EXPERIMENT STATION

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DIGESTION EXPERIMENTS WITH KANSAS FEEDS.

A KNOWLEDGE of the composition and digestibility of the feeds given our domestic animals is of the greatest practical importance. This fact is becoming sufficiently well recognized now, so that the Station has occasional requests from thinking feeders for analyses of feed, that they may make an intelligent selection in purchasing. Unfortunately we are unable to undertake such work at present for lack of time, but if it were possible to analyze feeds before buying it would bring about a revolution in the quality of our feeding stuffs. The physical qualities of a grain are easily observed; its productiveness, ease of culture, etc.; its inner capacity to nourish the body is much less easily measured. The time is fast going in which men will be satisfied with quantity only, with no regard to composition.

A knowledge of composition only is not sufficient. Two feeds may be quite similar in composition, or differ but little in that respect, and yet possess considerable difference in value because of differences in digestibility; not merely differences in their digestibility as a whole, but in that of the several constituents. Feeds are complex mixtures of a number of groups of chemical compounds. These groups differ in their food functions, and even the members of a given group differ in value. Perfect analysis of a feed is something

that the chemist has not yet attained, but, incomplete as it is, it may be made of much assistance.

In analyzing feeds, and for that matter human food also, a determination of the amount of each chemical element contained in it is not made. This would be possible, but is not desirable, since the value of a feed does not depend upon its elementary composition as much as upon the particular compounds of the elements which the substance contains. A determination of the amount of each one of these compounds would be very desirable, but is not possible. The best that can be done is to ascertain the percentages of certain groups of compounds, the individual members of which resemble each other in composition and properties. A certain amount of knowledge concerning the nature and functions of these substances is essential to an understanding of the results of an analysis of feed, or an intelligent application of them, and some consideration of this subject will be given before proceeding with the special matter of this bulletin.

In any analysis of feeds for purposes of accurate comparison it is necessary to estimate the amount of *water*. No matter how dry the feed may be, it contains some water, if it has not been artificially dried and then sealed from contact with the atmosphere. It is a simple matter to see that, if the dry matter of two feeds is of the same composition, their relative nutritive value will depend upon the amount of water which each contains, this being of no value, as such, above water taken alone. Tables of analyses often give the results in two ways, one showing the composition of the substance in its natural or ordinary state, and the other the same results of analysis recalculated to show what the composition would be if no water were present. In some connections one form is more useful, in others the other.

The *ash* of a feed is that which is left after burning off all combustible matter. It is the mineral portion. It is wrong to think of this as present in the feed in the form of minerals exclusively, however. Much of the matter left in the ash existed in the feed in the form of complex organic compounds. The proteids, for example, contain sulphur as an essential constituent, in which form it is an important element in nutrition, but this sulphur in the violent chemical changes incident to burning enters into combination as a sulphate. Phosphorus, too, is found in the ash as a phosphate, but exists in the feed in important organic combinations. The ash of feeds performs very important functions in nutrition, and at times it is found advisable to provide mineral matter in addition to that of the feed.

Under the name *protein*, a large number of substances are grouped which resemble each other in that they all contain nitrogen as an essential constituent. This group is frequently subdivided by analysis

into *proteids* and *amido-compounds.* The albumen of eggs, the curd of milk, the gluten of wheat and the muscular tissue of meat are common examples of proteids. The proteids are the most valuable of food constituents because of their relative scarcity, and their necessity in the performance of the vital functions of the body and for building up its tissues. Proteids can also perform the other functions of foods, such as the production of bodily heat and muscular force. They are thus of the greatest adaptability to the needs of the animal bodiy. The amido-compounds, while they contain nitrogen, and can perform some of the functions that proteids can in nutrition, are not equal to them in value.

The *fiber* of a feed consists principally of cellulose and its modifications. Cotton is pure cellulose; linen and other vegetable commercial fibers are of a similar nature. It constitutes the wall of the cells of which vegetable tissues consist, and is present even although there may not be any fibrous structure such as shown by the examples named. Fiber belongs to the group of substances known as carbohydrates. It is the least acted upon of any of them by the digestive fluids or by chemical agents. It is somewhat digestible, however, especially by the ruminants. It is more digestible in the young state than when mature. On account of its greater resistance to chemical agents it is possible to free it approximately from the other carbohydrates, and thus estimate it separately in analysis of feeds.

The *nitrogen-free extract* includes all of the carbohydrates except the fiber. In analysis it is not estimated directly, but its amount is ascertained approximately by adding together the percentages of the other constituents and subtracting the sum from the whole, or 100 per cent. Its most valuable constituents are sugars and starch. It is evident that it is of high importance as a constituent of feeds. Since it contains no nitrogen it cannot be used by the body to build up its muscular and tendonous tissues, and it is not available for some other of the nutritive processes. The chief purposes of the carbohydrates—that is, the fiber and the nitrogen-free extract—is to supply the energy of muscular exertion, keep up the animal heat, and contribute to the formation of fat.

The remaining constituent of feeds which is always determined in analysis is the *fat,* or, as it is sometimes called, the *ether extract.* As these names show, it is the part that is extracted when a feed is treated with ether, and it consists largely of fat. If the feed is a grain or seed of some kind the ether extract will be nearly pure fat, but feeds consisting largely of the leafy parts of plants yield an extract containing much that is not fat, and which is of less nutritive value. The fats perform about the same functions in nutrition as the

carbohydrates, but are far more effective within the limits that the body can utilize them. A given weight of fat will produce about 2.27 times as much heat or muscular force as an equal weight of carbohydrates.

In making the analyses recorded in this bulletin, the food principles named in the foregoing paragraphs were determined according to the methods recommended by the Association of Official Agricultural Chemists.

From the outline of the functions of the several groups of food principles presented, a few moments' consideration will enable one to see that the composition of a feed with reference to these is of the highest importance. Proteids are necessary to the production of all of the tissues of the animal body except the fat. They are therefore essential for growth, and young animals require a larger proportion of them, other things being equal, than mature animals. They are also essential in the formation of nitrogenous animal products, such as milk, eggs, and wool, and a liberal proteid ration is advantageous to all animals.

It is not the purpose of this bulletin to enter into a consideration of the details of animal nutrition, but a brief summary upon certain points seems to be too essential to be omitted on the assumption that they are already thoroughly understood by the reader.

The digestible constituents of a feed are those which can be absorbed from the digestive apparatus of the animal, or which are rendered capable of such absorption by the action of the digestive fluids during the passage of the feed through the digestive tract under the conditions presented by the natural healthy animal. Only substances so absorbed can nourish the animal, and while a certain amount of indigestible matter is essential to the normal action of the digestive tract, there is no danger that we shall get feeds that are too digestible. Practically, the more digestible a feed is the more valuable it is, other things being equal. Digestion experiments thus enable us to recognize the superior value of certain feeds that, by mere analysis, do not exhibit this excellence.

After the feed has been digested and absorbed it is utilized in the various functions of the body. In the case of the carbohydrates, a large part is stored in the liver immediately after absorption, and is yielded to the blood as it is required. To a certain extent the absorbed feed is built into other solid tissues of the body, especially with growing animals, but to a large extent it never becomes a part of the solids, but is utilized from the fluids of the body as a source of heat and muscular force. In all the functions of the body the food is used by being decomposed into simpler substances. There may be inter-

mediate substances, but the final products are those excreted by the skin, lungs, and kidneys.

The excretions from the intestines therefore include the indigestible parts of the feed, while those from the kidneys, lungs and skin represent most of the parts that have been digested and performed some function in the body of the animal. It will be apparent by a little thought that to fully investigate the functions that a feed has performed in an animal it would be necessary to determine the amount and composition of the feed, and the amount and composition of all the excretions, but that to determine what parts are digestible it is only necessary to ascertain the amount and composition of the dung, in addition to knowing the amount and composition of the feed eaten. However, in the process of digestion various fluids are poured into the digestive tract, which are in part reabsorbed, but not entirely so. The unabsorbed residues pass out with the undigested residues of the food. The dung will therefore contain not only the undigested part of a ration, but substances which have been produced from previously digested food. An exact calculation of the digestibility of a ration requires that a correction be made for these substances. On the other hand, the fluids from which these substances originated, although formed from digestive materials, are only the means by which the chief objects of feeding, such as meat, or milk-production, or muscular force, are attained. They are not the ultimate product, and all food constituents that go to their formation are unavailable for the production of force, meat, etc. Professor Atwater's practice in respect to human foods is to designate those parts of a ration which are absorbed, and do not reappear in the feces, as *available.* The available constituents of a feed, then, are found by subtracting the amounts of each found in the dung from the amounts of the same in the feed that produced the dung. The tables as given in this bulletin for *digestibility* might thus be properly referred to as representing *availability.* The correction necessary to make them show digestibility, strictly, is not large, but, as its amount is uncertain, we have not attempted to apply it.

Since the intestines of an animal are never entirely evacuated, but, especially in the case of ruminants, contain a considerable amount of feed in various stages of digestion, it is obviously impossible to feed an animal a certain amount of feed, and then collect the manure produced from that portion. If the animal be fed for some days upon the same ration, however, the dung produced from previous rations will finally be entirely evacuated, and the daily evacuations will then correspond in composition to the feed given. Since there is more or less variation in the completeness with which the bowels are emptied,

the manure produced is liable not to correspond in quantity with the feed given each day. If the manure were collected but a single day, the error on this account might be large, but if the collection extends over several days, the longer the better, the average error will be small. In our experiments, the period of preliminary feeding was about a week, and the dung produced during the next week was collected. The feed under test was given in the same quantity per day, as a rule, through the two weeks.

In carrying out the experiments, it was our object to feed the animal only as much as he would eat closely, if not entirely, so that the material eaten would represent fairly the composition of what should be consumed in regular feeding. If a larger amount of a coarse fodder had been given than the animal might be expected to eat, to the extent that animals do in regular feeding, he would have selected the better portions, and the digestion results obtained would have seemed better than a fair test would have shown.

The grains fed were finely ground, and the hays and fodders were cut into short lengths with a feed-cutter. The entire amount of a given feed that was to be used in the experiment was very carefully mixed and sampled for analysis. At the same time, the amounts that were to be given at each feed were weighed out, so that subsequent changes in the amount of moisture would not affect the conclusions drawn from analysis of the sample. The portions not eaten were saved during the time that the dung was being collected, and at the conclusion of the experiment were weighed and sampled for analysis.

During all of the feeding the animal was kept in a stall, and so tied that he could not eat any of his bedding. Most of the time he was given daily exercise. The stall was entirely protected from flies by screens, so as to prevent any worrying of the animal, with possibly abnormal results on this account.

In the earlier experiments the dung was caught as evacuated, by means of a leather bag attached to the animal by a suitable harness. In later experiments this was dispensed with, and a watcher was constantly with the animal to collect the manure as voided. The manure collected was taken to the laboratory at the end of each twenty-four hours. There it was very thoroughly mixed in a flat galvanized-iron pan, spread out in a layer about one and one-half inches thick, and weighed. One-twentieth of it was immediately taken while still on the scale as a sample for analysis. This sample was taken by cutting out plugs with a cork borer, the plugs being from points evenly distributed all over the pan. The sample so taken was put into a galvanized-iron pan and dried at a gentle heat, over a radiator in winter, and in the sun in summer. The pan was closely covered by wire screen,

to prevent access of flies. After drying, the sample was allowed to become air dry at ordinary temperature, and was weighed, ground, and sampled for analysis.

The following feeding stuffs have been experimented with, and the results are given in the succeeding pages:

Alfalfa hay cut when about ten per cent. in bloom.
Alfalfa hay cut when about fifty per cent. in bloom.
Alfalfa hay cut when in full bloom.
Buffalo-grass hay.
Prairie hay.
Kafir-corn stover.
Kafir-corn meal.
Soy-bean meal.

EXPERIMENTS WITH ALFALFA HAY.

The object of these experiments was to determine the digestibility of Kansas-grown alfalfa, and any variations in digestibility due to the stage of growth at which it was cut for hay.

The hay was all cut from the first crop of the season growing on the College farm, the first cutting being made when the plants were approximately ten per cent. in bloom; the second, when the plants were approximately fifty per cent. in bloom; and the third when they were in full bloom or a little beyond full bloom.

The hay from each cutting was well cured and of excellent quality when fed. The digestion experiment was performed upon the same steer in each case, which was a three-year-old grade Hereford and a good feeder. After determining about how much hay the steer would eat up clean at a feed, which was about seven pounds, he was fed eight pounds at each feed and two feeds a day during the experiment. The steer was somewhat wild when first put in the stall, and so the first period of preliminary feeding was extended to ten days. By this time he had become quite docile, and during the remainder of the feeding periods he was exercised daily by being led around the barnyard for about half an hour.

The other preliminary feeding periods were of six days each, and the periods of exact collection and observations were six days each, also.

The third cutting was fed first, and the second immediately after, these two experiments extending from June 22 to July 19, 1898. The steer was then allowed liberty for nine days before beginning the experiment with the first cutting. During his confinement in the stall, which was provided with wire screens, he was further protected from annoyance from flies by a thin muslin blanket the greater part of the time. The results of the experiments appear in the tables.

Table of Results in Digestion of Alfalfa Hay, first cutting, ten per cent. in bloom.

	In the air-dry substances, as analyzed.							Totals, as fed	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Hay fed	8.77	9.54	16.88	13.56	29.38	34.01	1.42	.....	10.45	18.50	14.86	32.20	37.29	1.56	.....
Hay uneaten	7.59	8.96	17.25	10.13	34.67	30.50	1.03	.....	9.61	18.67	10.96	37.52	33.01	1.11	.....
Dung	8.82	10.09	10.41	9.06	44.48	26.20	1.69	.....	11.07	11.41	9.94	48.78	26.89	1.85	.....
AMOUNTS, IN POUNDS.															
Hay fed	.....	.....	.....	.....	.....	.....	.....	96.00	8.76	15.52	12.46	27.01	31.28	1.31	83.88
Hay uneaten	.....	.....	.....	.....	.....	.....	.....	11.54	0.98	1.88	1.10	3.78	3.33	0.11	10.08
Hay eaten	.....	.....	.....	.....	.....	.....	.....	84.46	7.78	13.64	11.36	23.23	27.95	1.20	73.80
Dung	.....	.....	.....	.....	.....	.....	.....	.....	2.84	2.93	2.55	12.52	6.90	0.48	25.67
Hay digested	.....	.....	.....	.....	.....	.....	.....	.....	4.94	10.71	8.81	10.71	21.05	0.72	48.13
PERCENTAGE DIGESTIBLE.															
Hay eaten	.....	6.10	13.24	10.89	13.24	26.02	0.89	59.49	6.69	14.51	11.94	14.51	28.52	0.98	65.21
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Alfalfa hay	.....	63.49	78.52	77.55	46.10	75.31	60.00	59.49	63.49	78.52	77.55	46.10	75.31	60.00	65.21

Table of Results in Digestion of Alfalfa Hay, fiirst cutting, fifty per cent. in bloom.

	In the air-dry substances, as analyzed.							Totals, as fed	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Hay fed	7.71	9.49	15.88	12.63	31.44	34.23	1.25	.....	10.28	17.21	13.69	34.07	37.09	1.35	.....
Hay uneaten	8.76	10.37	16.12	12.94	32.27	31.02	0.96	.....	11.37	17.67	14.18	35.37	34.00	1.05	.....
Dung	6.94	11.02	10.75	9.69	42.39	26.46	2.44	.....	11.84	11.55	10.41	45.55	28.43	2.62	.....
AMOUNTS, IN POUNDS.															
Hay fed	.....	.....	.....	.....	.....	.....	.....	96.00	8.43	14.11	11.31	27.94	30.41	1.11	82.00
Hay uneaten	.....	.....	.....	.....	.....	.....	.....	10.07	0.98	1.52	1.22	3.04	2.92	0.09	8.60
Hay eaten	.....	.....	.....	.....	.....	.....	.....	85.93	7.45	12.59	10.09	24.90	27.49	1.02	73.40
Dung	.....	.....	.....	.....	.....	.....	.....	.....	3.21	3.13	2.82	12.34	7.70	0.71	27.10
Hay digested	.....	.....	.....	.....	.....	.....	.....	.....	4.24	9.46	7.27	12.56	19.79	0.31	46.30
PERCENTAGE DIGESTIBLE.															
Hay eaten	.....	5.33	11.90	9.14	15.79	24.88	0.39	58.29	5.78	12.89	9.90	17.11	26.96	0.42	63.16
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Alfalfa hay	.....	56.91	75.14	72.05	50.44	71.99	30.39	58.29	56.91	75.14	72.05	50.44	71.99	30.39	63.16

Table of Results in Digestion of Alfalfa Hay, first cutting, full bloom.

	In the air-dry substances, as analyzed.							Totals, as fed	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Hay fed	8.29	7.75	13.23	10.62	33.11	36.34	1.30	.....	8.45	14.43	11.58	36.10	39.62	1.41	.....
Hay uneaten	8.31	7.68	12.17	9.58	37.78	32.89	1.18	.....	8.37	13.27	10.45	41.20	35.88	1.28	.....
Dung	7.19	8.89	9.20	9.12	45.62	27.22	1.88	.....	9.58	9.98	9.81	49.15	29.27	2.02	.....
AMOUNTS, IN POUNDS.															
Hay fed	.....	.....	.....	.....	.....	.....	.....	96.00	7.03	12.01	9.64	30.04	32.95	1.17	83.20
Hay uneaten	.....	.....	.....	.....	.....	.....	.....	23.84	1.73	2.74	2.16	8.51	7.42	0.26	20.66
Hay eaten	.....	.....	.....	.....	.....	.....	.....	72.16	5.30	9.27	7.48	21.53	25.53	0.91	62.54
Dung	.....	.....	.....	.....	.....	.....	.....	.....	2.07	2.16	2.12	10.63	6.32	0.44	21.62
Hay digested	.....	.....	.....	.....	.....	.....	.....	.....	3.23	7.11	5.36	10.90	19.21	0.47	40.92
PERCENTAGE DIGESTIBLE.															
Hay eaten	.....	4.74	10.43	7.86	15.99	28.18	0.69	60.03	5.16	11.37	8.57	17.43	30.72	0.75	65.43
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Alfalfa hay	.....	60.94	76.70	71.66	50.63	75.24	51.65	60.03	60.94	76.70	71.66	50.63	75.24	51.65	65.43

For practically all feeding purposes, the most important nutrient to be considered is protein. Admitting this to be the case, the results obtained in these experiments with alfalfa are intensely interesting. It will be seen from the table that the amount of digestible protein in the air-dry hay of the first cutting is 13.24 per cent., while in the second cutting it has diminished to 11.90 per cent., and in the last cutting it is only 10.43 per cent. The proper stage of growth at which to cut alfalfa, then, is of vital importance to the alfalfa grower and feeder. The most distinguishing quality of alfalfa is its high percentage of protein. In this respect the best quality of hay would be produced by cutting the alfalfa when it is just beginning to bloom. On the other hand, a larger yield per acre of hay, and possibly of protein also, would be produced from a single crop by cutting when the plants have obtained full growth. At the same time, experience has proved that a greater number of crops in a single season can be secured by cutting at an early stage of growth, so that the total yield per acre for a given season would be in favor of the early cutting.

The evidence, then, both in regard to quality and quantity of hay produced, is vastly in favor of the early cutting, and feeders and alfalfa growers should bear this in mind. For feeding pigs, dairy cows, calves, and fattening steers, the early-cut hay is undoubtedly worth considerably more per ton than that cut when the plants have reached the stage of mature growth.

Another point of interest to be noted is the variation in digestibility of the same nutrients in the different kinds of hay. Generally speaking, the difference is in favor of the early-cut hay, though in the case of fiber the late-cut hay has a slight advantage. It will be seen that in the early-cut hay 78.52 per cent. of the protein is digestible, while in the late-cut hay 76.7 per cent. of the crude protein is digestible. The difference is much more marked in the case of the pure proteids, 77.55 per cent. of this nutrient being digested in the early-cut hay, while in the late-cut hay the figures drop to 71.66 per cent. On the whole, all the nutrients in alfalfa hay are highly digestible when it is compared in this respect with other feeds used for roughage. It also compares favorably in this respect with many of the concentrated feeds, such as the grains, mill feeds, etc., and when we consider the fact that there are only a very few of these feeds that contain as much digestible protein as alfalfa hay, and then remember the immense yield per acre in a season, with the ease of production, we are inevitably led to the conclusion that alfalfa is the most profitable feed a Kansas farmer can produce.

EXPERIMENT WITH HAY FROM BUFFALO-GRASS.

In the western half of Kansas practically all of the forage and a large share of the winter roughage for stock is obtained from buffalo-grass, or what is now popularly termed "short grass." Hence, the digestibility of this grass is an important as well as interesting subject to the Western feeder and stock-grower.

During the latter part of July, l899, a young man, a graduate of the College, and who was at that time in Logan county, was commissioned with the task of cutting enough buffalo-grass to answer the purposes of a digestion experiment. After experimenting upon various methods of cutting the grass, he decided upon the lawn-mower as the most perfect and rapid means of securing a fair sample of the grass. After about ten days of hard labor with this machine he secured about 300 pounds of well-cured grass, which was shipped to the Station at Manhattan. This hay was of excellent quality.

The hay was fed to a yearling steer, grade Short-horn, and weighing 710 pounds at the beginning of the experiment. He refused to eat the hay when it was first given to him, although he was fed nothing else during two days. The hay was then mixed with alfalfa hay, and the mixture was eaten very readily. The proportion of alfalfa hay was gradually reduced until, in about six days, the steer began eating the pure buffalo-grass hay. He was then fed five days upon this hay as a preliminary period of feeding, after which he was fed five days for the actual digestion experiment.

At the beginning of the preliminary period of feeding, all the hay was thoroughly mixed and sampled for analysis, and the remainder accurately weighed out into nine-pound lots, to be fed at the rate of two feeds per day, nine pounds at each feed.

The steer was exercised daily during all of the experiment except the five days when the dung was collected. The table shows the detailed results.

Compared with all other feeds used for roughage, except hay from the leguminous plants, hay from buffalo-grass contains a remarkably high percentage of digestible protein. In this respect it ranks but a very little below clover hay and is much above millet, timothy hay, oat hay, orchard-grass hay, wheat straw, and corn-stover.

It is remarkably rich in ash, but this ash seems to be very indigestible; however, this does not affect its value as a feed to any great extent. When all of the digestible nutrients it furnishes are considered, its value should be placed on a level with that of Red clover hay.

Table of Results in Digestion of Buffalo-grass Hay.

	In the air-dry substances, as analyzed.							Totals, as fed	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Hay fed	8.16	12.10	11.31	10.00	24.10	42.33	2.00	.....	13.17	12.31	10.89	26 24	46.10	2.18	.....
Hay uneaten	8.18	13.95	11.00	9.44	23.23	41.75	1.89	.....	15.19	11.98	10.28	25.30	45.47	2.06	.....
Dung	8.53	23.49	11.37	9.37	18.78	35.47	2.36	.....	25.68	12.43	10.24	20.53	38.78	2.58	.....
AMOUNTS, IN POUNDS.															
Hay fed	.....	.....	.....	.....	.....	.....	.....	90.00	10.55	9.86	8.72	21.01	36.92	1.75	80.1
Hay uneaten	.....	.....	.....	.....	.....	.....	.....	22.25	3.10	2.45	2.10	5.17	9.29	0.42	20.4
Hay eaten	.....	.....	.....	.....	.....	.....	.....	67.75	7.45	7.41	6.62	15.84	27.63	1.33	59.7
Dung	.....	.....	.....	.....	.....	.....	.....	.....	7.00	3.38	2.80	5.60	10.58	0.50	27.3
Hay digested	.....	.....	.....	.....	.....	.....	.....	.....	0.45	4.03	3.82	10.24	17.05	0.83	32.4
PERCENTAGE DIGESTIBLE.															
Hay eaten	.....	0.70	6.20	5.88	15.77	26.24	1.28	50.08	0.76	6.76	6.40	17.17	28.57	1.39	54.65
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Buffalo-grass hay	.....	6.04	54.39	57.70	64.65	61.71	62.41	50.08	6.04	54.39	57.70	64.65	61.71	62.41	54.65

EXPERIMENT WITH PRAIRIE HAY.

Prairie hay is one of the chief products of the Kansas farmer in many parts of the state. Their capacity to withstand the vicissitudes of Kansas climate give our native grasses a value that less favorable qualities in other respects have not outweighed, so that many acres are still preserved which would otherwise be devoted to the production of cultivated crops.

Very little has been done to determine the digestibility of prairie hay, and consequently little is known about it. In order to throw some light upon this subject, we performed a digestion experiment, following the same general methods that have been outlined previously. The hay was fed to the same three-year-old Hereford steer used in the experiments with alfalfa hay, and the preliminary feeding and the actual test were each of six days' duration.

The hay was cut near the 1st of August, 1898, and was of good average quality. On August 16 it was run through an ensilage cutter, thoroughly mixed, and a sample taken for analysis. The steer had been eating very nearly ten pounds of hay at each feed, and so 120 pounds of the cut hay was weighed out in ten-pound lots, to be fed in six days at the rate of two feeds per day. The steer was exercised daily, as in previous experiments. The results obtained are presented in the table.

The most striking fact presented in these results is the very low quantity of digestible protein contained in the prairie hay, there being less than one per cent. The digestible carbohydrates and fat in the prairie hay are a little higher than in wheat straw, but the digestible protein is about the same, so that, as a feed, prairie hay should be classed with wheat straw according to these results. These conclusions are so different from the general idea concerning the feeding value of prairie hay, that we determined to repeat the experiment before publishing any results. The feeding had been done and the samples had all been prepared for analysis when the chemical laboratory was destroyed by fire, and in this catastrophe the samples from this experiment, as well as those from an experiment with sorghum hay, were lost. It is the intention of the department to repeat both of these experiments as soon as possible. It is to be hoped that further investigation of prairie hay will show that our first experiment was upon an anomalous example.

EXPERIMENT WITH KAFIR-CORN STOVER.

In this experiment a good average quality of stover was used, which was prepared by first cutting and shocking, and later heading, the Kafir-corn. It was fed to a two-year-old grade Hereford steer which

Table of Results in Digestion of Prairie Hay.

	In the air-dry substances, as analyzed.							Totals, as fed.	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Pure protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Hay fed	9.07	7.86	3.62	3.62	29.77	47.44	2.24	.....	8.64	3.98	3.98	32.94	51.98	2.46	.....
Hay uneaten	8.55	8.06	4.06	3.87	31.16	46.08	2.09	.....	8.81	4.44	4.23	34.07	50.39	2.29	.....
Dung	7.27	13.69	6.69	6.56	26.39	43.64	2.32	.....	14.76	7.21	7.07	28.46	47.06	2.50	.....
AMOUNTS, IN POUNDS.															
Hay fed	.....	.....	.....	.....	.....	.....	.....	120.00	9.13	4.20	4.20	34.30	54.91	2.60	105.64
Hay uneaten	.....	.....	.....	.....	.....	.....	.....	30.60	2.37	1.20	1.14	9.18	13.57	0.62	26.94
Hay eaten	.....	.....	.....	.....	.....	.....	.....	89.40	6.76	3.00	3.06	25.12	41.34	1.98	78.70
Dung	.....	.....	.....	.....	.....	.....	.....	.....	5.05	2.47	2.42	9.75	16.12	0.86	34.25
Hay digested	.....	.....	.....	.....	.....	.....	.....	.....	1.71	0.53	0.64	15.37	25.22	1.12	44.45
PERCENTAGE DIGESTIBLE.															
Hay eaten	.....	1.97	0.61	0.74	17.76	29.14	1.97	51.45	2.17	0.67	0.81	19.53	32 05	1.42	55.84
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Prairie hay	.....	25.30	17.67	20.91	61.18	61.25	56.57	51.45	25.30	17.67	20.91	61.18	61.25	56.57	55.84

was a good feeder. The steer was fed during a preliminary period of seven days, the purpose of which was to determine the amount he would eat in a day, as well as to clear the digestive tract of all other feed. It was found that the steer would eat between five and seven pounds of stover at a feed, if he was fed twice a day. It was therefore determined to feed him seven pounds at each feed during the experiment proper.

After the preliminary period the steer was fed seven days, during which time an accurate record was kept of the amount fed and the amount left uneaten; the dung was all collected, weighed, and sampled in the manner previously described. A sample for analysis was also taken from the stover left uneaten. The steer was exercised by being led around the barn-yard for a short time each day.

The table shows the results obtained, and if they be compared with the corresponding figures for the digestibility of the best corn-stover, it will be found that, while the total digestible nutrients of Kafir-corn are slightly less in amount, the digestible protein is somewhat larger, thus giving a narrower nutritive ratio, with probable equal value in feeding. It is superior in all nutritive respects to average field-cured corn-stover.

EXPERIMENT WITH KAFIR-CORN.

Since grains cannot be fed alone, the determination of their digestibility cannot be accomplished by as simple a means as that of those feeds that can be fed alone. They must be fed with a fodder of known digestibility, and the digestibility of the combination determined in the manner already described. Having ascertained the total amounts digested from the mixture, we subtract the amount furnished by the fodder, as calculated from its digestibility, from the total, and the difference is the amount furnished by the grain. In this case it is obvious that if feeding the grain with the fodder alters the digestibility of the fodder, an error will be introduced in our calculations of the digestibility of the grain, but this is the best that can be done at present.

In this experiment the grain fed was Red Kafir-corn ground to a fine meal. For roughage Kafir-corn stover was used, the digestibility of which had been determined in the preceding experiment. As in that, the preliminary feeding was one of seven days, and the actual experiment seven days also.

The steer was the same one as used in the preceding experiment. He was given five pounds of the meal and five pounds of stover at each feed, and was fed twice a day. He ate practically all of the meal, there being only eight-tenths of a pound left out of a total of seventy pounds. This amount being so small, it was not analyzed.

Table of Results in Digestion of Kafir-corn Stover.

	In the air-dry substances, as analyzed.							Totals, as fed	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Stover fed	7.72	10.58	6.25	5.84	29.15	44.39	1.91	.....	11.47	6.78	6.33	30.87	48.81	2.07	.....
Stover uneaten	9.79	7.94	4.94	4.56	31.19	44.28	1.83	.....	10.63	5.37	4.95	33.88	48.10	2.02	.....
Dung	9.86	15.74	8.50	8.26	24.42	39.47	2.01	.....	17.46	9.43	9.16	27.09	43.79	2.23	.....
AMOUNTS, IN POUNDS.															
Stover fed	.....	.....	.....	.....	.....	.....	.....	97.50	10.32	6.10	5.70	27.78	43.93	1.86	90.00
Stover uneaten	.....	.....	.....	.....	.....	.....	.....	14.00	1.38	0.70	0.64	4.40	6.25	0.26	13.00
Stover eaten	.....	.....	.....	.....	.....	.....	.....	83.50	8.94	5.40	5.06	23.38	37.68	1.60	77.00
Dung	.....	.....	.....	.....	.....	.....	.....	.....	5.06	2.71	2.64	7.80	12.61	0.64	28.80
Stover digested	.....	.....	.....	.....	.....	.....	.....	.....	3.88	2.69	2.42	15.58	25.07	0.96	48.20
PERCENTAGE DIGESTIBLE.															
Kafir-corn stover	.....	4.65	3.22	2.90	18.67	30.05	1.15	57.74	5.04	3.49	3.14	20.23	32.56	1.25	62.57
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Kafir-corn stover	.....	43.40	49.81	47.82	66.64	66.53	60.00	57.74	43.40	49.81	47.82	66.64	66.53	60.00	62.57

Table of Results in Digestion of Kafir-corn Meal Fed with Kafir-corn Stover.

	In the air-dry substances, as analyzed.							Totals, as fed	Calculated to the water-free substances.						
	Water	Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat		Ash	Crude protein	Pure proteids	Fiber	Nitrogen-free extract	Fat	Totals
PERCENTAGE COMPOSITION.															
Kafir-corn meal eaten	16.07	2.06	11.19	10.94	2.04	68.14	0.50	.....	2.45	13.33	13.04	2.43	81.19	0.60	.....
Kafir-corn stover fed with meal	7.72	10.58	6.25	5.84	29.15	44.39	1.91	.....	11.47	6.78	6.33	30.87	48.81	2.07	.....
Uneaten Kafir-corn stover	7.87	8.60	4.19	4.06	32.04	45.88	1.42	.....	9.33	4.55	4.41	34.78	49.80	1.54	.....
Dung	10.13	11.60	13.75	13.69	18.63	43.77	2.12	.....	12.91	15.30	15.23	20.73	48.70	2.36	.....
AMOUNTS, IN POUNDS.															
Kafir-corn meal eaten	.....	.....	.....	.....	.....	.....	.....	69.2	1.42	7.74	7.60	1.41	47.17	0.35	58.1
Kafir-corn stover fed	.....	.....	.....	.....	.....	.....	.....	70.0	7.41	4.38	4.09	19.94	31.53	1.34	64.6
Kafir-corn stover uneaten	.....	.....	.....	.....	.....	.....	.....	14.9	1.28	0.62	0.60	4.76	6.82	0.21	13.7
Kafir-corn stover eaten	.....	.....	.....	.....	.....	.....	.....	55.1	6.13	3.76	3.49	15.18	24.71	1.13	50.9
Total nutrients eaten	.....	.....	.....	.....	.....	.....	.....	124.3	7.55	11.50	11.09	16.59	71.88	1.48	109.0
Total nutrients excreted	.....	.....	.....	.....	.....	.....	.....	.....	4.72	5.48	5.45	7.42	17.43	0.84	35.9
Total nutrients digested	.....	.....	.....	.....	.....	.....	.....	.....	2.83	6.02	5.64	9.17	54.45	0.64	73.1
Nutrients digested from stover	.....	.....	.....	.....	.....	.....	.....	.....	2.57	1.78	1.60	10.30	16.57	0.64	31.9
Nutrients digested from meal	.....	.....	.....	.....	.....	.....	.....	.....	0.26	4.24	4 04	—1.13	37.88	0.00	41.3
PERCENTAGE DIGESTIBLE.															
Kafir-corn meal	.....	0.38	6.13	5.81	00.00	54.72	0.00	61.23	0.45	7.30	6.95	00.00	65.20	0.00	72.95
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Kafir-corn meal	.....	18.31	54.78	53.16	00.00	80.32	0.00	61.23	18.31	54.78	53.16	00.00	80.32	0.00	72.95

Examination of the table shows that the fat of the Kafir-corn meal is apparently entirely indigestible. In this respect it is markedly inferior to corn-meal, and it is also inferior to that feed in its percentage of digestible protein and carbohydrates.

EXPERIMENT WITH SOY BEANS.

The interest now being taken in soy beans in Kansas should make this experiment of more than usual interest to farmers. Because of the high percentage of protein contained in them and the comparative ease with which they may be grown, they promise to become one of the most valuable of the nitrogenous feeds available to Kansas farmers. A digestion experiment with them affords a reliable basis for estimating their value in comparison with other feeds rich in protein.

The beans were of the Early Yellow variety, and were fed as meal to the same steer that was used in the experiments with Kafir-corn stover and Kafir-corn grain. The meal was fed with Kafir-corn stover like that which had been used in the two experiments just described.

The steer did not relish the bean meal at first and refused to eat it, but by mixing it with Kafir-corn meal and gradually reducing the proportion of the Kafir-corn meal he was at length induced to eat about five pounds of pure soy-bean meal with five pounds of Kafir-corn stover at each feed. He was fed upon the meal for a few days at this rate, and then for seven, constituting the actual experiment. The results obtained are shown in the table.

These results are certainly of great interest and also of the highest importance to the feeder. They present the fact that soy-bean meal contains a higher percentage of digestible protein than any other feed except cottonseed-meal. Not only is this true, but it is very rich in fat, the most valuable food principle next to protein, and this fat is practically all digestible. The protein also has a very high digestion coefficient, while, on the other hand, the digestibility of the nitrogen-free extract is rather lower than that of most other concentrated foods. As carbohydrates can be obtained cheaply in nearly all other feeds, their deficiency is of little or no importance. The problem of securing cheap protein has been the most difficult one for Kansas feeders to solve, and the absence of it has probably caused more loss in feeding than any other one thing. Where alfalfa can be grown the problem has been solved; but there are still many localities where farmers have experienced extreme difficulty in getting alfalfa to grow, and in such cases the value of the soy bean should be quickly recognized. Next to alfalfa, soy beans will be the cheapest source of protein to the Kansas feeder, if he grows them upon his own land. They can

Table of Results in Digestion of Soy-bean Meal Fed with Kafir-corn Stover.

	In the air-dry substances, as analyzed.							Totals, as fed.	Calculated to the water-free substances.						
	Water	Ash	Crude protein.	Pure proteids.	Fiber	Nitrogen-free extract.	Fat		Ash	Crude protein.	Pure proteids.	Fiber	Nitrogen-free extract.	Fat	Totals
PERCENTAGE COMPOSITION.															
Soy-bean meal fed	8.88	5.37	40.06	37.62	5.02	25.10	15.57	.....	5.89	43.96	41.29	5.51	27.55	17.09	.....
Soy-bean meal uneaten	8.40	5.70	40.00	37.94	4.76	25.60	15.54	.....	6.22	43.67	41.42	5.20	27.94	16.97	.....
Kafir-corn stover fed	7.72	10.58	6.25	5.84	29.15	44.39	1.91	.....	11.47	6.78	6.33	30.87	48.81	2.07	.....
Kafir-corn stover uneaten	9.43	9.28	5.50	5.38	29.82	44.53	1.44	.....	10.25	6.07	5.94	32.92	49.17	1.59	.....
Dung	9.13	14.25	13.44	12.75	22.82	38.16	2.20	.....	15.68	14.79	14.03	25.11	42.00	2.42	.....
AMOUNTS, IN POUNDS.															
Soy-bean meal fed	.....	.....	.....	.....	.....	.....	.....	70.0	3.76	28.04	26.33	3.51	17.57	10.90	63.78
Soy-bean meal uneaten	.....	.....	.....	.....	.....	.....	.....	23.2	1.31	9.23	8.76	1.10	5.91	3.59	21.14
Soy-bean meal eaten	.....	.....	.....	.....	.....	.....	.....	46.8	2.45	18.81	17.57	2.41	11.66	7.31	42.64
Kafir-corn stover fed	.....	.....	.....	.....	.....	.....	.....	70.0	7.41	4.38	4.09	19.94	31.51	1.34	64.60
Kafir-corn stover uneaten	.....	.....	.....	.....	.....	.....	.....	32.5	3.00	1.78	1.74	9.64	14.39	0.47	29.27
Kafir-corn stover eaten	.....	.....	.....	.....	.....	.....	.....	37.5	4.41	2.60	2.35	10.30	17.14	0.87	35.33
Total nutrients eaten	.....	.....	.....	.....	.....	.....	.....	84.3	6.86	21.41	19.92	12.71	28.80	8.18	77.97
Dung	.....	.....	.....	.....	.....	.....	.....	.....	3.53	3.29	3.12	5.59	9.34	0.54	22.25
Total nutrients digested	.....	.....	.....	.....	.....	.....	.....	.....	3.33	18.12	16.80	7.12	19.46	7.64	55.72
Nutrients digested from Kafir-corn stover	.....	.....	.....	.....	.....	.....	.....	.....	1.78	1.23	1.11	7.15	11.50	0.44	21.10
Nutrients digested from soy-bean meal	.....	.....	.....	.....	.....	.....	.....	.....	1.55	16.89	15.69	—3.03	7.96	7.20	33.62
PERCENTAGE DIGESTIBLE.															
Soy-bean meal	.....	3.31	36.09	33.53	00.00	17.01	15.38	71.79	3.63	39.61	36.80	00.00	18.67	16.88	78.79
COEFFICIENT OF DIGESTIBILITY; *i. e.*, PERCENTAGE OF EACH NUTRIENT DIGESTED.															
Soy-bean meal	.....	63.27	89.79	89.19	00.00	68.27	98.49	71.79	63.27	89.79	89.19	00.00	68 27	98.49	78.79

be grown at a cost of from fifteen to eighteen dollars per ton, and, if valued on the amount of digestible protein furnished, a ton of soy beans is worth as much as one and one-third tons of linseed-meal, according to our digestion experiment. Results of other stations reduce this advantage somewhat, but they still leave soy beans worth more than linseed-meal.

SUMMARY.

In the succeeding tables the important data of the digestion experiments described in this bulletin are collected for easy reference. With these is given a table showing the digestibility of some common feeds most likely to be compared with the ones experimented upon. To facilitate this comparison, in stating our results we have included a column headed "carbohydrates." This includes the fiber and the nitrogen-free extract.

It will be seen that, with reference to alfalfa, all of our samples are better than the average composition given for comparison. Comparing these with each other, the higher percentage of protein in that cut at the earliest stage is the most striking and important factor, since the protein is the constituent that gives alfalfa its great value. Since early cutting of alfalfa also results in securing a greater tonnage during the season, the importance of carrying this idea into field practice cannot be too strongly insisted upon. The early-cut crop is superior to bran and shorts in digestible protein.

The buffalo-grass hay is very much superior to ordinary prairie hay of this region in its percentage of protein, and also far superior to timothy hay in this respect. In its carbohydrates and fat it is not much different from these. This, the first digestion experiment made with buffalo-grass, throws much light on its feeding value.

Kafir-corn stover is superior to field-cured corn-stover in the digestibility of all of its food principles, but Kafir-corn meal is noticeably inferior to corn-meal. The most striking feature in the results with the meal is the apparent entire indigestibility of its fat.

The soy-bean meal is seen to be one of our most concentrated feed stuffs, being scarcely inferior to cottonseed-meal in protein, and exceeding it in fat, and being considerably superior to old-process oil-meal in both these respects. In carbohydrates it is practically the same as cottonseed-meal, but is inferior to linseed-meal. If soy beans can be made to yield sufficiently well, they will become a most important factor in Kansas feeding.

The Station will continue its investigations upon the digestibility of the characteristic feeds of the state, especially those which have received little or no attention elsewhere.

TABLE showing coefficients of digestibility, or the percentage of each principle that is digestible, the total amount of a given principle being 100 per cent.

FEEDING STUFF.	Coefficient of digestibility: *i. e.*, percentage of each nutrient digested.							
	Ash.....	Crude protein..	Pure proteids..	Fiber.....	Nitrogen-free extract.....	Carbohydrates.	Fat.....	Total dry matter.....
Alfalfa hay, first stage.....	63.49	78.52	77.55	46.10	75.31	62.05	60.00	59.49
Alfalfa hay, second stage.....	56.91	75.14	72.05	50.44	71.99	61.74	30.39	58.29
Alfalfa hay, third stage.....	60.94	76.70	71.66	50.63	75.24	62.65	51.65	60.03
Buffalo-grass hay	6.04	54.39	57.70	64.65	61.71	62.75	62.41	50.08
Prairie hay.....	25.30	17.67	20.91	61.18	61.25	61.07	56.57	51.45
Kafir-corn stover.....	43.40	49.81	47.82	66.64	66.53	66.68	60.00	57.74
Kafir-corn meal	18.31	54.78	53.16	00.00	80.32	77.97	00.00	61.23
Soy-bean meal.....	63.27	89.79	89.19	00.00	68.27	56.57	98.49	71.79

TABLE Showing the percentages of digestible principles, or the pounds per 100 pounds, in the feeds named, the amount of the air-dry feed being 100 per cent.

FEEDING STUFF.	Water in the air-dry substance.....	Percentage of digestible constituents in the air-dry substances.							
		Ash.....	Crude protein..	Pure proteids..	Fiber.....	Nitrogen-free extract.....	Carbohydrates.	Fats.....	Total dry matter.....
Alfalfa hay, first stage....	8.77	6.10	13.24	10.89	13.24	26.02	39.26	0.89	59.49
Alfalfa hay, second stage,	7.71	5.33	11.90	9.14	15.79	24.88	40.67	0.39	58.29
Alfalfa hay, third stage...	8.29	4.74	10.43	7.86	15.99	28.18	43.17	0.69	60.03
Buffalo-grass hay.....	8.16	0.70	6.20	5.88	15.77	26.24	42.01	1.28	50.08
Prairie hay.....	9.07	1.97	0.61	0.74	17.76	29.14	46.90	1.97	51.45
Kafir-corn stover.....	7.72	4.65	3.22	2.90	18.67	30.05	48.72	1.15	57.74
Kafir-corn meal.....	16.07	0.38	6.13	5.81	00.00	54.72	54.72	00.00	61.23
Soy-bean meal	8.88	3.31	36.09	33.53	00.00	17.01	17.01	25.38	71.79

TABLE showing digestible food ingredients in pounds per 100 pounds of certain feeding stuffs. Adapted from Farmers' Bulletin No. 22, United States Department of Agriculture.

FEEDING STUFF.	Percentage of digestible constituents in the air-dry substances.			
	Water.	Protein.	Carbo-hydrates.	Fat.
Corn-stover, field cured	40.5	1.98	33.16	0.57
Timothy hay	13.2	2.89	43.72	1.43
Red-clover hay	15.3	6.58	35.35	1.66
Alfalfa hay	8.4	10.58	37.33	1.38
Corn	10.9	7.92	66.69	4.28
Oats	11.0	9.25	48.34	4.18
Wheat bran	11.5	12.01	41.23	2.87
Wheat shorts	11.8	12.22	49.98	3.83
Cottonseed-meal	8.2	37.01	16.52	12.58
Linseed-meal (old process)	9.2	28.76	32.81	7.06

SUGAR BEETS, 1891-1900.

WE PROPOSE, in this bulletin, to present a statement of the results of last season's experiments with sugar beets in this state in connection with this department, together with a summary upon the results of all previous work, and with the thought that this will be the last publication necessary upon this subject, at least for many years, from this Station.

RESULTS IN 1900.

Most of the beets grown last year were the product of a careful and systematic test of the eastern part of the Kansas river valley by some gentlemen interested in ascertaining definitely the probability of producing good beets there, before investing capital in attempts to manufacture sugar. The seed used was furnished by the department of agriculture, and was supposed to be of superior quality. The production of the beets was under the supervision of Mr. R. Hoodless, who was employed for the purpose by the gentlemen interested. The seed was delivered early enough to allow timely planting. The results are given in detail in the table, next page, *et seq.*

Table Showing Analyses of Sugar Beets Grown in 1900.

Serial No.	Name of grower.	Post-office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
72	Siegfried Thomas...	Bunker Hill.....	Russell...	May 2	Dark sandy loam..	Oct. 15	4	Medium..	0.70	0.61	1.053	13.05	9.28	71.1	72
82	John Perry.....	Bennington	Ottawa...	May 1	Black loam	Oct. 26	6	Poor	1.11	0.83	1.063	15.39	12.25	79.5	82
65	Andrew Wolfe	Solomon	Dickinson...	May 1	" clay	Oct. 13	6	"	0.76	0.69	1.053	13.05	9.58	73.4	65
63	Grant Campbell	Muscotah	Atchison,	Apr. 25	" loam	Oct. 12	6	Good	1.58	1.50	1.044	10.92	6.85	62.7	63
36	J. W. Brown.....	Wakarusa	Shawnee,	Apr. 7	" "	Sept. 18	6	Fair.....	1.12	0.95	1.053	13.05	10.18	78.0	36
32	J. R. Shirar.....	"	"	Apr. 15	" "	Sept. 18	6	"	1.50	1.15	1.056	13.76	10.75	78.1	32
62	W. L. Richardson ..	Fame	Greenwood ..	May 1	Upland prairie....	Oct. 11	6	"	1.27	1.05	1.053	13.05	7.98	61.1	62
19	J. E. Koffel	Fall	Leavenworth,	Apr. 6	Sandy loam.....	Sept. 17	6	"	1.31	1.11	1.064	15.62	12.43	79.6	19
30	G. Legeir.....	"	"	May 15	.....	Sept. 17	5	Poor	0.61	0.50	1.056	13.76	10.00	72.7	30
12	E. Bales.....	Linwood	"	May 12	Sandy loam.....	Sept. 14	6	"	1.16	0.97	1.056	13.76	10.54	76.6	12
15	J. Ludhope	"	"	Apr. 10	Heavy "	Sept. 14	6	Medium..	1.59	1.31	1.059	14.46	11.83	81.8	15
78	J. Ludhope	"	"	Apr. 10	" "	Oct. 20	6	Good	1.33	1.06	1.057	13.99	10.25	73.3	78
14	L. G. Thompson	"	"	Apr. 20	Sandy "	Sept. 14	6	Poor	0.89	0.78	1.050	12.35	9.62	78.7	14
76	L. G. Thompson	"	"	Apr. 20	" "	Oct. 20	7	Fair.....	1.01	0.81	1.037	9.24	6.49	70.2	76
10	O. W. Roberson	Lenape	"	May 10	" "	Sept. 14	6	Medium..	1.39	1.15	1.061	14.93	12.80	85.7	10
60	O. W. Roberson	"	"	May 10	" "	Oct. 8	6	Fair.....	1.27	0.83	1.063	15.39	12.81	83.2	60
70	O. W. Roberson	"	"	May 1	" "	Oct. 15	6	Medium..	1.47	1.16	1.054	13.30	10.03	70.5	70
58	Eben Baldwin	Lake View.....	Douglas..	Apr. 3	" "	Sept. 21	6	Fair.....	1.14	0.99	1.053	13.05	9.70	74.3	58
56	L. Bearman.....	"	"	Apr. 2	Poor sandy loam...	Sept. 21	6	Poor	0.98	0.86	1.059	14.46	11.23	77.7	56
57	Gus Brune	"	"	Apr. 12	Sandy loam.....	Sept. 21	6	Medium..	1.23	1.03	1.057	13.99	10.87	77.7	57
54	W. H. Brune.....	"	"	Apr. 5	" "	Sept. 21	6	Fair.....	1.14	0.98	1.056	14.46	10.96	75.8	54

Table Showing Analyses of Sugar Beets Grown in 1900—Continued.

Serial No.	Name of grower.	Post-office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
84	W. H. Brune	Lake View	Douglas	April 5	Sandy loam	Nov. 1	2	Good	0.81	0.78	1.052	12.82	7.07	55.1	84
53	E. St. Clair	"	"	April 15	" "	Sept. 21	6	Medium	1.26	1.13	1.057	13.99	10.93	78.1	53
52	J. H. Erbest	"	"			Sept. 20	6	Poor	1.10	0.91	1.058	14.23	10.23	71.9	52
39	J. Q. Adams	Lawrence	"		Black loam	Sept. 19	6	Medium	1.38	1.11	1.046	11.40	8.25	72.4	39
75	J. Q. Adams	"	"	April 15	Dark sandy loam	Oct. 18	6	Good	1.19	1.03	1.036	9.00	5.32	59.1	75
89	J. Q. Adams	"	"	April 15	" " "	Nov. 19	9	Fair	0.65	0.56	1.054	13.30	8.45	63.5	89
55	Wood Butler	"	"		Upland prairie	Sept. 21	6	Medium	1.22	1.01	1.057	13.99	9.41	67.3	55
20	J. H. Corel	"	"	Mar. 28	Sandy loam	Sept. 17	6	Good	1.69	1.31	1.054	13.29	9.76	73.4	20
45	G. F. Fouchs	"	"	April 15	Black "	Sept. 20	6	Medium	1.14	0.94	1.059	14.46	11.83	81.8	45
48	Wm. Fouchs	"	"	April 6	" "	Sept. 20	6	"	1.06	0.89	1.054	13.30	9.75	73.3	48
35	Indian school	"	"	April 12	" "	Sept. 18	6	Good	1.46	1.22	1.057	13.99	10.25	73.2	35
37	Indian school	"	"	June 12	Upland prairie	Sept. 18	6	"	1.24	0.77	1.053	13.05	9.22	76.7	37
34	Indian school	"	"	April 12	Black loam	Sept. 18	6	"	1.60	1.25	1.057	13.99	9.74	69.6	34
59	Wm. Gibson	"	"	April 3	Sandy "	Sept. 21	6		1.33	0.91	1.047	13.64	8.25	60.5	59
49	Fred Heck	"	"	May 15	" "	Sept. 20	6	Poor	1.02	0.84	1.058	14.23	10.88	76.5	49
71	Geo. Heck	"	"	May —	Light soil	Oct. 15	6	Medium	1.22	0.95	1.052	12.82	9.32	72.7	71
46	Phillip Heck	"	"	April 6	Black loam	Sept. 20	6	Poor	0.97	0.86	1.061	14.93	11.71	78.4	46
42	J. Herning	"	"	May 1	" "	Sept. 19	6	"	1.03	0.89	1.061	14.93	12.13	81.2	42
43	B. Heshon	"	"	Mar. 28	Sandy "	Sept. 19	6		1.43	1.09	1.050	12.35	8.11	65.7	43
64	A. Howden	"	"	May 20	" "	Oct. 12	6	Poor	1.62	1.55	1.041	10.20	6.57	64.4	64
18	J. W. Junkins	"	"	April 15	" "	Sept. 17	6	Good	1.76	1.39	1.056	13.76	10.30	74.9	18

Table Showing Analyses of Sugar Beets Grown in 1900 —*Continued.*

Serial No.	Name of grower.	Post-office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
83	J. W. Junkins.....	Lawrence.....	Douglas..	April 15	Sandy loam.....	Oct. 13	6	Fair.....	0.89	0.73	1.052	12.82	8.49	66.2	83
21	J. G. Kochring.....	"	" ..	April 5	" "	Sept. 17	6	"	1.36	0.93	1.061	14.93	12.31	82.2	21
26	C. F. Leonard.....	"	" ..	May 10	Dark "	Sept. 17	6	"	1.12	0.98	1.053	13.05	11.34	86.9	26
44	G. A. Loitt.....	"	" ..	April 7	Sandy "	Sept. 20	6	Good.....	1.56	1.31	1.059	14.46	10.61	73.4	44
23	F. Loman.....	"	" ..	April 4	" "	Sept. 17	6	Poor.....	0.94	0.74	1.046	11.40	8.20	71.9	23
33	Henry Manwaring..	"	" ..	April 12	Black "	Sept. 18	6	Fair.....	1.60	1.26	1.053	13.05	8.54	65.4	33
74	S. S. McCann	"	" ..	April 15	Sandy "	Oct. 18	6	Medium..	1.47	1.21	1.037	9.24	5.37	58.2	74
41	J. Phillips	"	" ..	April 20	" "	Sept. 19	6	Poor.....	1.04	0.76	1.052	12.82	9.22	71.9	41
51	T. F. Pine.....	"	" ..	May 20	.....	Sept. 20	6	"	0.77	0.68	1.061	14.93	12.25	82.1	51
50	W. A. Pine	"	" ..	May 15	Black loam	Sept. 20	6	Good.....	1.34	1.12	1.052	12.82	8.43	65.8	50
31	B. F. Smith	"	" ..	April 12	" "	Sept. 18	6	Medium..	1.19	0.97	1.054	13.29	9.70	73.0	31
88	B. F. Smith	"	" ..	April 12	" "	Nov. 19	3	Good.....	2.70	1.99	1.047	11.64	6.75	58.0	88
40	W. H. Smith	"	" ..	April 1	Sandy "	Sept. 19	6	"	1.48	1.04	1.050	12.35	8.22	66.6	40
80	W. H. Smith.....	"	" ..	April 15	" "	Oct. 23	14	Fair.....	0.82	0.77	1.046	11.40	7.32	64.2	80
38	Fred Strahan	"	" ..	May 1	Upland prairie	Sept. 18	6	Medium..	0.84	0.70	1.057	13.99	10.93	78.1	38
47	Eli Wilson	"	" ..	April 4	Black loam.....	Sept. 20	6	Fair.....	1.28	1.07	1.060	14.70	11.71	79.7	47
66	Jno. C. Wise	"	" ..	May 1	" "	Oct. 13	6	"	1.24	0.94	1.059	14.46	11.00	76.1	66
27	Earnest Koerner....	Eudora.....	" ..	April 5	Sandy "	Sept. 17	6	"	1.34	1.12	1.061	14.93	12.77	85.5	27
22	Henry Koerner.....	"	" ..	April 7	Rich sand loam....	Sept. 17	6	"	1.54	1.29	1.053	13.05	9.58	73.4	22
24	J. Roe.....	"	" ..	April 4	Loamy sand.....	Sept. 17	6	Medium..	1.45	1.25	1.059	14.46	10.97	75.9	24
29	J. Schleigel.....	"	" ..	May 15	Sandy loam.....	Sept. 17	6	" ..	1.00	0.86	1.063	15.39	12.20	79.3	29

Table Showing Analyses of Sugar Beets Grown in 1900—*Concluded.*

Serial No.	Name of grower.	Post-office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
79	J. Schleigel	Eudora	Douglas	May 15	Sandy loam	Oct. 20	6	Good	1.68	.....	1.056	13.76	9.85	71.6	79
25	O. W. Schleigel	"	"	May 12	" soil	Sept. 17	6	Poor	1.27	1.02	1.056	13.76	10.31	75.0	25
28	August Zeinzesnik	"	"	Apr. 17	" loam	Sept. 17	6	"	1.11	0.87	1.058	14.23	10.88	76.5	28
17	J. W. Kindred	Weaver	"	May 12	Light sandy loam	Sept. 17	6	Fair	1.32	1.02	1.058	14.23	11.26	79.2	17
1	J. J. Groves	Edwardsville	Wyandotte	Apr. 1	Heavy loam	Sept. 11	6	"	1.88	1.66	1.056	13.76	10.72	77.9	1
81	C. U. Magee	"	"	Mar. 28	Black sandy loam,	Oct. 24	6	Good	.....	0.91	1.052	12.82	9.20	71.7	81
86	C. U. Magee	"	"	Mar. 28	" " "	Nov. 9	6	"	1.81	.....	1.050	12.35	9.13	73.9	86
2	Edward Magee	"	"	Apr. 6	Sandy loam	Sept. 11	6	"	1.86	1.65	1.059	14.46	10.66	73.7	2
61	Chadwick & Son	Loring	"	May 1	" "	Oct. 8	6	"	1.60	1.29	1.060	14.70	11.63	79.0	61
4	Henry Ewing	"	"	Mar. 28	Light sandy loam	Sept. 12	9	Fair	1.02	0.83	1.047	11.64	9.57	82.2	4
3	John Fore	"	"	Apr. 5	Upland prairie	Sept. 12	9	Poor	0.95	0.78	1.060	14.70	11.86	80.7	3
6	John Phipps	"	"	Apr. 3	Sandy loam	Sept. 12	3	Good	3.89	3.35	1.058	14.23	11.03	77.5	6
67	John Phipps	"	"	Apr. 15	" "	Oct. 15	3	"	2.29	2.04	1.050	12.35	8.90	72.1	67
5	H. W. Rhea	"	"	Apr. 7	Heavy "	Sept. 12	6	"	1.94	1.71	1.054	13.29	10.67	80.3	5
68	H. W. Rhea	"	"	Apr. 7	" "	Oct. 15	6	Fair	1.74	1.20	1.037	11.64	5.19	44.6	68
11	Fred Thomas	De Soto	Johnson	May 5	Sandy "	Sept. 14	6	Medium	1.34	1.12	1.059	14.46	11.09	76.7	11
77	Fred Thomas	"	"	May 5	" "	Oct. 20	6	Poor	1.03	0.94	1.046	11.40	8.31	72.9	77
16	W. J. White	"	"	.....	Loam	Sept. 17	6	"	1.38	1.09	1.063	15.39	12.81	83.2	16
9	J. R. Blair	Wilder	"	Apr. 7	Sandy loam	Sept. 13	6	"	1.43	1.16	1.054	13.29	10.42	78.4	9
73	R. W. Blair	"	"	.....	.....	Oct. 15	2	Medium	1.38	1.35	1.047	11.64	7.86	67.5	73
8	L. G. Frisbee	"	"	Apr. 7	Sandy loam	Sept. 13	6	Poor	1.68	1.24	1.056	13.76	10.07	73.2	8
7	Glynn Bros.	"	"	Apr. 7	" "	Sept. 13	6	Fair	1.71	1.41	1.058	14.23	10.08	70.8	7
13	Henry Lee	Cedar Junction	"	May 6	" "	Sept. 14	6	Poor	1.11	0.91	1.056	13.76	11.20	81.4	13
69	Henry Lee	" "	"	May 6	" "	Oct. 15	6	"	0.51	0.41	1.045	11.16	7.87	70.5	69

In discussing the results obtained in the test made in 1900, it is proper to observe that the beets were mature at an early date, and that they deteriorated later. It is possible that if analyses had been made earlier than any were, better figures would have been obtained. On account of the loss of our saccharimeter, when the laboratory was burned, and the non-receipt of our new one, earlier analyses were impossible. The average results are very low. They are as follows, with which are included the results for the three previous years:

COMPARISON OF RESULTS OBTAINED.	1897.	1898.	1899.	1900.
Average gross weight, in pounds	1.51	1.45	1.13	1.32
Average net weight, in pounds	1.09	1.12	0.87	1.08
Average specific gravity of juice.....	1.064	1.06	1.059	1.054
Average total solids in the juice.....	15.52	14.71	14.54	13.37
Average percentage of sugar in the juice,	11.88	11.56	10.89	9.89
Average coefficient of purity of the juice,	76.10	77.80	73.40	72.7

The seed used was furnished by the United States department of agriculture, and was distributed free through the mails, the samples of beets for analysis being collected in the same way. Five varieties of seed were used, which, with their distribution numbers, were as follows:

No. 3941, Vilmorin, from France.

No. 3942, Zehringen, Strandes, Germany.

No 3943, Kleinwanzlebener, Mrozinski No. 1, Russia.

No. 3944, Kleinwanzlebener, Dippe, Germany.

No. 4416, Kleinwanzlebener, Mrozinski No. 2, Russia.

The kind of seed used by each grower is not shown in the table, but is recorded in the department, and the following table shows the average percentage of sugar and the coefficient of purity obtained with the several varieties named:

Distribution number.	Samples analyzed.	Average percentage of cane sugar in the juice.	Average coefficient of purity.
3941	14	9.71	73.3
3942	14	9.22	70.4
3943	12	9.13	69.5
3944	20	10.44	76.1
4416	4	10.65	79.4

THE BEST RESULTS OF ALL PREVIOUS YEARS.

To provide the data for forming an intelligent judgment concerning the possibilities of establishing the beet-sugar industry in Kansas, we have collected here all of the analyses made in previous years in which the sugar was as high as fourteen per cent. The table which follows exhibits these.

Table Giving Analyses of all Samples of Beets Analyzed at the Station, 1891 to 1899, in which the Percentage of Sugar was above 14.

Serial No.	Name of grower.	Post-office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
				1891.											
....	W. O. Whipple	Lenora	Norton	Apr. 15	Sandy loam		....		1.51	1.14	1.087	20.8	15.89	76.0	....
....	Wm. Totton	Mankato	Jewell	May 15	Loam		....	Good	1.51	1.34	1.079	19.0	15.97	84.0	....
....	J. W. Allen	La Crosse	Rush				....		1.11	0.95	1.075	18.1	15.64	86.0	....
....	J. B. Miller	Great Bend	Barton	May —	River bottom		....	Stumpy	2.02	1.76	1.078	18.8	15.63	83.0	....
....	J. B. Miller	"	"	May —	"		....	Fair	1.22	1.05	1.075	18.1	14.98	83.0	....
....	J. B. Miller	"	"	May —	"		....	Stumpy	2.11	1.78	1.078	18.8	16.42	87.0	....
....	J. B. Miller	"	"	May —	"		....	"	1.47	1.23	1.080	19.3	16.65	86.0	....
....	J. B. Miller	"	"	May —	"		....	Fair	1.52	1.22	1.078	18.8	16.03	85.0	....
....	J. F. Willard	Wabaunsee	Wabaunsee	May 5	Heavy loam		....	"	0.58	0.32	1.069	16.8	14.19	84.0	....
....	R. W. Brown	Wall Street	Linn	May 13	Loam, subs. limes		....	Poor	0.88	0.77	1.085	20.4	16.06	79.0	....
....	Addison Sleeth	Humboldt	Allen	May —	Red loam		....		0.50	0.31	1.089	21.3	17.60	83.0	....
....	D. A. Van Nice	"	"	May 6	Sand, clay subs		....		0.77	0.57	1.094	22.4	18.78	84.0	....
....	A. W. Dwinell	"	"	May 12	Loam, clay subs		....		0.48	0.37	1.089	21.3	16.97	79.0	....
				1892.											
....	J. W. Graham	Zurich	Rooks	May 16	Upland prairie		....	Fair	1.10	0.90	1.089	21.28	17.50	82.0	....
....	J. W. Graham	"	"	May 16	" "		....	Excellent	1.20	0.90	1.099	23.53	17.90	76.0	....
....	P. Mersereau	Kalvesta	Finney	Apr. 21	Dark, sandy		....	Good	1.60	1.30	1.077	18.58	14.60	78.0	....
....	W. C. Dunker	Offerle	Edwards	May 15	Sandy loam		....	"	0.70	0.50	1.083	19.93	16.40	82.0	....
....	J. G. Binder	Waterville	Marshall	May 18	Upland prairie		....	Fair	1.80	1.30	1.075	18.01	14.30	79.0	....
....	J. Miller	Ramona	Marion		Heavy		....	Poor	1.28	1.00	1.077	18.58	15.70	84.0	....
....	M. M. Maxwell	Valley Falls	Jefferson	Apr. 27	Light, sandy		....	Good	0.83	0.70	1.070	16.98	14.60	86.0	....

Table Giving Analyses of all Samples of Beets Analyzed at the Station, 1891 to 1899, in which the Percentage of Sugar was above 14—*Continued.*

Serial No.	Name of grower.	Post office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
....	Ed. Pape.....	Topeka.....	Shawnee..	.....	.....	.....	....	Good.....	0.80	0.70	1.076	18.35	14.90	81.0	....
....	S. Tripp.....	Ottawa.....	Franklin,	May —	Gravelly loam.....	.....	....	Fair.....	0.20	0.16	1.081	19.48	15.70	81.0	....
				1893.											
....	J. B. Miller.....	.....	Barton...	.....	Sandy	.....	....	.....	1.32	1.10	1.077	18.58	14.57	73.0	....
				1897.											
152	Wm. Ford.....	Garden City	Finney...	May 1	Black loam	Dec. 8	6	Good.....	1.54	1.16	1.079	19.04	14.04	74.0	152
139	T. W. Marshall	Ulysses.....	Grant	May 22	Sandy alkaline.....	Nov. 24	6	Fair.....	1.21	1.03	1 082	19.71	15.47	78.0	139
142	Spiring Kresky	Minneapolis	Ottawa...	May 1	Black loam	Nov. 26	9	"	0.94	0.74	1.074	17.90	14.84	83.0	142
2	A. W. Gibson.....	Blue Rapids	Marshall,	April 15	Upland, rich.....	Oct. 28	10	"	2.39	1.81	1.069	16.77	14.18	85.0	2
155	Jacob S. Wolfe.....	Salina.....	Saline....	May 5	Black loam	Dec. 20	6	"	0.46	0.38	1.092	21.93	18.10	82.0	155
96	W. J. McColm.....	Waveland.....	Shawnee..	May 15	" "	Nov. 18	11	Good.....	0.87	0.68	1.074	17.90	15.77	88.0	96
83	T. J. Samuels.....	Wilsey.....	Morris....	.....	Black.....	Nov. 16	6	Poor.....	1.49	1.08	1.082	19.71	14.75	75.0	83
157	Wm. Barnett.....	Medicine Lodge..	Barber...	April 15	Black loam	Dec. 20	7	Fair.....	0.76	0.63	1.086	20.60	15.14	73.0	157
158	Jas. Benning.....	"	"	April 19	" "	Dec. 20	7	"	1.05	0.82	1.085	20.38	14.69	72.0	158
135	J. F. Swartsel.....	Admire.....	Lyon	April 24	" "	Nov. 23	8	"	1.06	0.78	1.077	18.58	14.93	80.0	135
124	A. S. McCully	Pontiac	Butler....	May 1	Dark mellow.....	Nov. 22	4	"	1.46	1.09	1.074	17.90	14.05	78.0	124
103	W. A. Mintier.....	Tonganoxie	Leavenworth..	May —	Heavy black	Nov. 19	4	Good.....	0.54	0.44	1.066	16.08	14.05	87.0	103
153	S. D. Gratigny	Loring	Wyandotte ..	May 15	Sandy limestone...	Dec. 8	4	"	1.35	0.89	1.078	18.81	14.11	75.0	153
156	C. E. Pincomb	Hector	Johnson..	May 5	Loose black.....	Dec. 20	6	"	1.75	1.35	1.072	17.45	14.08	80.0	156
112	F. E. Uhl.....	Gardner.....	"	May 12	Black loam	Nov. 20	8	Fair.....	1.12	0.94	1.068	16.54	14.29	86.0	112
59	F. G. Richmond.....	Hall's Summit...	Coffey....	May 15	" "	Nov. 11	4	Good.....	1.54	1.28	1.079	19.04	15.13	78.0	59

Table Giving Analyses of all Samples of Beets Analyzed at the Station, 1891 and 1899, in which the Percentage of Sugar was above 14—*Continued.*

Serial No.	Name of grower.	Post-office.	County.	Date of planting.	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
				1897.											
143	John Dame	Howard	Elk	May 12	Limestone	Nov. 26	4	Fair	1.28	1.03	1.072	17.45	14.73	84.0	143
106	W. J. Burtis	Fredonia	Wilson	May 1	Clay loam	Nov. 20	6	"	1.56	1.31	1.073	17.68	14.35	81.0	106
148	J. H. Bayer	Yates Center	Woodson,	June 15	Sandy upland	Dec. 1	10	"	0.53	0.41	1.081	19.49	14.32	73.0	148
				1898.											
65	C. H. Price	Jaqua	Cheyenne,	Apr. 10	Black loam	Oct. 29	6	Good			0.62	1.071	17.22	14.81	86.0	65
90	T. J. Flanagan	Poe	Logan	May 12	"	Nov. 4	6	"	1.02	0.85	1.080	19.26	14.75	77.0	90
21	J. W. Longstreth	Lakin	Kearny	Apr. 12	Sandy loam	Oct. 1	6	"	1.67	1.53	1.073	17.68	16.30	92.0	21
37	J. W. Longstreth	"	"	Apr. 12	"	Oct. 19	6	"	1.71	1.46	1.071	17.22	14.67	85.0	37
85	J. W. Longstreth	"	"	Apr. 12	"	Nov. 3	10	"	1.66	1.37	1.074	17.90	14.49	81.0	85
57	H. G. Nicholls	"	"	June 1	Sandy marl	Oct. 26	6	Fair	0.89	0.79	1.077	18.58	16.18	87.0	57
106	J. H. Sargent	Cora	Smith	Apr. 20	Upland prairie	Nov. 17	6	Poor	0.79	0.64	1.087	21.05	16.89	80.0	106
38	Herman Constein	Hanover	Washington,	May 6	Sandy loam	Oct. 19	6	Fair			1.38	1.069	16.77	14.41	86.0	38
74	P. Haverty	"	"	May 15	Bottom land	Nov. 1	3	Good	1.48	1.30	1.072	17.45	15.28	86.0	74
6	A. Munger	Hollis	Cloud	Apr. 29	Sandy clay	Sept. 24	6	"	0.67	0.57	1.079	19.04	17.21	90.0	6
23	A. Munger	"	"	Apr. 29	"	Oct. 4	6	Fair	0.65	0.55	1.074	17.90	16.59	93.0	23
81	A. Munger	"	"	Apr. 29	"	Nov. 2	10	"	0.58	0.43	1.072	17.45	14.96	86.0	81
107	M. M. Sherman	Geneseo	Rice	Apr. 20	Upland, hard subsoil	Nov. 19	2	Poor			2.52	1.074	17.90	15.29	85.0	107
49	J. R. Clinton	Hutchinson	Reno	May 13	Sandy loam	Oct. 24	6	"	0.96	0.87	1.073	17.68	15.81	90.0	49
26	Robert Moulds	Halstead	Harvey	Apr. 20	Sandy	Oct. 6	6	Medium	1.40	1.18	1.073	17.68	14.96	85.0	26
82	Robert Moulds	"	"	Apr. 20	"	Nov. 2	8	Good	1.80	1.29	1.068	16.54	14.76	89.0	82
109	Chas. Lambky	Waco	Sedgwick,	Apr. 12	Sandy loam	Nov. 25	10	Fair	0.98	0.85	1.072	17.45	14.84	85.0	109

Table Giving Analyses of all Samples of Beets Analyzed at the Station, 1891 to 1899, in which the Percentage of Sugar was above 14—*Concluded.*

Serial No.	Name of grower.	Post-office.	County.	Date of planting. *1899.*	Kind of soil.	Date of analysis.	No. beets.	Form of beets.	Average wt. in pounds.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity of juice.	Serial No.
									Gross.	Net.					
19	L. B. Bell	Winchester	Jefferson,	May 10	Sandy loam	Oct. 30	6	Fair	0.84	0.67	1.070	17.00	14.46	85.1	19
24	Peter Carey	Barrton	Harvey	June 1	Black clay	Nov. 9	6	Good	1.46	1.34	1.078	18.81	14.11	75.0	24
27	Abraham Dick	"	"			Nov. 9	6	Medium	0.53	0.47	1.073	17.68	15.72	88.9	27
16	Homer Brown	Arkansas City	Cowley	May 1	Black loam	Oct. 26	6	Fair	1.40	0.73	1.076	18.36	15.30	83.4	16
5	E. D. Kramer	LaHarpe	Allen	June 1			2	Poor	0.46	0.41	1.079	19.04	15.36	80.6	5
32	R. Ewing	Godfrey	Bourbon	May 25	Black loam	Nov. 9	6	Medium	0.25	0.20	1.071	17.22	14.17	82.3	32
31	A. Hunley	Fort Scott	"	May 25	"	Nov. 9	5	"	0.45	0.38	1.067	16.31	14.05	86.2	31

CONCLUDING STATEMENTS.

Study of the preceding tables can be intelligently done only by comparing the results with those obtained at other places. The sugar journals reported the production of beets last season, with percentages of sugar, as follows, at the places named: New York, 10 to 17.65; Nebraska, 13.5; Indiana, 13.7; Michigan, 14 to 15; Washington, 18; California, 17; Colorado, 17 to 22. The average results obtained in Kansas during the last four years have been lower than in any of the states quoted. It is not too much to say that unless beets can be grown with a considerable degree of certainty, that are better than ours have averaged, it is a waste of capital to attempt to establish the beet sugar industry in this state.

If we turn to the table showing the best results that have been attained in the state within the last ten years, it will be seen that many samples have been grown of high sugar content. If such beets as these could be produced uniformly, there would be no question of the possibility of their successful conversion into sugar.

What then should be our attitude on the general question? It seems clear that capital should embark in this industry with great caution. A careful test of the beet-producing capacity of a given locality should be made before spending much money, not only with a view to determining the soil and climatic relations, but the adaptability of the population to the intensive agriculture which must accompany beet culture. That the soil and climate of the state are not uniformly adapted to this crop is evident. Success will doubtless depend largely upon the wisdom with which the locality is chosen.

In an important respect, the climate of the eastern half of Kansas seems to be illy adapted to the production of beets rich in sugar. Spring and early summer rains produce a vigorous growth of the plants, but with almost unfailing regularity, July and August include a period of scanty rainfall, if not real drouth. During this time the beets are checked in growth, and ripening is promoted, with its accumulation of sugar. With the advent of the fall rains, however, a fresh growth is stimulated, and the beets, instead of continuing the elaboration of sugar, are more apt to use some of that already formed, in the production of new leaves.

Our climate cannot be materially modified. It seems to the writers that the only part of the state which offers real climatic advantages for sugar-beet production is the western, where the natural rainfall would be entirely insufficient, and the irrigation water applied could be gauged to the seasonal requirements of the crop.

Sugar beets, as hinted above, are properly a factor in intensive agriculture. Much labor must be put upon the land. The expense of

irrigation, considering the value of the crop, is much less relatively than with field crops of the ordinary kind. A number of farmers are growing beets experimentally the present season in the western part of the state, and their experience will doubtless be of great value to that region.

A final word as to the attitude of the Station in respect to experimentation with sugar beets. Many say that because the climatic conditions are known to be unlike those that have been found most favorable to the production of beets in Europe, the Station should not expend any of its funds in trials which will in all probability not lead to the establishment of the beet industry here. There is, however, another aspect of the question. Sugar factories are extremely expensive, running up into the hundreds of thousands of dollars in cost, and large ones are the most economical to work. We regard it as no less a function of the Station to save the state from loss, than it is to point a way to direct gain, and it is not improbable that the results of our tests upon this point alone have saved as much as the entire cost of the Station during its existence. Saving money is accompanied by less hurrahing than spending it, but the permanent prosperity of a people, or of an individual, depends quite as much upon the former as upon the latter.

We do not anticipate that it will be necessary to issue another formal bulletin upon the subject of sugar beets, but the Station stands ready now, as heretofore, to make such analyses as the people of the state desire in this line in all cases where five or more farmers of a locality unite to test its capacity to produce beets rich in sugar, and directions for culture, and as far as possible seed will be furnished for this purpose.