory "pilot" animal for investigations with cattle has obvious advantages. Such a "pilot" animal would have to be a smaller, cheaper (preferably laboratory) animal that could be easily obtained in sufficient numbers and that could be handled with ease. It is the rabbit that suggests itself for such use, since it is able to handle roughage and such feeds as are consumed by cattle. Before, however, the rabbit could be used as a "pilot" for steers some information must be made available as to the digestive behavior of the two species.

The first available records in literature comparing the digestive powers of steers and rabbits are the experiments of Weiske (1892 and 1894) and of von Knieriem

(1898). These early experiments, however, do not afford a valid comparison between the digestion of herbage by the two species of animals since the diets fed were not identical. Furthermore only one or two animals were used for each test, thus affording no measurement of the variability and error associated with the trial.

The similarity of steers and rabbits in their ability to utilize feeds of a similar nature has been discussed by Brody and Procter (1933) in a study of the "digestibility, metabolizability and utilizability of rations". After a review of the data of Forbes, Wiegner and Mitchell, the authors state that "while the average digestibility in the rabbit is somewhat below the average in the steer, the average of the metabolizability and utilizability (net-energy) of the rations are the same for both species; but it must be remembered that Wiegner had one or two data points above the maintenance level, while Forbes and Mitchell had several points above maintenance. It is probable, however, that for practical purposes the rabbit might serve very well as an experimental animal for evaluating metabolizable and net energies of cattle feeds."

A discussion of the sheep vs. the rabbit as "pilot" animal for steers is found in a thesis by Campbell (1938). He concludes that, since the results obtained with sheep (Forbes 1937) or rabbits (Crampton and Campbell

1938) cannot be directly applied to steers and since correction factors must be used in either case, the rabbit offers definite advantages over the sheep as a "pilot" for steers. The rabbit was found to be just as uniform as the sheep in its ability to digest pasture herbage. At the same time the rabbit is cheaper, smaller, more easily obtained and handled than the sheep, and has a smaller feed requirement.

Rabbits, however, appear to be promising "pilots" for sheep as was indicated by the work of Watson and Godden (1935), and by trials comparing sheep and rabbits on the same diet as reported by Watson and Horton (1936) and referred to by Crampton (1939).

No accounts could be found in the literature comparing steers and rabbits on the same diet. In 1938, however, a trial was conducted at Macdonald College with four steers and five rabbits on an identical diet of dried pasture herbage (Crampton and Campbell 1938). This work demonstrated that rabbits show as great a uniformity in their ability to digest pasture herbage as do steers. Certain differences in the digestibility by the two species were brought out. Relative to their ability to utilize the dry matter of their diet, rabbits digested the crude protein fraction of the feed better and the crude fibre fraction less well than did the steers.

These findings, however, do not exclude the existence of a more or less constant ratio or proportion between the ability of steers and rabbits to handle their feeds. Such a ratio, if established, would make the rabbit a useful animal for predicting digestive behavior of steers.

Specifically, the object of this trial was to obtain further information as to the relative ability of steers and rabbits to digest pasture herbage.

GENERAL PLAN

The general plan of this study was to conduct digestion trials with steers and rabbits on identical diets of lawn clippings.

EXPERIMENTAL PROCEDURE

Diets and Their Preparation

Lawn clippings collected at different periods of the summer from the campus of Macdonald College were used as feed in the comparative digestibility trials. The grass was gathered by means of specially designed collecting boxes attached to a power mower. The freshly cut grass was then spread immediately and dried in the sun. Due to unfavorable weather conditions, a part of the "September Grass" had to be dried artifically in a ventilated corn drier which was set not to exceed a temperature of 43° C.

The fact that a part of the grass was dried by means of artificial heat does not influence the purpose of this experiment. Watson and Ferguson (1932) have demonstrated that artificial drying of grass at a temperature of 200° C. did not appreciably change the digestibility of the grass by sheep. Thus a temperature of 43° C. should not be expected to change the digestibility of the feed to any large extent. But even if changes in digestibility of the feed had taken place, this would not destroy the validity of comparison of its digestibility by steers and rabbits, because it was the plan of this experiment to determine whether changes in diet would be reflected

similarly by the two species of animals.

Three lots of grass were collected separately, each representing the herbage of a different period of the growing season of the summer of 1938.

The first lot of grass, designated as "May Grass", was used in "Trial A". This was a composite of four clippings which were made on May 7th (1005 lbs.), May 12th (775 lbs.), May 20th (885 lbs.) and May 27th (367 lbs.). One clipping made about May 1st was discarded because it contained much dead grass from 1937. Some of the grass received rain while being cured. The first two cuttings consisted mostly of Kentucky blue grass. The third and fourth cuttings contained some clover and some dandelions in bloom.

The second lot of grass, designated as "July and August Grass", was used in "Trial B". It was cut on July 7th (500 lbs.), July 29th (700 lbs.), August 4th (600 lbs.), August 12th (700 lbs.) and August 23rd (770 lbs.). There was a larger amount of white clover in this lot than in the "May Grass". The clover was coming into bloom.

The third lot of grass, designated as "August and September Grass",was used in "Trial C". It represented the fall growth of the sod land. It consisted of 430 lbs. of grass cut on August 23rd, which was dried in the sun, plus two clippings taken on September 2nd (1250 lbs.) and

September 16th (930 lbs.). The last two lots of grass were dried with artificial heat as already noted.

Since rabbits will pick and choose coarse feed, refusing to eat certain parts of the plant, it was decided to grind all grass for both rabbits and steers. This was done in a hammer mill, using a 15/32 inch sieve. Each cutting (belonging to "May Grass" for example) was ground separately. The different cuttings of a lot were then mixed in a power-driven feed-mixer, each batch containing a proportionate amount of each cutting. One bag of grass was set aside from each mix, and subsequently these were remixed as the feed for the rabbits. A representative sample of the remixed grass of each lot was also used for the chemical analysis representing the feed consumed by both the rabbits and the steers.

Animals Used and Their Care

The experimental animals used in the three trials were four steers and six rabbits. The same animals were used in each one of the three trials.

The steers were from average to good feeders about 1 1/2 years old and weighing approximately 650 to 850 lbs. They were chained in individual stalls (see Plate I) which were boarded up to a height of about six feet, and equipped with a well drained wooden floor. No

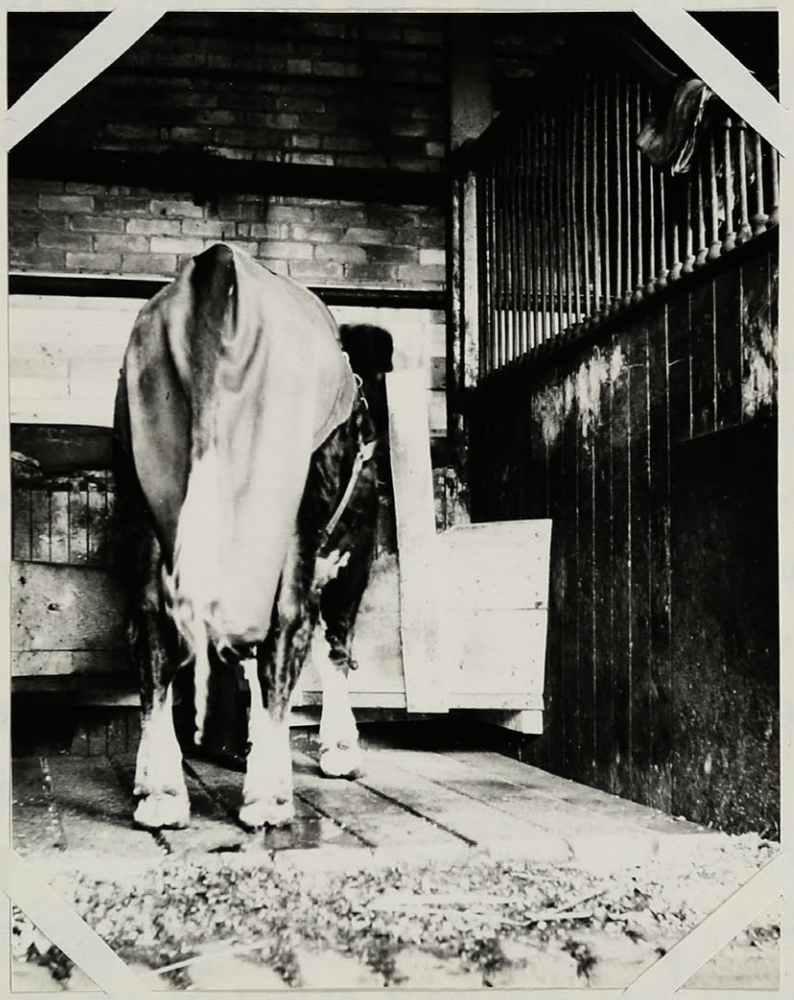


PLATE I.

Stalls used in digestibility trials with steers.

bedding was used on the floor while the trials were in progress. Water was provided ad libitum. The steers were fed twice a day, morning and night. The feed was weighed out at each meal and a representative 100 gram sample of the two daily feedings was taken each day for moisture determination. The animals received as their sole diet water, ground pasture grass and salt, the latter at the rate of about 1/2% of the feed.

The amount of feed that could be easily consumed by each steer in a day was determined first. The steers were then held at that feed level for all three preliminary and collection periods. There was no feed wasted or refused at any time, except by steer No. 3 which during the first days of "trial C" failed to consume his allowance. His feed was reduced for a brief period. It was then increased to a level somewhat lower than the original one. The steer completed the last nine days of the test with a uniform feed intake. The same steer on the tenth day of the collection period of "trial B" consumed an unknown quantity of hay and was removed from the trial on the morning of that day.

The feces were collected in large rubberized bags, originally designed by Garrigus (1935), suspended from a suitable harness(see Plate II) in such a way as to give the steer freedom to lie down and to move around

PLATE II.

Harness and sack used for collection of feces in digestibility trials with steers.

without losing any feces. The bags were changed at each feeding when a clean dry bag was weighed and put on. At the next feeding this bag was removed and weighed with its contents. The difference in the two weights was recorded as the moist weight of the feces voided. The full bag was then turned inside out into a large pan. The feces adhering to the bag were scraped off by means of a long-handled enamel spoon. The feces were then mixed and a representative sample was taken to the laboratory in a wide-mouthed sealed glass jar. 1/50 aliquot of every collection of feces was taken; it was acidified with a 2% acid alcohol solution (2% H_2SO_4 by volume in 95% ethyl alcohol) to insure an acid reaction and prevent loss of nitrogen. The aliquot was then dried to constant weight at about 105 - 115° C. The dry weight of the two daily aliquots times fifty was recorded as the dry matter excretion for the given steer for the given day. All dried aliquots of each steer were composited for chemical analysis.

The rabbits used in the digestibility trials were six albino females secured from the Macdonald College rabbitry. They were about five months of age and weighed approximately 2300 grams each at the beginning of the first trial. They were put into individual metabolism cages (Plate III) so designed to permit a record not only of the feces voided but also of the

PLATE III.

Metabolism cages used for rabbits in digestibility trials.

feed wasted. Water was supplied ad libitum. The daily allowance of 130 grams of grass was weighed into the feed container of each rabbit. The total weight of feeder plus feed was then recorded. The loss in weight at the next feeding time represented the feed consumed plus wastage for that day. A new portion of 130 grams was then added. The waste feed was collected from a screen once a week, dried to constant weight at 105 - 115° C. and the intake was corrected accordingly. The upper limit of feed intake was thus controlled. The lower limit of feed intake could not be controlled altogether, but by determining before-hand an adequate amount of feed which at the same time was readily consumed in a day, the average feed consumption was relatively uniform. The feed left in a feeder from a previous day was always thoroughly mixed with the freshly added feed in order to compel the rabbits to eat all feed without discrimination. The moisture content of the feed was determined on 100 gram samples, two determinations being made at the beginning and two at the end of the 14 day collection period. The moisture content of the rabbit feed remained practically constant since the feed was stored in the laboratory under fairly uniform conditions of temperature and moisture.

The rabbit feces were collected once a day.

They were acidified and then dried to constant weight at 105 - 115° C. The dry weight was recorded. All the rabbit feces were collected and preserved for chemical analysis.

Table I gives the time schedule of the digestion trials.

Table I. Time Schedule of Digestion Trials.

Animals	Trial	Preliminary Period			Collection Period		
		Date Commenced	Date Concluded	Number of Days	Date Commenced	Date Concluded	Number of Days
Steers	A	Sept. 13	Sept. 23	11	Sept. 24	Oct. 8	15
	B	Oct. 9	Oct. 17	9	Oct. 18	Oct. 31	14
	C	Nov. 1	Nov. 7	7	Nov. 8	Nov. 21	14
Rabbits	A	July 9	July 22	14	July 23	Aug. 5	14
	B	Sept. 15	Sept. 26	12	Sept. 27	Oct. 10	14
	C	Oct. 12	Oct. 21	10	Oct. 22	Nov. 4	14

Chemical Analyses

Moisture, ash, protein and ether extract in both feeds and feces were determined according to the standard A. O. A. C. methods.

Crude Fibre Determination

In order to accelerate the filtering process of the crude fibre determination "Celite Filter Aid"(a product prepared by the Canadian Johns-Manville Co. Ltd., from a pure form of diatomaceous silica) was used. A quantity of celite was thoroughly pre-ignited to remove all possible traces of combustible material. Small amounts of this celite were spread over the surface of the asbestos pad in the Gooch crucible and also stirred into the hot alkali solution containing the crude fibre residue, after the second 30-minute boiling period as provided in the official A. O. A. C. methods for crude fibre determination. The rate of filtering was greatly increased. At the same time no difficulty was experienced in the duplication of results, in spite of the fact that only approximately equal amounts of celite were used for the different single determinations.

Lignin Determination

The method recommended by Crampton and Maynard (1938) for the determination of lignin in feeds and feces

was used in this study, with the two modifications proposed by Crampton and Campbell (1938): firstly, substituting hardened filter paper for silk bolting cloth and, secondly, discontinuing the boiling of the lignin suspension in dilute acid and chloroform soon after the scum formed on the surface of the liquid breaks.

A further modification was introduced by the use of celite (diatomaceous earth) as filter aid. It was used in the same way as described under "Crude Fibre Determination". Celite proved again a satisfactory filter aid in increasing the speed of filtration, at the same time not interfering with the accuracy of the results.

Cellulose Determination

For the determination of cellulose the method by Crampton and Maynard (1938) was used without modification.

Statistical Analysis of Data

The coefficients of apparent digestibility obtained from the three digestion trials were put through an analysis of variance and covariance.

Since a correlation can be determined only on paired observations, it was necessary to delete two of the six rabbits used in the digestion trials for these analyses. Rabbits No. 31, 33, 34 and 36 (Appendix Tables Ib, Ic, Id; IIb, IIc, IId; IIIb, IIIc, IIId) were picked at random and were paired with steers No. 1, 2, 3 and 4 respectively. All the analyses of variance and covariance (Appendix Tables IV to XIII) were based on these four pairs of animals. The standard error used in connection with coefficients of digestibility (Table II) was calculated from the "Interaction" variances.

The calculations of correlation and regression coefficients were based on the variance due to "Herbage" plus "Interaction", in as much as it was wished to measure changes in digestibility caused by changes in diet.

Results

The details of the chemical composition of the diets fed and of the apparent digestibility of these diets for steers and for rabbits are given in Appendix Tables I, II and III.

Table II shows the mean coefficients of apparent digestibility to the nearest whole percent for each species of animals on each of the three diets fed and the standard deviation of each fraction of the diet. These standard deviations are applicable to the coefficients of digestibility of each of the trials within the given species of animal and within the feed fraction in question.

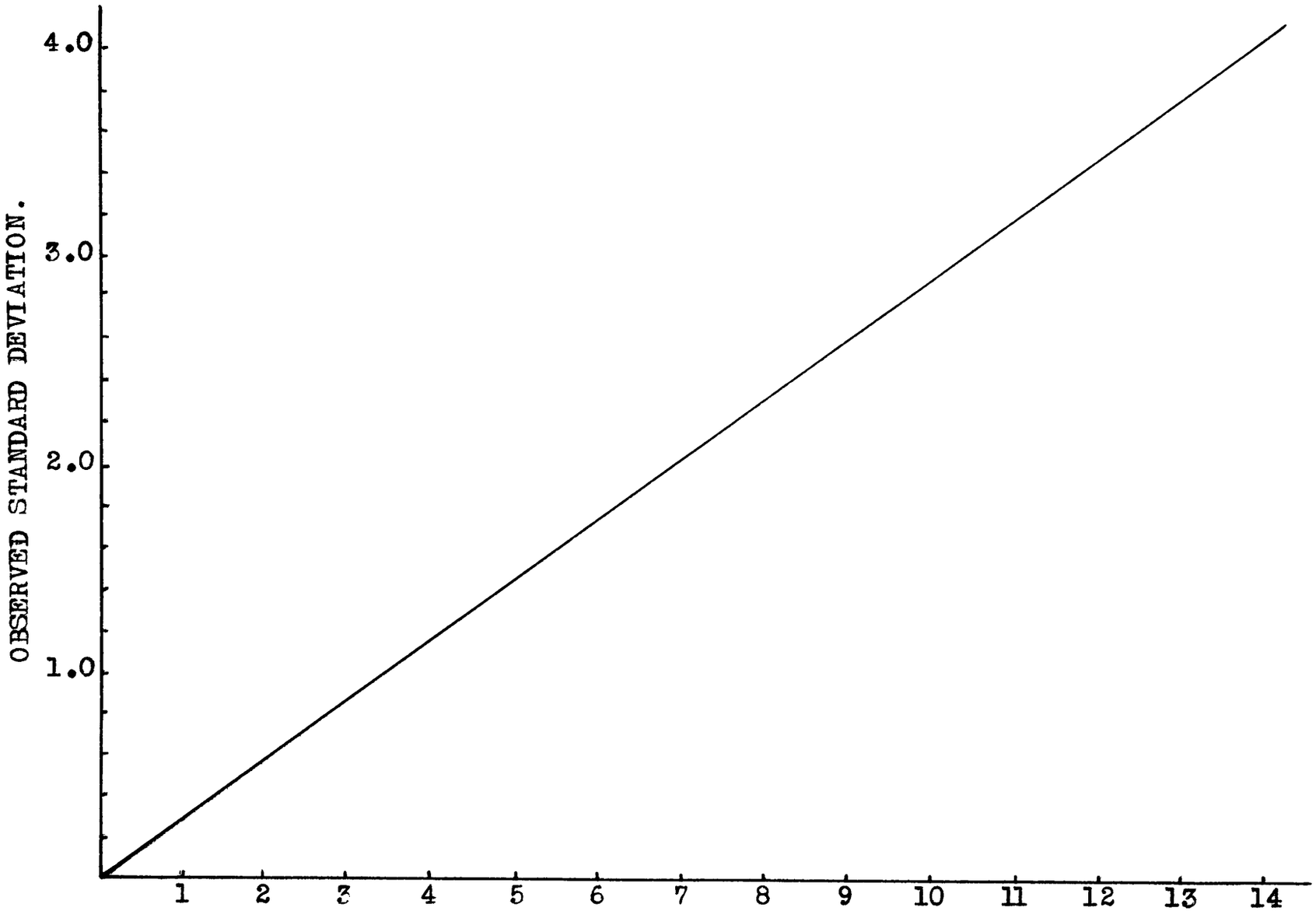
Table II. Summary of Coefficients of Apparent Digestibility

(to nearest whole percent)

Trial	Animals	Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
A	Average for 4 steers	70	74	77	34	77	74	75	15	79	97
	Average for 6 rabbits	51	52	70	35	24	53	44	6	28	72
B	Average for 4 steers	62	66	72	7	65	67	66	13	71	97
	Average for 6 rabbits	50	50	63	1	31	54	47	-2	38	86
C	Average for 4 steers	62	70	76	63	67	68	68	38	72	97
	Average for 6 rabbits	53	56	70	56	31	56	49	29	38	86
All	Standard Deviation for steers*	.67	.47	.29	4.39	.94	.76	.17	2.69	2.32	2.09
	Standard Deviation for rabbits	.80	.93	.80	7.91	2.11	1.14	1.11	2.33	2.52	2.13

* Standard Deviations for steers and rabbits were obtained from an analysis of variance, as shown in Appendix Tables IV to XIII.

CHART I.



in 95% of cases between digestibility coefficients of individual animals due to uncontrolled variation. Maximum Difference Expected = $\sigma \times \sqrt{2} \times t$ (with N = 6)

Discussion

The Ability of Steers vs. Rabbits to Digest Pasture Herbage

It is evident from Table II that rabbits were not able to digest the dry matter of the different diets as efficiently as were the steers. If the grand average of the three diets is a criterion, the rabbits digested their diet only 78% as efficiently as did the steers.

In order to facilitate the comparison of the digestibilities of the different fractions the coefficients of digestibility, expressed as functions of the respective digestibility of dry matter, are shown in Table III.

Table III. Digestibility of Feed Fractions Relative to the Digestibility of Dry Matter.

Trial	Animal	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellulose	Other CH_2O
A	4 steers	1.06	1.10	.49	1.10	1.06	1.07	.21	1.13	1.39
	6 rabbits	1.02	1.37	.69	.47	1.04	.86	.12	.55	1.41
B	4 steers	1.06	1.16	.11	1.05	1.08	1.06	.21	1.15	1.56
	6 rabbits	1.00	1.26	.02	.62	1.08	.94	-.04	.76	1.72
C	4 steers	1.13	1.23	1.02	1.08	1.10	1.10	.61	1.16	1.56
	6 rabbits	1.06	1.32	1.06	.58	1.06	.92	.55	.72	1.62

Note: Calculated from Text Table II using formula: $\frac{\text{coef. of digestibility of nutrient}}{\text{coef. of digestibility of dry matter}}$

This table shows that, relative to their ability to digest dry matter, rabbits digested the crude protein of their diet consistently somewhat better and crude fibre and cellulose less well than did the steers. "Organic matter" and "total carbohydrates" also show somewhat lower digestibility by the rabbits. This, however, is likely due to the fact that crude fibre is a part of both of these fractions.

Thus the findings of Crampton and Campbell (1938) have been confirmed,- that from pasture herbage rabbits obtain a somewhat larger portion of their nourishment from the protein fraction than do steers and less from the carbohydrates.

The Variability of Steers vs. the Variability of Rabbits

The standard deviations shown in Table II give an indication of the amount of variability that can be expected in the digestion coefficients. Two thirds of the digestion coefficients picked at random under the conditions of these trials would be expected to fall within the limits of the standard deviation in question.

In order to predict the variability expected in 95% of cases the standard deviation may be translated into terms of the "maximum difference expected" with the help of Chart I.

Ninety-five percent of the digestion coefficients chosen at random under the conditions of these trials should fall within a range of ± the "maximum difference expected" corresponding to the standard deviation in question. Or it would be considered, for example, that digestion coefficients of rabbits in diet "C" falling above 55.75% or below 50.25% (53 ± 2.75) would be the result of real differences in availability of the diet to the animal and not merely a chance deviation to an animal's individuality.

Comparing the standard deviations of steers and rabbits in terms of their means it is evident that the rabbits were in all cases more variable than the steers in their ability to digest pasture herbage. At the same time the variability found in the digestion coefficients of rabbits is not so great as to make these coefficients of practical significance. (Consult standard deviations Table I by means of Chart I.) An exception might be made in the case of the digestion of ether extract which in these trials was quite variable for both species of animals.

It should be kept in mind that the reliability of a mean is increased with an increase in the number of experimental animals. From the standpoint of equipment, and cost, and particularly in respect to the practicability

of providing necessary feed supplies, rabbits have a decided advantage over steers. For example, approximately 450 pounds of herbage are required to feed one steer during a 21 day digestion trial as against a corresponding requirement of 6 pounds by the rabbit.

Thus the conclusion appears to be justified that even though the rabbits showed a somewhat greater variability than the steers in digesting the pasture herbages used in these trials, this does not preclude their use as pilot animals for steers.

Correlation and Regression Coefficients

The correlation and regression coefficients between the coefficients of digestibility of steers and rabbits fed on three diets of pasture herbage are shown in Table IV.

Table IV. Summary of Correlation and Regression Coefficients**.

Fraction of the Feed	Correlation (r) between coefficients of digestibility of steers and rabbits*.	Regression (b) of steer digestibility per unit change in rabbit digestibility.
Dry Matter	-.50	-1.12
Organic Matter	.15	.17
Crude Protein	.87	.63
Ether Extract	.72	.99
Crude Fibre	-.92	-1.07
Nitrogen-Free Extract	-.28	- .46
Total Carbohydrates	-.78	-1.18
Lignin	.97	.79
Cellulose	-.85	-.56
Other Carbohydrates	-.07	-.02

*Correlation necessary for statistical significance with N = 8, P = .05 is (r) = .63

**For calculation of correlation and regression coefficients see Appendix Tables IV to XIII.

Of the ten feed fractions six show a significant correlation between the digestive behavior of steers and rabbits. Crude protein, ether extract and lignin show significantly positive correlations, whereas crude fibre, cellulose and total carbohydrates show significantly negative correlations. The negative correlation of dry matter approaches significance. No correlation could be detected between the digestibilities of "other carbohydrates", nitrogen-free extract and organic matter.

Since the correlation of crude protein, ether extract and lignin are significant and positive it appears justified to believe that the two species of animals reacted in a similar way in digesting these fractions of pasture herbage. With the existence of such a correlation it becomes possible to predict in this respect the digestive behavior of steers from a digestion trial run with rabbits.

In an effort to find an explanation for the significant negative correlations obtained with crude fibre, cellulose and "total carbohydrates", it should be noted that all the cellulose-containing fractions of the feed as well as those fractions the digestibility of which by the manner of computation depend upon a cellulose-containing fraction (nitrogen-free extract and total carbohydrates) show either negative or non-significant

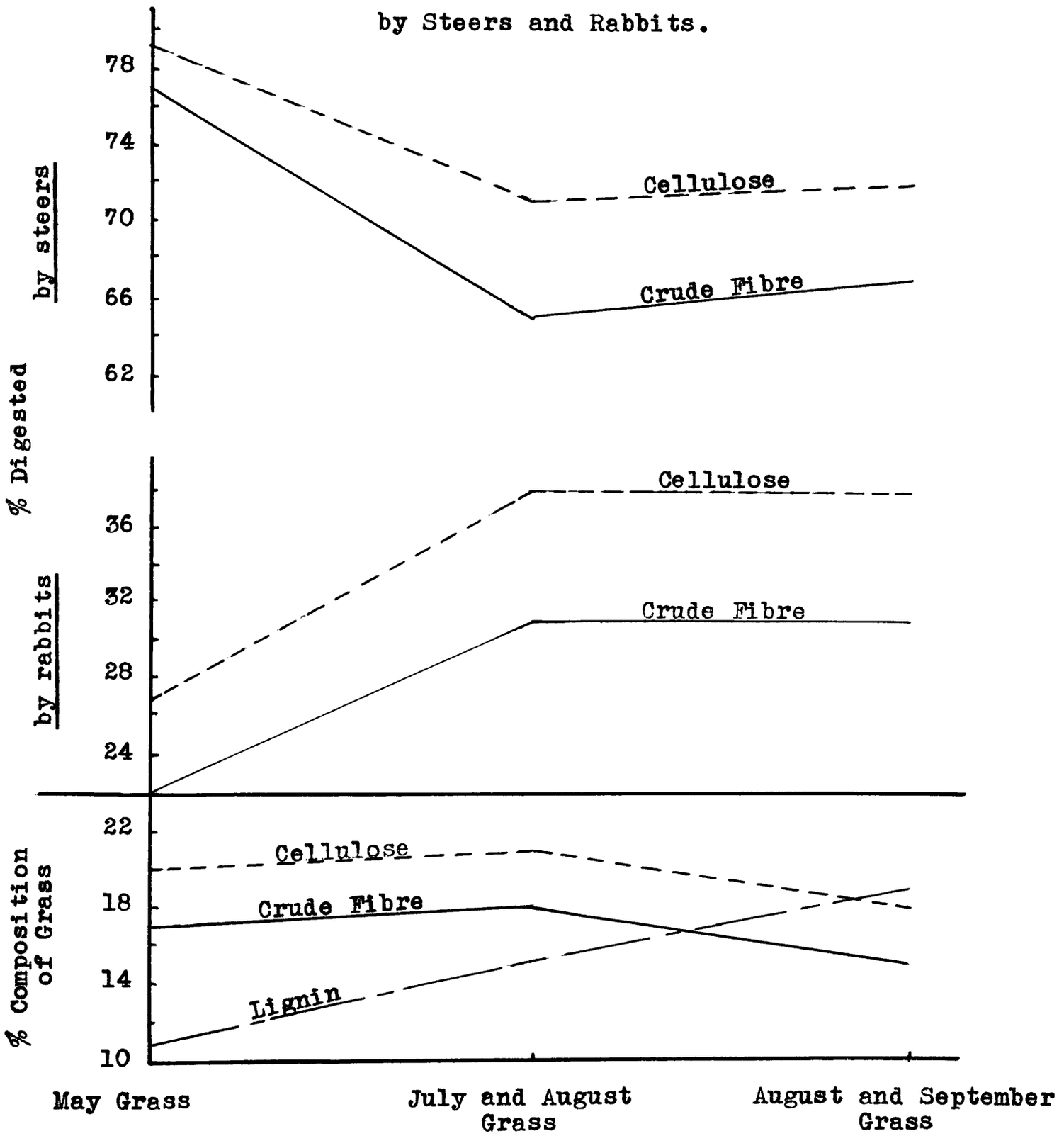
correlations. If the digestibility coefficients of crude fibre and cellulose are plotted alongside the cellulose, crude fibre and lignin content of the diets (Chart II) we find that the trends of digestibility of crude fibre and cellulose show striking resemblances. Since these two fractions of feed and feces are determined chemically in an altogether different manner, this resemblance strongly suggests that the correlations obtained for these fractions must have been due to actual changes in the ability of the animals to digest them.

From the findings of Crampton and Forshaw (1938) (1939) and noting the rising lignin content of the diets fed in these trials, we would expect a decline in digestibility from the "May Grass" to the "July and August Grass". This expected decline in digestibility is actually shown by the steers but not by the rabbits. Evidently the rabbits were out of line from the findings of the previously mentioned experiments.

The rabbits used in these tests were started on "trial A" at an age of about five months. From the time schedule of the digestibility trials (Table I) we note that two months elapsed from the beginning of rabbit "trial A" to the beginning of rabbit "trial B". It would seem reasonable to believe that with newly weaned rabbits their ability to digest cellulose or crude fibre may

CHART II.

Cigestibility of Crude Fibre and Cellulose by Steers and Rabbits.



increase with maturity. It appears possible, therefore, that the increase in percent digestibility by the rabbits of the cellulose and crude fibre fractions of the "July and August Grass" over the "May Grass" may have been in part due to an actual increase in the ability of the rabbits to digest these fractions of their diets as result of their increased age. This would in part explain the negative correlations obtained.

No information could be found in the literature on the influence of age upon the ability of the rabbit to digest pasture herbage. This factor might be worthy of further attention.

The fact that no correlation could be detected between the ability of steers and rabbits to digest the "other carbohydrates" fraction of their diets can be explained on the basis that this fraction represented the easily digestible part of all diets and but little change in its digestibility would be expected.

SUMMARY AND CONCLUSIONS

Digestibility experiments with steers and rabbits fed on identical diets of pasture herbage demonstrated that, while rabbits were somewhat more variable than steers in their ability to digest pasture herbages used in these trials, this does not preclude their use as pilot animals for steers.

This investigation substantiated the finding of Crampton and Campbell (1938) that rabbits obtain a somewhat larger proportion of their nourishment from the protein fraction of pasture herbage than do steers and a smaller proportion from carbohydrates.

Evidence is presented to indicate the existence of a significant correlation between the abilities of steers and rabbits to digest certain fractions of pasture herbage.

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APPENDIX

Table Ia. Composition of Diet and Feces (as % of dry matter).

Trial A - May Grass.

Material	Animals	Moisture	Ash	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
Feed	All	11.24	9.49	90.51	29.47	3.14	16.78	41.12	57.90	11.13	19.92	26.85
Feces	Steers											
	A 1	4.38	24.64	75.36	22.18	6.20	12.46	34.52	46.98	29.38	12.89	4.71
	A 2	3.29	23.03	76.97	22.64	6.50	12.53	35.30	47.83	31.40	13.27	3.16
	A 3	3.68	23.54	76.46	21.99	7.46	13.01	34.00	47.01	31.54	14.32	1.15
	A 4	3.50	22.64	77.36	22.22	7.21	13.44	34.49	47.93	32.09	13.42	2.42
Feces	Rabbits											
	A 31	7.67	12.60	87.40	18.86	4.44	25.60	38.50	64.10	20.47	28.70	14.93
	A 32	8.38	11.77	88.23	17.94	2.94	27.34	40.01	67.35	21.59	28.74	17.02
	A 33	7.32	12.04	87.96	18.25	4.43	26.57	38.71	65.28	21.58	28.08	15.62
	A 34	7.60	11.47	88.53	18.15	4.12	26.26	40.00	66.26	21.95	29.99	14.32
	A 35	7.12	10.84	89.16	18.09	3.69	25.77	41.61	67.38	21.78	29.63	15.97
	A 36	7.48	12.33	87.67	18.01	5.09	25.63	38.94	64.57	20.87	29.52	14.18

Table Ib. Calculation of Coefficients of Apparent Digestibility for Steers.

Trial A - May Grass
(weight in pounds, collection period 15 days)

Steer No.		Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
A 1	Feed	206.42	186.83	60.83	6.48	34.64	84.88	119.52	22.98	41.12	55.42
	Feces	60.98	45.95	13.52	3.78	7.60	21.05	28.65	17.92	7.86	2.87
	Amount digested	145.44	140.88	47.31	2.70	27.04	63.83	90.87	5.06	33.26	52.55
	% digested	70.46	75.41	77.77	41.67	78.06	75.20	76.03	22.02	80.89	94.82
A 2	Feed	258.02	233.53	76.04	8.10	43.30	106.10	149.39	28.72	51.40	69.28
	Feces	79.94	61.53	18.10	5.20	10.02	28.22	38.23	25.10	10.60	2.53.
	Amount digested	178.08	172.00	57.94	2.90	33.28	77.88	111.16	3.62	40.80	66.75
	% digested	69.02	73.65	76.20	35.80	76.86	73.40	74.41	12.60	79.38	96.35
A 3*	Feed	189.24	171.28	55.77	5.94	31.75	77.82	109.57	21.06	37.70	50.81
	Feces	57.63	44.06	12.67	4.30	7.50	19.59	27.09	18.18	8.25	.66
	Amount digested	131.61	127.22	43.10	1.64	24.25	58.23	82.48	2.88	29.45	50.15
	% digested	69.55	74.28	77.28	27.61	76.38	74.83	75.28	13.68	78.12	98.70
A 4	Feed	258.02	233.53	76.04	8.10	43.30	106.10	149.39	28.72	51.40	69.28
	Feces	78.86	61.01	17.52	5.69	10.60	27.20	37.80	25.31	10.58	1.91
	Amount digested	179.16	172.52	58.52	2.41	32.70	78.90	111.59	3.41	40.82	67.37
	% digested	69.44	73.87	76.96	29.75	75.52	74.36	74.70	11.87	79.42	97.24

* Steer A 3 was cut off the trial on the 10th day on account of consuming an unknown quantity of hay of unknown quality.

Table Ic. Calculation of Coefficients of Apparent Digestibility for Rabbits.

Trial A - May Grass (weight in gms., 14 day period)

Rabbit No.		Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
A 31	Feed	1583.2	1433.0	466.6	49.7	265.7	651.0	916.7	176.2	315.4	425.1
	Feces	800.0	699.2	150.9	35.5	204.8	308.0	512.8	163.8	229.6	119.4
	Amount digested	783.2	733.8	315.7	14.2	60.9	343.0	403.9	12.4	85.8	305.7
	% digested	49.47	51.21	67.66	28.57	23.72	52.69	44.06	7.04	27.20	71.91
A 32	Feed	1457.8	1319.5	429.6	45.8	244.6	599.4	844.1	162.3	290.4	391.4
	Feces	651.1	574.5	116.8	19.1	178.0	260.5	438.5	140.6	187.1	110.8
	Amount digested	806.7	745.0	312.8	26.7	66.6	338.9	405.6	21.7	103.3	280.6
	% digested	55.34	56.46	72.81	58.30	27.23	56.54	48.05	13.37	35.57	71.69
A 33	Feed	1595.0	1443.6	470.0	50.1	267.6	655.9	923.5	177.5	317.7	428.3
	Feces	806.3	709.2	147.1	35.7	214.2	312.1	526.4	174.0	226.4	125.9
	Amount digested	788.7	734.4	322.9	14.4	53.4	343.8	397.1	3.5	91.3	302.4
	% digested	49.45	50.87	68.70	28.74	19.96	52.42	43.00	1.97	28.74	70.60
A 34	Feed	1563.4	1415.0	460.7	49.1	262.3	642.9	905.2	174.0	311.4	419.8
	Feces	776.3	687.3	140.9	32.0	203.9	310.5	514.4	170.4	232.8	111.2
	Amount digested	787.1	727.7	319.8	17.1	58.4	332.4	390.8	3.6	78.6	308.6
	% digested	50.35	51.43	69.42	34.83	22.26	51.70	43.17	2.07	25.24	73.51
A 35	Feed	1417.4	1282.9	417.4	44.5	237.8	582.8	820.7	157.8	282.3	380.6
	Feces	684.0	609.9	123.7	25.2	176.3	284.6	460.9	149.0	202.7	109.2
	Amount digested	733.4	673.0	294.0	19.3	61.5	298.2	359.8	8.8	79.6	271.4
	% digested	51.74	52.46	70.39	43.37	25.86	51.17	43.84	5.58	28.20	71.31
A 36	Feed	1588.9	1438.1	468.2	49.9	266.6	653.4	920.0	176.8	316.5	426.6
	Feces	807.3	707.8	145.4	41.1	206.9	314.4	521.3	168.5	238.3	114.5
	Amount digested	781.6	730.3	322.8	8.8	59.7	339.0	398.7	8.3	78.2	312.1
	% digested	49.19	50.78	68.94	17.63	22.39	51.88	43.34	4.69	24.71	73.16

Table Id. Coefficients of Apparent Digestibility.

Trial A - May Grass.

Animal	Animal Number	Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellulose	Other CH_2O
Steers	A 1	70.46	75.41	77.77	41.67	78.06	75.20	76.03	22.02	80.89	94.82
	A 2	69.02	73.65	76.20	35.80	76.86	73.40	74.41	12.60	79.38	96.35
	A 3	69.55	74.28	77.28	27.61	76.38	74.83	75.28	13.68	78.12	98.70
	A 4	69.44	73.87	76.96	29.75	75.52	74.36	74.70	11.87	79.42	97.24
	Average	69.62	74.30	77.05	33.71	76.71	74.45	75.11	15.04	79.45	96.78
Rabbits	A 31	49.47	51.21	67.66	28.57	23.72	52.69	44.06	7.04	27.20	71.91
	A 32	55.34	56.46	72.81	58.30	27.23	56.54	48.05	13.37	35.57	71.69
	A 33	49.45	50.87	68.70	28.74	19.96	52.42	43.00	1.97	28.74	70.60
	A 34	50.35	51.43	69.42	34.83	22.26	51.70	43.17	2.07	25.24	73.51
	A 35	51.74	52.46	70.39	43.37	25.86	51.17	43.84	5.58	28.20	71.31
	A 36	49.19	50.78	68.94	17.63	22.39	51.88	43.34	4.69	24.71	73.16
	Average	50.92	52.20	69.65	35.24	23.57	52.73	44.24	5.79	28.28	72.03

Table IIa. Composition of Diets and Feces (as % of dry matter).

Trial B - July and August Grass.

Material	Animals	Moisture	Ash	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
Feed	All	13.53	8.74	91.26	27.93	3.33	17.57	42.43	60.00	15.25	21.07	23.68
Feces	Steers											
	B 1	3.11	17.57	82.43	20.75	7.75	15.54	38.39	53.93	35.96	16.28	1.69
	B 2	2.84	17.13	82.87	21.20	7.74	17.01	36.92	53.93	35.43	16.82	1.68
	B 3	3.00	17.09	82.91	21.19	8.99	16.15	36.58	52.73	33.75	16.32	2.66
	B 4	2.77	17.16	82.84	20.99	8.13	16.14	37.58	53.72	35.54	15.54	2.64
Feces	Rabbits											
	B 31	6.61	10.89	89.11	20.92	6.19	24.49	37.51	62.00	30.70	25.79	5.51
	B 32	6.24	10.33	89.67	20.28	7.12	23.80	38.47	62.27	29.25	25.45	7.57
	B 33	6.90	9.73	90.27	20.02	5.72	24.04	40.49	64.53	31.30	25.93	7.30
	B 34	6.14	9.90	90.10	20.29	7.07	24.52	38.22	62.74	31.09	26.13	5.52
	B 35	6.72	9.51	90.49	21.40	6.28	24.48	38.33	62.81	31.01	25.85	5.95
	B 36	6.68	9.92	90.08	19.47	6.87	23.88	39.86	63.74	31.40	25.89	6.45

Table IIb. Calculation of Coefficients of Apparent Digestibility for Steers.

Trial B - July and August Grass.

(weight in pounds, collection period 14 days)

Steer No.		Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Total CH_2O
B 1	Feed	191.41	174.68	53.46	6.37	33.63	81.22	114.85	29.19	40.33	45.33
	Feces	70.10	57.78	14.55	5.43	10.89	26.91	37.80	25.21	11.41	1.18
	Amount digested	121.31	116.90	38.91	.94	22.74	54.31	77.05	3.98	28.92	44.15
	% digested	63.38	66.92	72.78	14.76	67.62	66.87	67.09	13.63	71.71	97.40
B 2	Feed	239.26	218.35	66.83	7.97	42.04	101.52	143.56	36.49	50.41	56.66
	Feces	92.21	76.41	19.55	7.14	15.68	34.04	49.73	32.67	15.51	1.55
	Amount digested	147.05	141.94	47.28	.83	26.36	67.48	93.83	3.82	34.90	55.11
	% digested	61.46	65.01	70.75	10.41	62.70	66.47	65.36	10.47	69.23	97.26
B 3	Feed	263.18	240.18	73.51	8.76	46.24	111.67	157.91	40.13	55.45	62.32
	Feces	100.87	83.63	21.37	9.07	16.29	36.90	53.19	34.04	16.46	2.68
	Amount digested	162.31	156.55	52.14	- .31	29.95	74.77	104.72	6.09	38.99	59.64
	% digested	61.67	65.18	70.93	-3.54	64.77	66.96	66.32	15.18	70.32	95.70
B 4	Feed	239.26	218.35	66.83	7.97	42.04	101.52	143.56	36.49	50.41	56.66
	Feces	89.87	74.45	18.86	7.31	14.51	33.77	48.28	31.94	13.97	2.37
	Amount digested	149.39	143.90	47.97	.66	27.53	67.75	95.28	4.55	36.44	54.29
	% digested	62.44	65.90	71.78	8.28	65.49	66.74	66.37	12.47	72.29	95.82

Table IIc. Calculation of Coefficients of Apparent Digestibility for Rabbits.

Trial B - July and August Grass (weight in gms., 14 day period)

Rabbit No.		Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
B 31	Feed	1591.2	1452.1	444.4	53.0	279.6	675.1	954.7	242.7	335.3	376.8
	Feces	802.3	714.9	167.8	49.7	196.5	300.9	497.4	246.3	206.9	44.2
	Amount digested	788.9	737.2	276.6	3.3	83.1	374.2	457.3	- 3.6	128.4	332.6
	% digested	49.58	50.77	62.24	6.23	29.72	55.43	47.90	- 1.48	38.29	88.27
B 32	Feed	1532.3	1398.4	428.0	51.0	269.2	650.2	919.4	233.7	322.9	362.8
	Feces	731.2	655.7	148.3	52.0	174.0	281.3	455.3	213.9	186.1	55.4
	Amount digested	801.1	742.7	279.7	-1.0	95.2	368.9	464.1	19.8	136.8	307.4
	% digested	52.28	53.11	65.35	-1.96	35.36	56.74	50.48	8.47	42.37	84.73
B 33	Feed	1589.2	1450.3	443.9	52.9	279.2	674.3	953.5	242.4	334.8	376.3
	Feces	830.0	749.2	166.2	47.5	199.5	336.1	535.6	259.8	215.2	60.6
	Amount digested	759.2	701.1	277.7	5.4	79.7	338.2	417.9	-17.4	119.6	315.7
	% digested	47.77	48.34	62.56	10.21	28.55	50.16	43.83	- 7.18	35.72	83.90
B 34	Feed	1534.1	1400.0	428.5	51.1	269.5	650.9	920.4	234.0	323.2	363.3
	Feces	779.0	701.9	158.1	55.1	191.0	297.7	488.7	242.2	203.6	43.0
	Amount digested	755.1	698.1	270.4	-4.0	78.5	353.2	431.7	- 8.2	119.6	320.3
	% digested	49.22	49.87	63.10	-7.83	29.13	54.26	46.90	- 3.50	37.00	88.16
B 35	Feed	1525.5	1392.2	426.1	50.8	268.0	647.3	915.3	232.6	321.4	361.2
	Feces	796.6	720.8	170.5	50.0	195.0	305.3	500.3	247.0	205.9	47.4
	Amount digested	728.9	671.4	255.6	.8	73.0	342.0	415.0	-14.4	115.5	313.8
	% digested	47.78	48.23	59.99	1.57	27.24	52.83	45.34	- 6.19	35.94	86.88
B 36	Feed	1561.0	1424.6	436.0	52.0	274.3	662.3	936.6	238.1	328.9	369.6
	Feces	761.7	686.1	148.3	52.3	181.9	303.6	485.5	239.2	197.2	49.1
	Amount digested	799.3	738.5	287.7	- .3	92.4	358.7	451.1	- 1.1	131.7	320.5
	% digested	51.20	51.84	65.99	- .58	33.69	54.16	48.16	- .46	40.04	86.72

Table IId. Coefficients of Apparent Digestibility.

Trial B - July and August Grass

Animal	Animal Number	Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellulose	Other CH_2O
Steers	B 1	63.38	66.92	72.78	14.76	67.62	66.87	67.09	13.63	71.71	97.40
	B 2	61.46	65.01	70.75	10.41	62.70	66.47	65.36	10.47	69.23	97.26
	B 3	61.67	65.18	70.93	-3.54	64.77	66.96	66.32	15.18	70.32	95.70
	B 4	62.44	65.90	71.78	8.28	65.49	66.74	66.37	12.47	72.29	95.82
	Average	62.24	65.75	71.56	7.48	65.15	66.76	66.29	12.94	70.89	96.55
Rabbits	B 31	49.58	50.77	62.24	6.23	29.72	55.43	47.90	-1.48	38.29	88.27
	B 32	52.28	53.11	65.35	-1.96	35.36	56.74	50.48	8.47	42.37	84.73
	B 33	47.77	48.34	62.56	10.21	28.55	50.16	43.83	-7.18	35.72	83.90
	B 34	49.22	49.87	63.10	-7.83	29.13	54.26	46.90	-3.50	37.00	88.16
	B 35	47.78	48.23	59.99	1.57	27.24	52.83	45.34	-6.19	35.94	86.88
	B 36	51.20	51.84	65.99	- .58	33.69	54.16	48.16	- .46	40.04	86.72
	Average	49.64	50.36	63.21	1.27	30.62	53.93	47.10	-1.72	38.23	84.44

Table IIIa. Composition of Diets and Feces (as % of dry matter).

Trial C - August and September Grass

Material	Animals	Moisture	Ash	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
Feed	All	8.45	14.69	85.31	28.42	5.19	14.99	36.71	51.70	18.61	17.55	15.54
Feces	Steers											
	C 1	2.88	33.53	66.47	17.87	4.92	12.87	30.81	43.68	29.50	12.10	2.08
	C 2	2.43	33.05	66.95	18.11	5.14	13.38	30.32	43.70	30.23	13.74	- .27
	C 3	2.56	33.61	66.39	17.90	4.80	13.03	30.66	43.69	30.75	12.54	.40
	C 4	2.33	32.69	67.31	17.83	5.14	12.98	31.36	44.34	29.51	12.52	2.31
Feces	Rabbits											
	C 31	5.27	22.90	77.10	18.29	4.67	20.89	33.25	54.14	26.71	22.30	5.13
	C 32	5.19	21.96	78.04	19.13	4.83	21.59	32.49	54.08	27.91	22.75	3.42
	C 33	5.27	21.03	78.97	16.96	5.39	22.43	34.19	56.62	25.90	23.68	7.04
	C 34	5.07	21.95	78.05	18.08	4.81	22.47	32.69	55.16	28.39	23.56	3.21
	C 35	4.88	18.48	81.52	17.40	4.72	22.81	36.59	59.40	30.63	24.09	4.68
	C 36	4.61	23.02	76.98	17.17	4.37	21.23	34.21	55.44	28.57	22.11	4.76

(1x)

Table IIIb. Calculation of Coefficients of Apparent Digestibility for Steers.

Trial C - August and September Grass.

(weight in pounds, collection period 14 days)

Steer No.		Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
C 1	Feed	193.67	165.22	55.04	10.05	29.03	71.10	100.13	36.04	33.99	30.10
	Feces	69.81	46.40	12.48	3.43	8.98	21.51	30.49	20.59	8.45	1.45
	Amount digested	123.86	118.82	42.56	6.62	20.05	49.59	69.64	15.45	25.54	28.65
	% digested	63.95	71.92	77.33	65.87	69.07	69.75	69.55	42.87	75.14	95.18
C 2	Feed	242.08	206.52	68.80	12.56	36.29	88.87	125.16	45.05	42.49	37.62
	Feces	95.33	63.82	17.26	4.90	12.76	28.90	41.66	28.82	13.10	- .26
	Amount digested	146.75	142.70	51.54	7.66	23.53	59.97	83.50	16.23	29.39	37.88
	% digested	60.62	69.10	74.91	60.99	64.84	67.48	66.71	36.03	69.17	100.69
C 3	Feed	184.25	157.18	52.36	9.56	27.62	67.64	95.26	34.29	32.34	28.63
	Feces	72.16	47.91	12.92	3.46	9.40	22.12	31.53	22.19	9.05	.29
	Amount digested	112.09	109.27	39.44	6.10	18.22	45.52	63.73	12.10	23.29	28.34
	% digested	60.84	69.52	75.32	63.81	65.97	67.30	66.90	35.29	72.02	98.99
C 4	Feed	239.95	204.70	68.19	12.45	35.97	88.09	124.05	44.65	42.11	37.29
	Feces	91.28	61.44	16.28	4.69	11.85	28.63	40.47	26.94	11.43	2.11
	Amount digested	148.67	143.26	51.91	7.76	24.12	59.46	83.58	17.71	30.68	35.18
	% digested	61.96	69.99	76.13	62.33	67.06	67.50	67.38	39.66	72.86	94.34

Table IIIc. Calculation of Coefficients of Apparent Digestibility for Rabbits.

Trial C - August and September Grass (weight in gms., 14 day period)

Rabbit No.		Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellu-lose	Other CH_2O
C 31	Feed	1528.7	1304.1	434.5	79.3	229.2	561.2	790.3	284.5	268.3	237.6
	Feces	713.6	550.2	130.5	33.3	149.1	237.3	386.3	190.6	159.1	36.6
	Amount digested	815.1	753.9	304.0	46.0	80.1	323.9	404.0	93.9	109.2	201.0
	% digested	53.32	57.81	69.97	58.01	34.95	57.72	51.12	33.01	40.70	84.60
C 32	Feed	1492.2	1273.0	424.1	77.4	223.7	547.8	771.5	277.7	261.9	231.9
	Feces	689.8	538.3	132.0	33.3	148.9	224.1	373.0	192.5	156.9	23.6
	Amount digested	802.4	734.7	292.1	44.1	74.8	323.7	398.5	85.2	105.0	208.3
	% digested	53.77	57.71	68.88	56.98	33.44	59.09	51.65	30.68	40.09	89.82
C 33	Feed	1546.7	1319.5	439.6	80.3	231.9	567.8	799.6	287.8	271.4	240.4
	Feces	760.0	600.2	128.9	41.0	170.5	259.8	430.3	196.8	180.0	53.5
	Amount digested	786.7	719.3	310.7	39.3	61.4	308.0	369.3	91.0	91.4	186.9
	% digested	50.86	54.51	70.68	48.94	26.48	54.24	46.19	31.62	33.68	77.75
C 34	Feed	1520.4	1297.1	432.1	78.9	227.9	558.1	786.0	282.9	266.8	236.3
	Feces	715.6	558.5	129.4	34.4	160.8	233.9	394.7	203.2	168.6	23.0
	Amount digested	804.8	738.6	302.7	44.5	67.1	324.2	391.3	79.7	98.2	213.3
	% digested	52.93	56.94	70.05	56.40	29.44	58.09	49.78	28.17	36.81	90.27
C 35	Feed	1474.2	1257.6	419.0	76.5	221.0	541.2	762.1	274.3	258.7	229.1
	Feces	712.7	581.0	124.0	33.6	162.6	260.8	423.3	218.3	171.7	33.4
	Amount digested	761.5	676.6	295.0	42.9	58.4	280.4	338.8	56.0	87.0	195.7
	% digested	51.66	53.80	70.41	56.08	26.43	51.81	44.46	20.42	33.63	85.42
C 36	Feed	1601.0	1365.8	455.0	83.1	240.0	587.7	827.7	297.9	281.0	248.8
	Feces	749.7	577.1	128.7	32.8	159.2	256.5	415.6	214.2	165.8	35.7
	Amount digested	851.3	788.7	326.3	50.3	80.8	331.2	412.1	83.7	115.2	213.1
	% digested	53.17	57.75	71.71	60.53	33.67	56.36	49.79	28.10	41.00	85.65

Table IIId. Coefficients of Apparent Digestibility.

Trial C - August and September Grass

Animal	Animal Number	Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	N-free Extract	Total CH_2O	Lignin	Cellulose	Other CH_2O
Steers	C 1	63.95	71.92	77.33	65.87	69.07	69.75	69.55	42.87	75.14	95.18
	C 2	60.62	69.10	74.91	60.99	64.84	67.48	66.71	36.03	69.17	100.69
	C 3	60.84	69.52	75.32	63.81	65.97	67.30	66.90	35.29	72.02	98.99
	C 4	61.96	69.99	76.13	62.33	67.06	67.50	67.38	39.66	72.86	94.34
	Average	61.84	70.13	75.92	63.25	66.74	68.01	67.64	38.46	72.30	97.30
Rabbits	C 31	53.32	57.81	69.97	58.01	34.95	57.72	51.12	33.01	40.70	84.60
	C 32	53.77	57.71	68.88	56.98	33.44	59.09	51.65	30.68	40.09	89.82
	C 33	50.86	54.51	70.68	48.94	26.48	54.24	46.19	31.62	33.68	77.75
	C 34	52.93	56.94	70.05	56.40	29.44	58.09	49.78	28.17	36.81	90.27
	C 35	51.66	53.80	70.41	56.08	26.43	51.81	44.46	20.42	33.63	85.42
	C 36	53.17	57.75	71.71	60.53	33.67	56.36	49.79	28.10	41.00	85.65
	Average	52.62	56.42	70.28	56.16	30.74	56.22	48.83	28.67	37.65	85.59

Table IV. Analysis of Variance and Covariance of Digestion Coefficients for Dry Matter.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	14.5		3.2		
Animals	3	2.1		1.6		
Herbage + Interaction	8	19.1	4.4	3.8	1.9	-4.2
Herbage	2	75.0		13.1		
Interaction (Error)	6	.45	.67	.64	.80	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = -.50$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\text{Variance } y} = -1.12$$

Table V. Analysis of Variance and Covariance of Digestion Coefficients for Organic Matter

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	13.9		11.3		
Animals	3	2.3		3.2		
Herbage + Interaction	8	18.3	4.3	14.3	3.8	2.4
Herbage	2	72.3		54.8		
Interaction (Error)	6	.22	.47	.86	.93	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = .15$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\text{Variance } y} = .17$$

(47)

Table VI. Analysis of Variance and Covariance of Digestion Coefficients for Crude Protein.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	6.2		11.3		
Animals	3	2.3		2.9		
Herbage + Interaction	8	7.6	2.8	14.5	3.8	9.1
Herbage	2	30.1		56.1		
Interaction (Error)	6	.08	.29	.64	.80	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = .87$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\text{Variance } y} = .63$$

(4X)

Table VII. Analysis of Variance and Covariance of Digestion Coefficients for Ether Extract.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	600.5		573.4		
Animals	3	71.2		13.9		
Herbage + Interaction	8	799.0	28.3	783.2	38.0	774.1
Herbage	2	3138.1		2944.8		
Interaction (Error)	6	19.31	4.39	62.6	7.91	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = .72$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\text{Variance } y} = .99$$

Table VIII. Analysis of Variance and Covariance of Digestion Coefficients for Crude Fibre.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	30.6		25.8		
Animals	3	6.3		17.5		
Herbage + Interaction	8	39.8	6.3	28.9	5.4	-31.0
Herbage	2	78.2		102.3		
Interaction (Error)	6	.89	.94	4.44	2.11	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = -.92$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$(b) = \frac{\text{Covariance } xy}{\text{Variance } y} = -1.07$

Table IX. Analysis of Variance and Covariance of Digestion Coefficients for Nitrogen-Free Extract.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	12.6		6.0		
Animals	3	2.0		6.2		
Herbage + Interaction	8	16.6	4.1	5.9	2.4	-2.8
Herbage	2	64.6		19.8		
Interaction (Error)	6	.58	.76	1.31	1.14	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = -.28$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\text{Variance } y} = -.46$$

Table X. Analysis of Variance and Covariance

of Digestion Coefficients for Total Carbohydrates.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	17.5		9.0		
Animals	3	3.0		6.3		
Herbage + Interaction	8	23.0	4.8	10.0	3.2	-11.8
Herbage	2	91.1		36.3		
Interaction (Error)	6	.31	.17	1.22	1.11	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = -.78$

Correlation needed for significance(with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\sigma^2_y} = -1.18$$

(xx)

Table XI. Analysis of Variance and Covariance of Digestion Coefficients for Lignin.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	157.4		229.7		
Animals	3	25.0		12.1		
Herbage + Interaction	8	207.1	14.4	311.3	17.6	247.3
Herbage	2	806.6		1229.1		
Interaction (Error)	6	7.25	2.69	5.42	2.33	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = .97$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\sigma^2_y} = .79$$

Table XII. Analysis of Variance and Covariance of Digestion Coefficients for Cellulose.

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	17.7		37.1		
Animals	3	7.6		5.5		
Herbage + Interaction	8	21.5	4.6	48.9	7.0	-27.6
Herbage	2	69.8		176.6		
Interaction (Error)	6	5.38	2.32	6.36	2.52	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = -.85$

Correlation needed for significance(with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\sigma^2_y} = -.56$$

(xx)

Table XIII. Analysis of Variance and Covariance of Digestion Coefficients for Other Carbohydrates

Source of Variability	Degrees of Freedom	Steers		Rabbits		Covariance
		Variance σ^2_x	Standard Deviation σ_x	Variance σ^2_y	Standard Deviation σ_y	
Total	11	4.0		51.5		
Animals	3	5.5		21.1		
Herbage + Interaction	8	3.4	1.8	62.2	7.9	-1.0
Herbage	2	.6		238.1		
Interaction (Error)	8	4.36	2.09	4.53	2.13	

Simple correlation between rabbits and steers (D/F = 8) $r = \frac{\text{Covariance } xy}{\sigma_x \sigma_y} = -.07$

Correlation needed for significance (with P = .05; N = 8) is r = .63

Change in steer digestibility with unit change in digestibility by rabbits

$$(b) = \frac{\text{Covariance } xy}{\sigma^2_y} = -.02$$