FEEDING DAIRY COWS.

A THESIS PRESENTED TO THE GRADUATE COMMITTEE

OF THE VIRGINIA POLYTECHNIC INSTITUTE

IN APPLICATION FOR THE DEGREE

OF MASTER OF SCIENCE.

by

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FEEDING DAIRY COWS.

Feeding standards have only been in use the last 100 years and have made wonderful strides in this short period of time. *"The first attempt to express the relative value of different feeding stuffs in a systematic manner was made by Thaer, of Germany, who, in 1810, published a table of hay equivalents with meadow hay as the standard. According to this writer the amounts of various other feeding stuffs required to equal 100 pounds of meadow hay in feeding value were:

91 lbs. clover hay	417 lbs. rutabages.
91 lbs. alfalfa hay	602 lbs. cabbages.
200 lbs. potatoes	625 lbs. mangels.

'Naturally opinions on feed values varied, so there were about as many tables of hay equivalents as there were writers on the subject.

'Chemistry having paved the way, Grouven, in 1859, proposed the first feeding standard for farm animals, based on crude protein, carbohydrates, and fat in feeding stuffs. This, however, was imperfect, since it was based on the total instead of the digestible nutrients.

'In 1864 Dr. Emil von Wolff presented in the Mentzel and von Lengerke's Agricultural Calendar for that year the first table of feeding standards based on the digestible nutrients contained in feeding stuffs; These standards set forth the amount of digestible crude protein, carbohydrates, and fat required daily by the different classes of

*"Feeds & Feeding", Henry & Morrison, Page 109,15 Edition,1915.

farm animals.

'The Wolff feeding standards appeared annually in the Mentzel-Lengerke Calendar down to 1896. From 1897 to 1906 they were presented by Dr. C. Lehmann, of the Berlin Agricultural High School, with some modifications. In 1907 Dr. O. Kellner took charge of this portion of the Calendar and substituted tables and feeding standards based on starch values."

Of recent years the following men have played a very important part in perfecting feeding standards: Armsby, following Kellner's lead and using digestible protein and therms net energy values, who in turn is being followed by Eckles of Missouri and the Virginia Station. Haecker, of the Minnesota Station, has taken into consideration the fat content of milk and his standard is for dairy cows only. The Cornell standard worked out by Savage is a modification of the Haecker standard, and considerable stress is placed upon the total digestible nutrients contained in feeds. This standard is adapted to dairy cattle only.

The Swedish Feed-unit system has been worked out on altogether different lines, and is the result of milk actually produced for feeding certain feeds. The requirements are very close to that of the Armsby, Eckles, and Virginia standards.

Feeding Experiment with Six Holstein Cows.

Two of which were fed Maintenance ration.

Two of which were fed Maintenance ration plus excess starch

Two of which were fed Maintenance ration plus excess protein

Complete Outline of Experiment.

Outline of Feeding Experiment to Determine the Protein and Energy requirement for Milk Production, submitted jointly by the Dairy Husbandry and Chemical Departments.

Feeds consumed by animals may be measured by work done, growth of the body and the lain on fat, the production of bodily heat, and reproduction with its attentant function. The production of milk, is the essential function of cows from a commercial standpoint, and their feed must necessarily be measured by such production.

In order to measure feed in terms of milk production, all results of feeding other than milk production must be eliminated as far as possible for the time being. Where this can be done with the facilities at hand, a balance of such condition must be maintained.

In the proposed feeding test, two or more groups of animals are to be used, rangeing in number from 5 to 7. It is therefore neneccary to apply the above rules to these groups.

A. Work done. This may take a number of forms, as (a) moving the body from place to place, (b) motion of the parts of the body while in place, (c) mastication and digestion of food, and various functions of the different organs of the body, such as heart action, nerve activity, etc. It is thought that none of these functions can be eliminated

Chemical analysis of Feeds, Digestion Experiments, etc.

All feeds will be analyzed for protein, fat, nitrogen, free extract, crude fiber, ether extract, and ash.

The milk produced by the cows in each group is to be weighed separately and samples taken each day and sent to the chemical laboratory where composite ten-day samples representing each cow will be analyzed for fat, nitrogen, sugar and ash.

At the period of maximum production digestion experiments with the animals in each group will be conducted which will cover periods of not over ten days.

Measurement of Results.

Results will be measured by protein and energy values produced in milk, in relation to (a) total protein minus maintenance protein (b) total energy value minus maintenance energy values.

Feeding Period.

The feeding period shall be 50 days with digestion period of 10 days.

Conclusions that may be drawn.

It would appear that conclusions should be drawn in two directions and possibly others which do not appear now.

(a) It has not been determined with any degree of positiveness how much protein and energy is required above maintenance to produce a pound of milk. These tests should determine this point for the foods used. The difference between this amount and the actual elements in the milk may be considered the force required to digest and assimilate the given foods.

(b) It is contended with apparent reason by many feeders, that an added amount of protein in proportion to energy value acts as a stimulant to extreme production. This contention is based upon the fact that most feeders who secure large records for cows feed very large amounts of protein. These tests should determine this point. It is proposed to continue the tests varying the proportion of protein until the maximum for production is reached.

The physiological results of excessive amounts of protein upon the animal is a problem which will be attacked with other cows, feeding a ration rich in protein to one group and another poor in protein for a period of ten years or more. A Jersey herd owned by the Institute is available for this work.

They must, therefore, be balanced as far as possible, In order to accomplish this the following precautions will be observed:

1. All animals in the experiment will be subjected to the same conditions in reference to exercise. They will occupy the same yard and stable at the same time, and no animals will be required to walk or exercise in any way not required by all.

2. All animals will be combined in the same form and under like conditions in every respect.

3. The work required to digest the food will depend on the kind of food consumed; that is, it will take more work to digest a pound of protein in roughage than a pound in grain, and more work to digest some kinds of grain than others. The kind and relative amounts of grain and roughages will be the same for all animals in the basal ration.

B. (1). The growth of the body and to some extent, the ability to digest food will depend on the age of the animal. Each group will, therefore, have the same number of animals of the same age or degree of development. Animals from five to nine years of age, other things being equal, will be considered with the same degree of development.

(2). In reference to the laying on of fat, it is believed that this can be and should be eliminated in the test. It is realized that to do this will require the most careful attention to details in several directions, (a) the feed will have to be adjusted to the weights from day to day. The points to be observed will be as follows: (b) representative weight will have to be taken daily, (c) it is proposed to take these weights early in the morning before feeding and watering, and before the animals are disturbed as far as possible, (d) the weights

are to be taken the same time daily and the same time after feeding, watering and milking; (e) it is recognized that the feed required to maintain a cow to even weight by producing will depend upon the capacity of the individual and the most palatable food will have to be furnished to secure this result, (f) the food chosen for the basal ration will, therefore, be the most palatable possible, (g) it is very hard to maintain even weight on heavy producers immediately after calving, especially if they are unusually fat, as is often the case. Cows will, therefore be chosen at least two months after calving for the test.

C. In order that there may be no appreciable variation in the food required to maintain the bodily heat, all cows in the test will be subjected to the same treatment as to time in the stable and in the yard. Care will be taken to see that the exposure in the stable is the same for all cows. Ventilation will be provided so as to prevent draughts, and lighting will be given.

D. It is believed that the function of reproduction and heat periods can and should be eliminated so that there will be no variant but milk production, the element to be measured.

E. As feed is to be measured in terms of milk production, not only the direct resultant force of food digestion must be eliminated, or balanced in the groups, but any other influence which would effect the milk production should either be eliminated or balanced. Those appearing to be fundamental may be enumerated as follows: (a) Breed. All animals are to be of the same breed. (b) Period of lactation. The tendency of every cow is to go dry for a period each year, the length of this period and time when the cow begins to materially drop off in her milk varying greatly with the individual. It is believed that pure

bred cows may be used generally for the tests to the sixth or seventh month and in some cases still later. Only persistent milkers will be used that the period of lactation will be balanced in each group.

Basal Ration.

The basal ration will be computed for each cow in the test on the basis of the amount of protein in the probable amount of milk produced plus the maintenance protein. The energy values will be computed on the same basis. Preliminary tests will be conducted to determine the probable amount of milk produced. The maintenance requirements and energy values given in Farmers' Bulletin No. 345 will be used for these determinations.

Supplemental Ration.

(1) To group (1) there will be added to this ration one pound of protein in as pure form as possible, probably black albumin.

(2) To group (2) the basal ration will be fed alone.

(3) To groups (3) the basal ration and one pound of carbohydrates in pure form will be fed.

These relations in the ration of each animal will be maintained throughout, each animal being fed to even weight, and to be in good flesh when the experiment begins. If it is determined to increase the ration of any animal to maintain even weights, the amount of each element which enters into the ration such as silage, bran, black albumin, etc., will be varied in proportion.

Number 1.

What was the influence of time of experiment on the health and reproduction of the animals?

With the limited number of animals that we have used there has not been any noticeable difference in the health of the animal while on test as compared to the time off of test, and in regard to breeding there has been no difficulty in getting the cows to breed on account of the delayed breeding.

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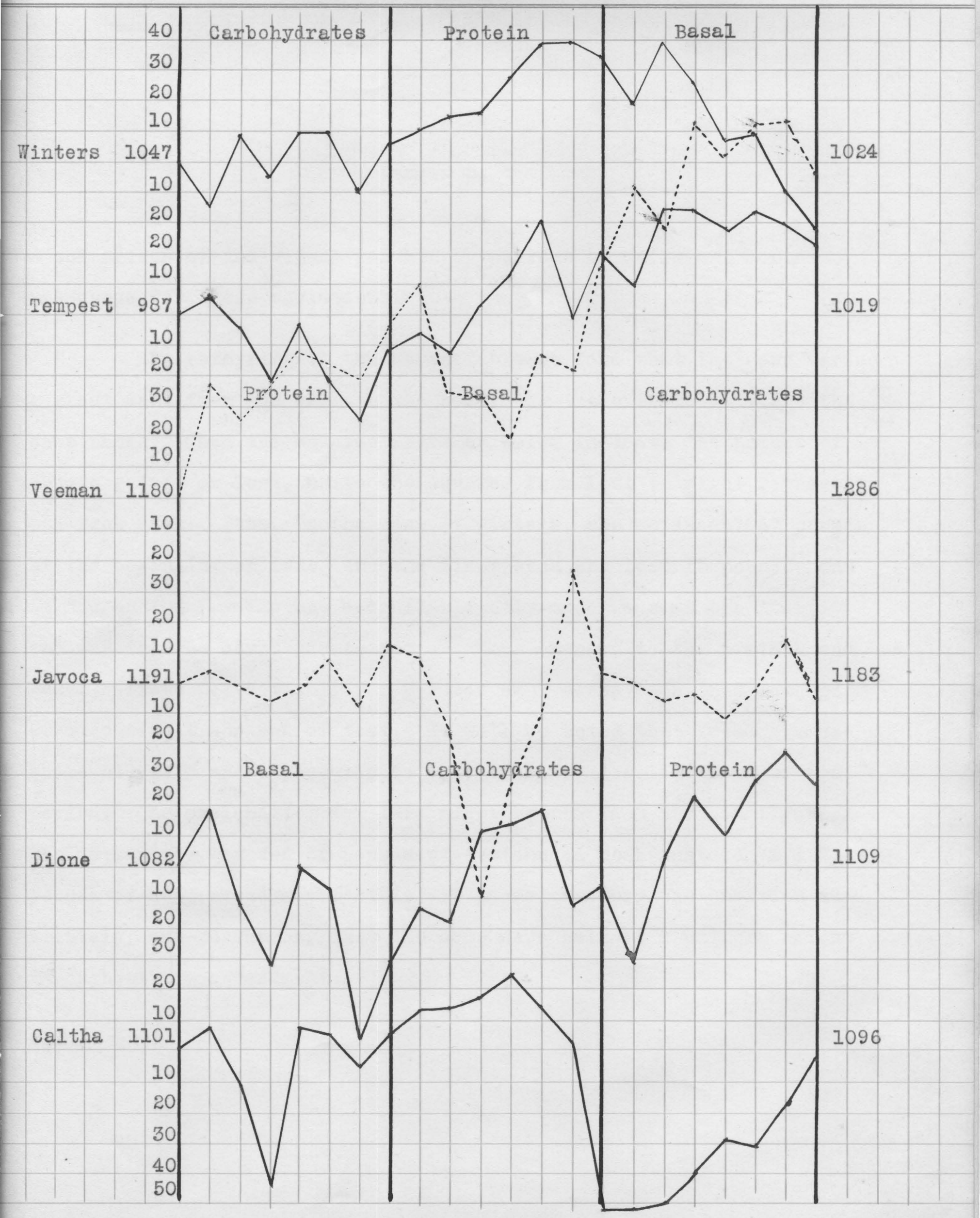
SUBJECT

Table showing individual weights of cows by weeks.



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Number 2.

A comparison of individual weights by periods of weeks and months and cause for these variations.

By referring to the above table we find that the cows varied a great deal from one week to the next. To the extreme left are the cows names. Then the squares above or below indicate the number of pounds gained or lost, while the squares from left to right represent one week each. Thus, in the case of Winters, she weighed 1047 pounds at the beginning of test, and the first week she lost 15 pounds, and at the end of 7 weeks she weighed slightly more than at the start and was fed the carbohydrate ration then changed to the protein and basal rations respectively for periods of 7 weeks each, and weighed 1024 pounds at the end of test. It will be noted that Veeman gained quite steadily and especially is this true for the last half of the period. One explanation for this might be the fact that in figuring the ration she was fed 3¼ pounds of cottonseed meal instead of 1 3/4 pounds of cottonseed meal. This, it seems, answers the question absolutely, and we can say that the cows were held at a uniform weight throughout the experiment.

Number 3.

What change, if any, upon milk production was shown by changing rations? Was the ration in all cases sufficient or was it too large for the average dairyman?

Total Production on Basal Ration ----------6 cows -		8645.3
" " " " and starch ------		8055.6
	loss	589.7
" " " " and Protein		9311.9
	gain	666.6

The table gives a good idea of the effect upon milk production of the rations used. The Basal ration produced 8645.3 pounds of milk and from a close study of the daily reports of the amounts of feed refused by the cows it would seem that the ration was as heavy as could be recommended to the average dairyman. The addition of one pound of Starch to the Basal ration did not give as great a production as the Basal ration alone, indicating that an excess of carbohydrates has a tendency to make the ration less digestible.* The addition of 1 pound Black Albumin increased the production 666.6 pounds over that on the Basal ration, and 1256.3 above that from the Starch ration.

See Fraps page 470

The results obtained agree with results of Others. The basal ration was sufficient - and the addition of Carbohydrates apparently restricted the digestibility of the ration.

Number 4.

What relationship exists with the production value of these experiments with Armsby's and Haecker's Standard? With Kellner's Heat Value, with the Scandinavian Feed-unit System, and with Eckles' results with Jersey cows.

[1]Below is given a table in which these standards are all compared. The amount of nourishment is the amount suggested by the different standards for twenty-four hours for a cow weighing 1,000 pounds and yielding in the twenty-four hours 22 pounds of milk testing 4 per cent of butter fat. All standards have been reduced to their carbohydrate equivalent by multiplying the digestible fat by 2¼ and adding the digestible carbohydrates and digestible protein. This carbohydrate equivalent has been changed to therms by multiplying the pounds of carbohydrate equivalent by 1,071 calories and dividing by 1,000. This reduced the recommended amount of nutrients to the term used by Armsby in his standards for dairy cows.

The striking thing about this table is the close agreement in the amount of food necessary as proposed by Armsby, Kellner, Eckles and the Scandinavian Feed-unit System. The Armsby, Kellner, and Feed-unit System standards have been worked out independently, the Feed-unit System in a totally different way of experimentation and yet close agreement is seen.

1. The American Society of Animal Production,
Record of Proceedings of Annual Meeting, Nov.,1914, Page 69.

Weight 1000 lbs. -Daily production 22 lbs. of milk, 4 per cent fat.

	Digestible Lbs.	Production value Therms.
Wolff-Lehmann	2.5000	17.805
Haecker	1.886	16.562
Cornell	2.126	16.727
Armsby	1.600	12.600
Kellner	2.000	12.852
Eckles	1.710	12.600
Scandinavian Feed-unit System..	1.650	12.876
*Virginia	1.688	14.294

There is a close agreement between the Haecker and Cornell requirements of total food as measured by total production value in therms in the food supplied. The Wolff-Lehmann standard, the oldest of all, requires a still larger amount of productive energy in the food supplied."

There is a very close agreement between the Virginia results as regards the protein requirement to the results of Armsby, Eckles, and the Scandinavian Feed_Unit system. *The therms required is slightly higher than Armsby, Kellner, Eckles and the Scandinavian Feed-unit system, but not nearly as high as the requirements of the Wolff-Lehmann, Haecker, and Cornell standards.

*The Temp. during the digestion trials was very low and the thermal energy necessary to keep the animals warm would be higher than the calculated values.

Number 5.

Was the protein of the ration sufficient or too great? Should it have been changed during the feeding trial?

The protein was sufficient in the case of this experiment and the results indicated that it should not have been changed during the feeding trial.

In comparing the basal with the carbohydrate ration there was a loss in production by the adding of starch, and where the protein was added it increased the production as one would naturally expect. Referring back to the table giving individual weights of the cows it would seem that the maintenance standard was practically correct as regards the cows with their respective production. Also as indicated by the individual cow, Veeman, which was fed more protein than the ration called for, that she gained, but did not seem to hold up in milk production any better than the other cows.

Number 6.

Cost of milk production in comparison with feed cost. Was the increased productiveness caused by excess protein profitable?

Cost of Ration for Dairy Cows.

Basal

8.5	lbs.	C.S.M.	51	days	--	433.5	lbs.	@	$32.00 =	$ 6.936
11.875	"	Gluten	51	"	--	605.625	"	@	34.00 =	10.296
10.5	"	Bran	51	"	--	535.4	"	@	26.00 =	6.962
33.625	"	Corn	51	"	--	1714.875	"	@	38.00 =	32.583
369.0	"	Silage	51	"	--	18819.	"	@	4.00 =	37.638

Milk produced, 8645.3 lbs. at feed cost of $1.091 per cwt.

Basal and Protein.

Milk produced, 9311.9 lbs. at feed cost of $1.091 per cwt. =

$101.593

or a differance of 7.178

306 lbs. Black Albumen made a difference of 7.178

In other words Black Albumen is worth $2.346 per cwt as a feed.

Basal and Starch.

Milk produced 8055.6 lbs. at feed cost of $1.091 per cwt. =

$ 87.887

or a loss of 6.528

From the above table it will be noted that the cost of producing 100 pounds of milk on a basal ration was $1.091, while on a protein ration, figuring that it cost the same for production, black albumen was worth $2.346 per cwt., which is hardly the price of the product, while in the case of starch ration figuring at the same cost for producing 100 pounds of milk means a loss of $6.528 in addition to the cost of the starch fed.

Number 7.

What influence if any does the experiment have upon the individual.

	Veeman	Javoca	Dione	Caltha	Winters	Tempest
Date of freshening	August 19	September 1	August 12	August 11	August 9	August 14.
no of days to beginning of test.	82	69	89	90	92	87
	Protein		Basal		Starch	
Production 1st period.	2013.9	2306.2	1587 .3	1080.5	1600.9	1483.1
	Basal		Starch		Protein	
2nd period	1686.0	1866.0	1425.4	813.9	1471.2	1262.2
	Starch		Protein		Basal	
3rd Period	1338.4	1393.9	1370.9	887.5	1221.6	1203.9
During Test	5038.3	5766.1	4383.6	2781.9	4293.7	3949.2
Remaining year's Production	6774.0	5292.0	7374.4	4569.0	5630.3	6235.9
Total year's Production	12812.3	11058.1	11758.0	7350.9	9924.0	10185.1

Total Production on Basal Ration ------- 6 cows, 8645.3

" " " " & Starch 6 " 8055.6 loss 589.7

" " " " & Protein 6 " 9311.9 gain 666.1

Previous Lactation Period.

corresponding to 1st Period.	7573.8	4734.2	5782.4	5408.4	2945.1	2673.3

corresponding to remaining Year's production.	9759.2	6156.8	6558.8	5776.9	5582.8	3805.9
Total year's production.	17333.0	10891.0	12341.2	11185.3	8527.9	6453.2

Total year's production for test year of 61,998.0

Total production during test period of 26,212,8

Total year's production for a previous lactation period of the 6 cows 66,731.6

Total production during a similar period as test period of the 6 cows 29,091.2

61998.0 : 26212.8 :: 1 : 4228 On test year

66731.6 : 29091.2 :: 1 : 4356 Previous year

66731.6 : 61998.0 :: 1 : 9275 Ratio between the 2 years.

From the above table you will notice that Veeman produced considerably more milk the year off of test but the relative proportion is about the same. Javoca produced about the same each year, but while on test she produced 474 pounds more milk during the test period than the remaining period, while the previous period she produced 1422 pounds more milk during a similar remaining period than the similar test period.

Thus making a difference of 1896 pounds of milk. Dione was fairly constant one year with the other. Caltha dropped some for the test year and especially on test, while Winters just reversed, producing more milk the test year, and especially during the test period. Tempest produced 10185 pounds during the test year and only 6453 the corresponding year. Tempest's greatest increase was during the period while off of test which is somewhat typical of Winters.

The summary as indicated by the proportions and their relation between the total production of the six cows for the year and the time while on test of 1 to .4283, while the previous lactation period using similar periods for each individual the combined result is 1 to .4356, a very small difference. A Proportion of the total production of the two years shows that the cows only produced 92 3/4% as much milk during the test year as compared to the previous lactation period.

One other factor that should be mentioned is that the cows were all mature and in their prime during the test year, while during the previous lactation period they were all immature cows,) which goes to show that there was really more difference than the figures indicate.

Number 8.

m What influence does the change in the rations have upon the protein, fat, and carbohydrates produced?

When the cows were fed excess protein it was found that the amount of protein available for milk production was materially increased. The amount of protein in the milk was only very slightly increased except in the case of Caltha, but here the amount of protein had been increased over that of the protein during the period that the excess carbohydrate was fed. The difference between the yield from basal and the basal plus protein ration was only .022 pounds protein per day, although the latter ration was fed 100 days later in the lactation period.

The carbohydrates in milk vary with the individual cow. When Winters was changed from excess carbohydrate to excess protein there was an increase in the yield of milk sugar, but when the same change was made with Tempest the yield dropped off a little and yields from both cows dropped when they were put on the basal ration.

The sugar content of the milk from Veeman and Javoca gradually dropped, being highest when excess protein was fed and lowest when excess carbohydrates were fed. But notice the position in the lactation period.

The sugar content of milk in the case of Dione was greatest when the basal ration was fed and it fell off considerably when the change was made to excess carbohydrate, but when the ration was changed to excess protein the yield of milk sugar was increased a little. On the other hand, Caltha - with the same change of rations - had the highest yield of milk sugar with basal ration, and when the two changes in the ration were made the yield dropped slightly at both changes.

The effect of the different rations on the milk flow advanced except when Winters was changed from the excess carbohydrate to excess protein ration and here the milk flow averaged an increase of 5 pounds per 10 days for fifty days.

It is difficult to know exactly how to compare the figures of the milk flow on account of the variance in the food consumed.

Amount of Feeds Eaten. In Pounds.

	Basal Ration		Basal plus Carbohydrate		Basal Ration plus Protein	
	Feed	Milk.	Feed	Milk	Feed	Milk
Winters	568.60	252.2	666.20	292.2	656.40	297.3
Tempest	574.00	247.9	556.60	271.2	596.80	252.2
Veeman	774.65	337.3	698.86	275.7	832.05	377.9
Javoca	745.15	373.1	680.15	324.9	790.45	432.4
Dione	623.35	296.1	621.55	284.9	629.15	282.2
Caltha	520.65	201.7	503.05	186.1	533.05	181.2

Effect of different rations on fat content of milk.

Expressed in pounds per 10 days. Average of five periods.

	Basal Ration		Basal ration plus Carbohydrate		Basal Ration plus Protein.	
	Fat	Milk	Fat	Milk	Fat	Milk
Winters (3)	9.602	252.2	10.986 (1)	292.2	11.176 (2)	297.3
Tempest (3)	8.398	247.9	9.105 (1)	271.2	8.566 (2)	252.2
Veeman (2)	12.347	337.3	10.034 (3)	275.7	14.207 (1)	377.9
Javoca (2)	12.911	373.1	11.231 (3)	324.9	16.161 (1)	432.4
Dione (1)	10.665	296.1	10.023 (2)	284.9	10.832 (3)	282.2
Caltha (1)	6.300	201.7	5.336 (2)	186.1	5.405 (3)	181.2

In the case of Veeman and Javoca where excess protein was fed first the amount of fat in milk is very much greater than when the other two rations are fed and excess carbohydrate, which was fed last only showed very slight drop from the yield of fat when the basal ration was fed.

Winters, which was fed excess protein second, showed an increase of .19 lb. fat per 10 days even though receiving the excess protein feed later in the lactation period and in the next period when the basal ration is fed there is a drop of at least a pound of fat per 10 days.

Tempest shows a gradual drop in fat production as the lactation period proceeds.

Dione, although receiving the excess protein ration last, gives a bigger yield of fat than at any other period, but on changing from basal to excess carbohydrate the effect of the advancement of the lactation period is in evidence.

Caltha shows the effect of the lactation period when changed from basal to excess carbohydrate but when the ration is changed to excess protein the yield in fat is increased over that from the excess carbohydrate although not over that of the basal ration.

Effect of different rations on the protein content of milk.

Expressed in pounds per 10 days.

	Basal Ration		Basal Ration plus Carbohydrate		Basal Ration plus Protein	
	Protein	Milk	Protein	Milk	Protein	Milk
Winters.	(3) .809	252.2	(1) .900	292.2	(2) .927	297.3
Tempest	.778	247.9	.808	271.2	.771	252.2
Veeman	.995	337.3	.906	275.7	1.176	377.9
Javoca	(2) 1.033	373.1	(3) .951	324.9	(1) 1.213	432.4
Dione	.842	296.1	.792	284.9	.898	282.2
Caltha	(1) .535	201.7	(2) .476	186.1	(3) .513	181.2

In the case of Veeman and Javoca where excess protein is fed first, the yield of protein is made greater than when the other two rations are fed and when the basal is changed to the excess carbohydrate it does not have enough effect to counteract the action of the advance in the lactation period, though the drop in yield is not nearly so great as it is when the excess protein is changed to basal.

Winter's record would indicate that both the excess carbohydrates and excess protein ration increased the amount of protein in milk. It is evident that the excess protein increased the yield over

that from the excess carbohydrate but although the difference between yield from the excess carbohydrate and basal ration is .091 lbs. protein, this may be accounted for by the difference in the lactation period.

Tempest showed the effects of the lactation period and when the excess protein ration was changed to the basal the protein in milk held practically constant and even showed a slight increase. This may have been caused by the after effects of the protein as the average of the first 20 days showed that the yield of protein was .817 lbs. instead of .778 which was the average for the whole five periods.

Dione shows that the addition of carbohydrates does not counteract the loss in protein but upon the addition of protein to the ration the yield of protein is increased though it is the last part of the lactation period.

Caltha shows that the addition of carbohydrate does not prevent a falling off in the yield of protein and upon the addition of protein to the basal ration it is enough to increase the yield over that from the excess carbohydrate ration but not enough to equal that from the basal ration which was fed practically 100 days previously.

Number 9,

A comparison of the digestion coefficients obtained with those of Henry, Armsby, Jordan, the starch values of Kellner and the results of this experiment.

Table showing a Comparison of the Digestible Nutrients of the feeds used in this Experiment.

	Henry	Jordan	Armsby	Kellner
Corn Meal				
Digestible Protein	7.5	6.99	6.79	6.6
" Carbohydrates	67.8	66.60	*88.84	#81.5
" Fat	4.6	4.24		
Wheat Bran				
Digestible Protein	12.2	11.98	10.21	9.1
" Carbohydrates	40.9	39.98	*48.23	#42.6
" Fat	2.9	2.72		
Gluten Meal				
Digestible Protein	30.2	32.19	33.09	71.7
" Carbohydrates	43.9	41.13	*78.49	#80.9
" Fat	4.4	2.55		
Cottonseed Meal				
Digestible Protein	33.4	40.31	35.15	39.5
" Carbohydrates	24.3	18.27	*84.20	#72.3
" Fat	7.9	10.8		

* Therms net energy value
\# Starch equivalent

Corn Silage

Digestible	Protein	1.1	.84	1.21	0.4
"	Carbohydrates	15.0	11.55	*16.56	#8.6
"	Fat	0.7	.64		

From the above table it will be noted that the figures agree fairly close and the chief difference is probably due to a difference in the quality and manufacture of the byproduct feeds as it is with these that the greatest difference is shown. Below is given a comparison of digestion coefficients, comparing the results of Henry with the results of the Virginia experiment.

Comparison of Average and Actual Digestion Coefficients
When fed Basal Ration.

	Henry- Winters Va.-		Henry- Veeman Va.-		Henry- Caltha Va.-	
	Average	Actual	Average	Actual	Average	Actual
Protein	68.56	63.56	71.55	67.86	66.70	58.66
Fat	77.76	91.70	80.47	87.59	77.34	88.71
Crude Fiber	67.03	56.10	65.78	49.84	67.52	44.45
N.Free Ext.	75.05	79.78	75.09	78.02	73.99	75.16
Total	73.09	74.50	73.39	72.64	72.25	69.06
When fed Basal Ration plus Carbohydrate.						
Protein	66.50	55.91	73.26	65.57	67.39	61.00
Fat.	77.17	86.21	81.02	93.38	77.56	83.23
Crude Fiber	67.17	44.00	65.54	58.28	67.37	42.31
N.Free Ext.	74.99	75.21	77.23	82.07	75.90	76.14
Total	72.94	68.70	75.01	76.56	73.64	69.33
When Fed Basal Ration plus Protein.						
Protein	72.88	68.32	74.55	67.18	71.51	74.16
Fat	78.34	86.29	80.63	91.50	77 74	90.51
Crude Fiber	67.14	42.93	65.79	55.31	67.32	61.08
N.Free Ext.	74.86	76.39	75.15	78.39	74.11	83.83
Total	73.54	70.53	73.85	73.61	72.72	78.79

The actual digestion is about the same as the calculated. In some cases one is higher and in others the reverse is true.

But in every instance the digestibility of the protein and the crude fiber is less than the calculated digestibility except where the actual digestibility of the protein is a little higher when Caltha is fed excess protein, and the actual digestibility of the fat and the N. Free Ext. is higher in every instance.

In summing up the above data the following conclusions are brought out:

1. The variability of individual cow's weights for periods of one week.
2. The increased production when protein is added to the basal ration as compared to the addition of starch.
3. The large number of feeding standards at the present time.
4. The similarity of the results of this experiment to that of Armsby's and Eckles'.
5. The production of the six mature cows was only 92 3/4 as much the test year as compared to their production as immature cows.