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EXPERIMENTS IN PIG FEEDING.

This article gives results of experiments in feeding pigs in 1888, 1889, and 1890. These experiments are reported in full or in part:

No. 60. Feeding Value for Pigs of Corn, Corn and Grass, and Grass.

No. 87. Comparative value of Soaked and Dry Corn.

No. 27. Value in Feeding Pigs of Droppings from Cattle.

No. 113. Apple Pomace, Methods of Preserving, and Feeding Value for Pigs.

Corn is the great fattening food for pigs in a large part of the United States. In eight trials in which corn only was fed, aside from salt and coal slack, pigs varying in average weight from 65 to 290 lb. and kept in pens or small lots without grass, gained at the rate of from 10.46 lb. to 14.73 lb. per bushel, 56 lb. shelled corn, the average gain being 12.36 lb. The rate of gain for food eaten, and the food eaten in proportion to weight decreased after four or six weeks feeding with corn only. The corn eaten per day varied from 3.41 lb. eaten by pigs averaging 65.58 lb. to 10.71 lb. eaten by pigs weighing 311 lb. The corn eaten per day per 100 lb. live weight varied from 1.95 lb. eaten by pigs fed 84 days and averaging 207 in weight, to 5.19 lb. eaten by pigs averaging 65.58 lb. In one case in the fourth week of pen feeding two pigs gained 3.21 lb. each per day—at the rate of 16.81 lb. per bushel of corn. This was the greatest gain per day and was also the best rate of gain in any trial. There seemed to be no constant relation between the weight of the pigs or the season of the year and the food eaten or the gains made.

In four trials, pigs fed all they would eat of shelled corn with blue grass pasture ate 4,216.5 lb. of corn and gained 905 lb., which was at the

rate of 12.04 lb. gain per bushel of corn. Pigs under like conditions, except that they were fed but half as much corn, ate 2,190 lb. of corn and gained 505 lb, which was at the rate of 12.93 lb. per bushel. Pigs in dry lots fed shelled corn ate 4,207 lb of corn and gained 790.5 lb., which was at the rate of 10.52 lb. per bushel.

After periods varying from six to nine weeks, the pigs which had been fed a half ration of corn on pasture, were given a full feed of corn, the others being fed as before. In three trials lasting four or five weeks each, the pigs which had had a full feed of corn throughout ate 1,796 lb. of corn and gained 329 lb., which was at the rate of 10.11 lb. per bushel. Those which had been fed a half feed of corn in the first part of the trials ate 2,075.5 lb. of corn in the second part and gained 462.5 lb., which was at the rate of 12.5 lb. per bushel. Those fed corn only ate 1,624.5 lb. of corn and gained 224 lb., which was at the rate of 7.44 lb. per bushel.

In two trials pigs fed soaked corn ate more and gained more than those fed dry corn. In one trial they gained more and in one less in proportion to food eaten than those fed dry corn. The differences were not great in either case.

Two pigs in a two-acre pasture in which three yearling steers were fed corn gained in 24 weeks 195 lb. In a second trial two pigs with like conditions gained 231 lb. in 31 weeks. In neither case was the gain large. In each case the pigs at the close of the trial were in good condition for full feeding and made large gains when so fed.

A trial of apple pomace as food for pigs resulted unsatisfactorily. The pomace kept well; chemical analysis of it showed an apparently good composition for feeding purposes; but the pigs ate very little of the pomace.

Experiment No. 60. Feeding Value of Corn, of Corn and Grass, and of Grass for Pigs.

Four trials were made during 1888, 1889, and 1890 to compare the results in pig feeding of giving corn only, and a full or partial ration of corn with grass. In one trial a set of pigs had no other food than grass. In all cases coal slack and salt were supplied. In the first trial the pigs were kept in pens one rod square, these being moved as necessary. In the later trials the pigs with grass were kept in lots containing one-quarter acre each of blue grass sod of ten years' standing. The pigs fed corn only were kept in lots as nearly as possible free from vegetation. The pigs were Poland-Chinas nearly alike in age and weight in each trial; but the lots selected for the several trials differed considerably, as shown by the average weights at the commencement of each trial, which were 45, 178, 128, and 61 lb., respectively.

The summer of 1888 was characterized by unusual drought. Grass grew little and was in poor condition in the latter part of the season. Under these conditions three pigs, lot G, with no other food than grass,

lost 27.5 lb. from July 20th to Sept. 10th, losing nearly all of this during the first 10 days. With full feed of corn these pigs gained 54.5 lb. in four weeks, which was less than the gain of either of the other lots in the experiment. Probably older pigs would have done better, but it seemed so evident that it is unprofitable to confine pigs to a grass diet solely, that further trials were not made.

During the same season, for the six weeks from July 30th to Sept. 10th, the three pigs, lot H, with a full feed of corn with grass ate 412.5 lb. of shelled corn and gained 114 lb., which was a gain of one pound for 3.61 pounds of corn eaten. The three in lot I, which received a half feed of corn with grass, ate 223 lb. corn and gained 59.5 lb.—one pound of gain for 3.74 lb. corn eaten. Three in lot K, which received a full feed of corn, but without grass, ate 430.5 lb. of corn and gained 97.5 lb—one pound gain for 4.41 lb. corn eaten. By cutting the grass from a square rod of land adjoining the pens each time they were moved, 376 lb. fresh grass, containing 200 lb. dry matter were obtained. This shows approximately the quantity of grass to which the pigs in each of the lots, H and I, had access.

For the four weeks from Sept. 10th to Oct. 8th all the pigs were given all they would eat of new corn. Lot G gained 54.5 lb.; lot H, 64.5 lb.; lot I, 77.5 lb.; lot K, 66.5 lb. The quantity of corn eaten was not determined.

In 1889 the three pigs of lot B with a full feed of corn and grass, in eight weeks from June 17th to August 12th, ate 788 lb. of corn and gained 136 lb., which was one pound of gain for 5.79 lb. of corn. The three of lot C with a half feed of corn on grass ate 391 lb. of corn and gained 36 lb., which was one pound gain for 10.86 lb. corn. The three of lot A with a full feed of corn, but without other food, ate 668 lb. of corn and gained 90.5 lb., which was one pound gain for 7.38 lb. corn. For the four weeks from Aug. 12th to Sept. 9th this experiment was continued, with a full, instead of a half feed of corn to pigs of lot C. During this period lot B ate 412 lb. of corn and gained 81 lb., which was one pound gain for 5.08 lb. corn. Lot C ate 401 lb. corn and gained 91 lb., which was one pound gain for 4.4 lb. corn. Lot A, ate 354 lb. of corn and gained 60.5 lb., which was one of grain for 5.85 lb. corn. These results are quite noticeable, in that each lot made better gains, actual and relative, than in the earlier period. The pigs which had had a half feed of corn with grass during the previous eight weeks made the best gain. The pigs without grass ate less than those with corn and grass, but made a fair gain.

In 1890, in eight weeks, from May 5th to June 30th, five pigs, lot B, with full feed of corn and pasture ate 1,665 lb. of corn and gained 363.5 lb., which was one pound gain for 4.58 lb. corn. The five, lot C, with half feed of corn and pasture ate 842 lb. corn and gained 202 lb., which was one pound gain for 4.16 lb. corn. The five, lot A, with a full feed of corn without grass ate 1,795.5 lb. corn and gained 389.5 lb., which was one pound gain for 4.61 lb. corn.

For the four weeks from June 30th to July 28th, during which lot C had a full feed of corn, the same as lots A and B, lot A ate 772 lb. of corn and gained 119.5 lb., which was one pound gain for 6.46 lb. corn. Lot B ate 747 lb. corn and gained 130.5 lb., which was one pound of gain for 5.72 lb. corn. Lot C ate 764 lb. of corn and gained 165 lb., which was one pound of gain for 4.63 lb. corn.

The results in this trial were noticeable in that during the first period of eight weeks the pigs without grass made larger gain than those with a full feed of corn and grass and with almost exactly the same rate of gain for corn eaten.

The fourth trial was commenced Sept. 1, 1890, and continued 14 weeks, until Dec. 8th. For the first nine weeks the four pigs in lot B, with a full feed of corn and pasture, ate 1,351 lb. of corn and gained 291.5 lb., which was one pound gain for 4.64 lb. corn. The four in lot C, with a half feed of corn and pasture, ate 734 lb. of corn and gained 207.5 lb., which was one pound of gain for 3.53 lb. corn. The four in lot A, with a full feed of corn without other food, ate 1,313 lb. of corn and gained 213 lb., which was one pound gain for 6.16 lb. corn.

From Nov. 3d all the pigs had a full feed of corn. Nov. 10th one of the pigs in lot B was injured in weighing and was removed. In the five weeks to Dec. 8th this lot ate 637 lb. of corn and gained 115.5 lb., which was one pound gain for 5.51 lb. corn. The four pigs in lot C ate 910.5 lb. of corn and gained 206.5 lb., which was one lb gain for 4.4 lb. corn. The four pigs in lot A ate 498.5 lb. of corn and gained 44.5 lb., which was one pound gain for 11.2 pound corn.

In this trial the pigs with a half feed of corn did better than in any other of the trials. Those fed corn only showed the bad effects of long continued feeding of this kind more decidedly than those under like feeding in either of the other trials. The weather was mild and the blue grass continued to furnish a fair quantity of food until the close of the trial.

A summary of these trials is given in the table opposite.

Gain from Dry Corn only.

A summary of the results from feeding 11 different lots of pigs in different years and at different seasons with shelled corn, without other food except coal slack and salt, is given in the second table opposite.

These pigs were fed as check lots, or means of comparison in experiments designed to test comparative value of other foods. The results with lots Nos. 1, 2, and 11 are given for different periods.

Among pig feeders in the central western states a gain of 10 lb. per bushel, 56 lb. of shelled corn, is commonly considered satisfactory. It will be noticed that in 11 of the 16 trials reported this gain was exceeded. Only four of the 11 lots fell below this gain at any period of the trials reported. The largest gain was 16.81 lb. per bushel by two pigs averaging 311 lb. in the fourth week of pen feeding. These two pigs had been on grass with access to the droppings from two corn-fed heifers. When

TABLE SHOWING IN POUNDS THE TOTAL GAIN, THE CORN FED, AND THE POUNDS OF CORN FED FOR EACH POUND GAINED DURING BOTH PERIODS OF EACH OF THE FOUR TRIALS.

First Period.

No. of Trial.	Lots given full feed of corn with grass.			Lots given half feed of corn with grass.			Lots given corn only.		
	Gain.	Corn.	Rate.	Gain.	Corn.	Rate.	Gain.	Corn.	Rate.
1	114	412.5	3.61	59.5	223	3.74	97.5	430.5	4.41
2	136	788	5.79	36	391	10.86	90.5	668	7.38
3	363.5	1665	4.58	202	842	4.16	389.5	1795.5	4.6
4	291.5	1351	4.64	207.5	734.	3.53	213	1313	6.16
Total	905	4216.5	4.65	505	2190	4.33	790.5	4207	5.32

Second Period.

No. of trial.	Same as above.			Lots given full feed of corn with grass.			Same as above.		
	Gain.	Corn.	Rate.	Gain.	Corn.	Rate.	Gain.	Corn.	Rate.
1	*64.5	.....	.....	*77.5	.....	.....	*66.5	.....	.....
2	81	412	5.08	91	401	4.4	60.5	354	5.85
3	130.5	747	5.72	165	764	4.63	119	772	6.46
4	115.5	637	5.51	206.5	910.5	4.4	44.5	498.5	11.2
Total	327	1796	5.49	462.5	2075.5	4.48	224	1624.5	7.25

*Not included in totals.

TABLE SHOWING RESULTS OF FEEDING CORN ONLY TO PIGS.

No. of lot.	Time of feeding.	No. of days.	No. of pigs.	Average weight of pigs.	Gain per day.	Food per day.	Pounds of food for one pound gain.	Pounds of gain per bu. of corn fed.	Pounds of corn fed per 100 lb of weight.
1	Nov. 24 to Dec. 29	35	2	290.37	2.56	10.48	4.18	13.39	3.69
1	Nov. 24 to Dec. 22	28	2	284.37	2.7	10.34	3.82	14.66	3.63
1	Dec. 15 to Dec. 22	7	2	311	3.21	10.71	3.33	16.81	3.44
2	May 5 to June 2	28	5	153.3	1.39	6.07	4.37	12.81	3.96
2	June 2 to June 30	28	5	192.25	1.38	6.73	4.84	11.57	3.5
2	June 30 to July 28	28	5	223.65	.85	5.51	6.46	8.66	2.46
3	April 29 to May 27	28	2	209.37	1.4	5.34	3.8	14.73	2.55
4	June 10 to July 22	42	2	211.62	.9	4.81	5.35	10.46	2.27
5	July 30 to Sept. 10	42	3	65.58	.77	3.41	4.41	12.69	5.19
6	June 17 to Sept. 9	84	3	207.16	.6	4.05	6.76	8.28	1.95
7	Dec. 30 to Feb. 4	56	5	108.9	.51	4.13	8.08	6.93	3.79
8	Jan. 24 to Feb. 21	28	6	105.62	1.05	4.88	4.65	12.04	4.62
9	Nov. 22 to Jan. 4	42	2	209.5	1.3	6.55	5	11.2	3.12
10	Jan. 17 to Feb. 21	35	4	191.87	1.29	5.95	4.6	12.17	3.1
11	Nov. 3 to Dec. 15	42	3	120.25	.74	4.49	6.05	9.25	3.73
11	Dec. 15 to Dec. 22	7	3	137.58	.55	3.43	6.2	8.94	2.49

put in the pen, Nov. 24th, they were in fair flesh. Contrary to usual experience they made the best gain in the fourth week after being put in pen, gaining 3.21 lb. per day and at the rate of 16.81 lb. per bushel. For

four weeks their gain was at the rate of 14.66 lb. per bushel. In only one other case was this equaled in a period of four weeks. Two pigs, averaging 209.27 lb., fed from April 29th to May 27th, gained at the rate of 14.73 lb. per bushel. In no case did pigs make satisfactory gains after six or eight weeks feeding on corn alone. This is illustrated in the case of lot 2, which during the first period of four weeks gained at the rate of 12.81 lb. per bushel; during the third period at rate 8.66 lb. per bushel. The four lots, the gain of which is reported for first four weeks of pen feeding, averaged in gain 13.56 lb. per bushel, which was one pound gain for 4.12 lb. corn eaten.

The food eaten per day per 100 lb. weight varied remarkably—from 1.95 lb. to 5.19 lb. The latter was by the youngest and lightest pigs used in any of the trials; averaging 65.58 lb. weight. The four lots eating least in proportion to weight varied in average weight from 137 lb. to 223 lb. In two of these cases the pigs had been fed several weeks, the pigs eating less, although having greater weight than in the first part of the trial.

The food required to make one pound of increase in weight in these trials depended less on the weight and age of the pigs than on other conditions. For periods of four to six weeks the greatest gain in proportion to weight was made by pigs averaging 311 lb.; the next greatest by a lot averaging 209 lb.; the next by a lot averaging 153 lb.; the next by a lot averaging only 65 lb. The least gain for periods of six weeks was by a lot averaging 223 lb.; the next smallest was by a lot averaging 120 lb.

Experiment No. 87. Comparative Value of Soaked and Dry Corn in Pig Feeding.

Two trials have been made to compare the value of soaked and dry shelled corn for pig feeding. In each case four pigs were used, two being fed soaked, and two dry corn. The pigs were kept in pens and had no other food. The first trial extended from April 29 to May 27, 1889; the second from June 10 to July 22, 1889. In the second trial the pigs were well fattened when the experiment commenced. In soaking the corn about 8 gallons of water were used for each bushel of shelled corn. Sixty pounds of corn were put in the water at a time and left until all was fed.

In the first trial pigs fed soaked corn ate 315 lb. during 28 days and made gains of 35 and 51 lb. each, or 86 lb. for the pair. This was one lb. gain for each 3.66 lb. corn eaten, or 15.30 lb. gain for each bushel of corn eaten. The pigs fed dry corn ate 299 lb. and made gains of 29 and 49.5 lb. each, or 78.5 lb. for the pair. This was one pound gain for each 3.84 lb. of corn eaten, or 14.58 lb. gain for each bushel of corn eaten.

In the second trial the pigs fed soaked corn ate 505 lb. of corn during 42 days and made gains of 47 and 41 lb. each or 88 lb. for the pair. This was one pound of gain for each 5.73 lb. corn eaten, or 9.77 lb.

gain for each bushel of corn eaten. The pigs fed dry corn ate 404 lb. and made gains of 39.5 and 36 lb. each, or 75.5 lb. for the pair. This was one pound gain for each 5.35 lb. corn eaten, or 10.46 lb. gain for each bushel of corn eaten.

In each experiment the pigs fed soaked corn ate more and gained more than those fed dry corn. In the first trial they made better gains for the food eaten; in the second trial not quite so good. In the first trial the gains made by each lot were very satisfactory; in the second trial less so, probably because the pigs were fairly fat at the commencement of the trial.

Experiment No. 27. Value of Droppings from Corn-fed Cattle for Pigs.

In 1889, and 1890, tests have been made of the value of the droppings from corn-fed cattle on pasture as food for pigs.

June 10, 1889, two Poland-China pigs, one weighing 150.5 lb., the other 135 lb., were placed in a two-acre pasture in which three yearling steers were grazed and liberally fed with shelled corn. In 24 weeks, up to Nov. 25th, these pigs had gained 195 lb.

April 28, 1890, two pigs, one weighing 125 and the other 137 lb., were placed in the same pasture in which three heifers were grazed and fed corn. In 31 weeks, to Nov. 24th, these pigs gained 231 lb., one gaining 147 lb., the other 84 lb.

In 1889, three pigs with a full feed of corn on a pasture adjacent to the one used in these trials gained 217 lb., the average weight increasing from 180 lb. to 253 lb. in 12 weeks, from June 17th to Sept. 9th. In the same number of weeks the two pigs following the corn-fed cattle gained 117 lb. This is an average of 58.5 lb. gain for each as compared with an average gain of 72.3 lb. made by the full fed pigs.

In 1890, five pigs with a full feed of corn on grass, in 12 weeks, from May 5th to July 28th, gained 494 lb., an average of nearly 99 lb. each. In the same time the two pigs following the cattle gained 118 lb., an average of 59 lb. each.

The two pigs used in the test of 1890, when put in a pen and fed corn alone from Nov. 28th to Dec. 29th, made more rapid gain than we have secured in any other trial with pigs. During the fourth week of this period the two gained 45 lb., or 3.21 lb. each per day, with consumption of 3.33 lb. corn for one pound gain, or 16.81 lb. gain for one bushel, 56 lb. corn.

During 28 days in May, 1891, two pigs following two grass-fed yearling steers gained 44 lb.

Experiment No. 113. Apple Pomace, Methods of Preserving, and Feeding Value.

In October, 1890, fresh apple pomace was obtained from the cider press of H. M. Dunlap, Savoy, and placed in a large box made of matched lumber, with tight fitting lid. The box was filled, the lid was closed and

the box left in the barn until Feb. 21, 1891, when it was opened. For about four inches the pomace was rotten. Below this it was in good condition. For six weeks it was fed to two lots of three pigs each, in pens, they having shelled corn in addition. The pigs cared little for the pomace. They did not eat much of it at first and less as the time advanced. The first week 145 lb. was given the six pigs; the sixth week only 24. In each case the larger part was not eaten. The pigs had been fed corn only for several weeks before the feeding of the pomace was begun. A more favorable result was anticipated. Mr. Dunlap has found pigs eating freely of pomace for years past, apparently with satisfactory results, but no careful tests have been made. In his experience the pomace when thrown out in large piles in the open air kept for months in, apparently, good condition.

A sample of the pomace was analyzed by Mr. Farrington with the following results:

	Fresh.	Water-free.
Water	44.36	.....
Ash	2.09	3.75
Protein	4.75	8.16
Crude fiber	12.72	22.85
Nitrogen-free extract	28.75	52.07
Ether-extract	7.33	13.17
Total	100	100

The pomace was evidently quite acid. The large percentage of "ether-extract" also indicates this. This acidity probably explains the unpalatability of the food. Its composition would indicate a good feeding value. Evidently the pomace can be preserved for months in a fairly air tight box without much change aside from a probable increase in acidity.

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COMPOSITE MILK SAMPLES TESTED FOR BUTTER FAT.

Experiment No. 122.

This article includes a record of observations made at a creamery where the patrons are paid on the test plan.

As farmers and dairymen become familiar with the fact that creameries can pay them for milk on its merits, they are anxious to patronize those creameries that adopt the test plan. They are also learning that they can improve the quality of the milk and increase the returns for their work by testing their cows and weeding out the unprofitable ones.

By keeping records of each cow it is soon evident that if one cow is paying her expenses, another one is paying ten, twenty, thirty, or more,

per cent. profit. A very simple account with each cow will pay well for the time required to keep the record. First of all, each cow should be given a number or a name. The record may include the cow's weight, age, and feed; and still more important as a beginning would be blank sheets containing for each cow, columns with the following heads: Date when expected to calve; date of calving; when dried up; number of days in milk; weight of milk given at each milking. Also an occasional test of the milk should be made and recorded during the period of lactation. Supplied with such important information and evidence as this the owner can decide, not as a matter of opinion simply, but as something clearly demonstrated, which cows should go to the butcher and which he should use for continuing his dairy.

The increased attention given by the dairymen to their cows has necessarily increased the number of creameries which pay for their milk on the basis of the number of pounds of butter fat instead of the number of pounds of milk. There seems to be a growing demand among patrons that creameries shall pay them on the "test plan."

It has already been proposed that a test of what is called a "composite" sample of the milk is sufficiently accurate and requires much less work and expense than a test of the milk brought by each patron daily.

This composite sample can be obtained by putting into a quart glass fruit jar, which is a convenient receptacle for this purpose, a small quantity of the milk brought by the patron each day. At the end of the week the jar contains a mixture of the milk brought during the seven days, and a test of this mixture (composite sample) is to take the place of the daily test. From the record of the pounds of milk brought by each patron during the week and the test of his composite sample for the week a simple calculation shows the pounds of butter fat supplied to the creamery by each patron, and for that he is paid.

The accuracy of one test by the composite sample, as a substitute for seven or more separate tests of the samples, depends, when made as detailed in the following pages, on the uniformity in quantity and quality of the milk from which the composite sample is made up; but, as will be seen, the method is sufficiently accurate for all practical purposes at a creamery.

In testing milk for the amount of butter fat it contains it is necessary to have the milk thoroughly mixed and homogeneous, and not separated as when sour, or when the cream has risen. The milk of the composite sample when kept seven days will naturally sour, and the cream will separate to a certain extent.

To make some observations on the practicability of the test of composite samples of milk, the following investigation was undertaken at the creamery of Gurler Bros., De Kalb, Ill.

Twenty patrons of the creamery were selected, and among them were included those who brought milk that varied most from day to day in quantity and quality.

First. The milk brought by each of these patrons was tested each day, the per cent. of butter fat, "test," and the pounds of milk recorded.

Second. A quantity of the well-mixed milk was taken daily from the large weighing can and used to make up a composite sample in three different ways, series A, B, C. Quart glass fruit jars were used for holding the composite samples, each jar being labeled with the patron's name or number.

To the jars of series A the same quantity of milk, one-tenth of a quart, was added each day.

To the jars of series B the quantity of milk added each day was governed by the number of pounds of milk of which it was a part; the same fraction of the milk brought by each patron was saved every day, but the fraction varied for different patrons. For instance, to jar B, patron No. 1, one-thousandth of the quantity of milk he brought was added every day; to jar B, patron No. 2, one-five-hundredth of the quantity of milk; and so on, taking in each case such a fraction of the pounds of milk brought that the sum of the seven fractions for the week would make about a pint of milk.

The purpose in doing this was to find out whether any error would be introduced by using one dipper in making up the composite sample from rich or poor milk in large or small quantities.

To the jars of series A and B were added 15 to 20 grains of a preservative that would keep the milk from souring. The preservative used was a mixture made at a drug store by the following formula:

Corrosive sublimate	2	oz.
Fine salt [Na. Cl.]	2	oz.
Powdered borax	8	oz.
Aniline red	1½	dr.

This preservative is a deadly poison, and the aniline is put into the mixture for the purpose of highly coloring the milk and thus showing that something has been added to it, and so guarding against tasting it.

The cost of the quantity of this preservative used in each jar was a little more than one-tenth of a cent.

Into the jars of series C the milk was put in the same quantity as into jars of series A, but *no preservative whatever* was added. After putting the milk into the jars in series A, B, and C, it was thoroughly mixed each day, by holding the jar right side up and giving it a motion that caused the milk to revolve in it as if on an axis which extended through the center of the jar from top to bottom. This sort of a motion cleans the cream from the sides of the jar and mixes it again with the milk in a very satisfactory way. Unless some such precaution is used to clean the cream from the sides of the jar, a portion of it sticks to the jar very tenaciously and vitiates the results of the test. After the jars have received the milk for the day and it has been mixed, they are covered to prevent any evaporation. The temperature of the room in which the composite samples were kept ranged during the week between 50° and 80° F.

Table 1 shows the pounds of milk brought by each patron during seven days and the test or per cent. of butter fat in the milk each day.

TABLE 1. Pounds of Milk brought to Creamery daily, for seven Days, by each of Twenty Patrons, and total. Per Cent. of Butter Fat, "Test," found by Test made of each Lot of Milk when brought, and Average of the seven Tests. Total Pounds of Butter Fat calculated from this Average Per Cent. and from the Per Cent. found each Day.

Patron.		Day in April, 1891, when milk was received.							Total milk, lb.	Av'ge Per Cent. fat, 7 tests.	Total butter fat, lb., calculated from.	
		9	10	11	12	13	14	15			Av'ge Per Cent. "test"	Daily Per Cent. "test"
1	Milk, lb	159	151	165	172	167	172	193	1,179	3.62	42.68	42.64
	Per cent. fat, "test"	3.6	3.6	3.8	3.5	3.6	3.6	3.7				
2	Milk, lb	127	101	112	116	117	121	111	805	3.71	29.86	29.7
	Per cent. fat, "test"	3.2	4	4	3.6	3.6	3.8	3.8				
3	Milk, lb	130	118	126	137	136	135	122	904	3.75	33.9	34.08
	Per cent. fat, "test"	3.7	4	3.7	3.7	3.6	3.6	4				
4	Milk, lb	179	168	163	170	272	267	170	1,389	3.63	50.42	50.25
	Per cent. fat, "test"	3.4	3.8	3.6	3.8	3.6	3.5	3.8				
5	Milk, lb	70	61	56	50	108	56	50	451	3.95	17.81	17.73
	Per cent. fat, "test"	3.5	4.2	4	4	4	3.5	4.4				
6	Milk, lb	142	116	126	115	128	128	139	894	3.64	32.54	32.52
	Per cent. fat, "test"	3.4	3.7	3.7	3.8	3.5	3.5	3.9				
7	Milk, lb	248	226	225	223	225	244	236	1,627	3.82	62.15	62.16
	Per cent. fat, "test"	3.6	3.8	3.8	3.8	3.9	3.9	4				
8	Milk, lb	115	72	115	96	137	105	64	704	4.10	28.86	28.81
	Per cent. fat, "test"	4.3	4.7	4.1	4.2	4	3.6	3.9				
9	Milk, lb	658	590	586	587	592	595	580	4,188	4.30	180.08	179.85
	Per cent. fat, "test"	4	4	4.4	4.6	4.5	4.2	4.4				
10	Milk, lb	475	465	453	457	480	475	436	3,241	4.16	134.82	134.65
	Per cent. fat, "test"	3.9	4.3	4.2	4.3	4.2	4	4.2				
11	Milk, lb	141	143	146	146	177	151	152	1,056	3.96	41.82	41.78
	Per cent. fat, "test"	4	4	4.1	3.8	4.1	3.8	3.9				
12	Milk, lb	183	178	179	180	182	190	174	1,266	4.52	57.22	57.28
	Per cent. fat, "test"	4.4	4.6	4.5	4.5	4.6	4.4	4.7				
13	Milk, lb	128	130	126	130	211	184	125	1,034	4.22	43.63	43.58
	Per cent. fat, "test"	4.1	4.2	4.2	4.4	4.1	4.2	4.4				
14	Milk, lb	159	153	134	152	148	155	127	1,028	3.77	38.75	38.76
	Per cent. fat, "test"	3.6	3.7	4.1	3.7	3.8	3.6	3.9				
15	Milk, lb	128	111	102	111	110	112	97	771	3.82	29.45	29.43
	Per cent. fat, "test"	3.5	4	4.1	3.9	4	3.6	3.7				
16	Milk, lb	212	217	210	191	213	266	190	1,499	3.77	56.51	56.41
	Per cent. fat, "test"	3.6	3.7	3.7	4	4	3.4	4.1				
17	Milk, lb	197	202	206	211	210	208	206	1,440	3.63	52.27	52.28
	Per cent. fat, "test"	3.2	3.6	3.7	3.6	3.8	3.8	3.7				
18	Milk, lb	108	98	106	...	141	98	105	656	3.71	24.33	24.33
	Per cent. fat, "test"	3.4	3.7	3.7	3.8	3.9	3.7	3 8				
19	Milk, lb	106	107	105	93	...	105	74	590	4.11	24.11	24.24
	Per cent. fat, "test"	3.7	4.1	4.3	4.3	...	3.7	4.6				
20	Milk, lb	256	237	250	224	408	255	203	1,833	3.95	71.49	72.07
	Per cent. fat, "test"											

One Test Each Week Not Sufficient.

The table also shows the variation from day to day in the pounds of milk brought by each patron and in the per cent. of butter fat in the same.

Although the quantity of milk and the test is about the same every day for one patron, these figures show that a test of the milk only once in a week may not be sufficiently accurate to warrant the adoption of a weekly test of the milk as the percentage of butter fat to be used in paying the patron for the milk he brings.

For instance, the table shows that the total milk brought by patron No. 2 for the week was 805 pounds. If he were paid for his milk by the test made on April 9th (3.2 per cent.), the account would show that he had brought to the creamery during the week $805 \times .032 = 25.76$ lb. of butter fat. If, however, the weekly test made on April 10th (4 per cent.) were taken, his account would show $805 \times .04 = 32.20$ lb. of butter fat as his weekly contribution to the creamery. That is, there would be a difference of 6.44 lb. in the total butter fat he should be paid for, depending on which of the two days in the week the test was made.

Another illustration of this is shown in the case of patron No. 9, who brought during the week 4,188 lb. of milk. If the weekly test had been made April 9th (4 per cent.), the weekly account would show $4{,}188 \times .04 = 167.52$ lb. butter fat. If the test had been made April 12th (4.6 per cent.) his account would show $4{,}188 \times .046 = 192.65$ lb. butter fat—a difference of 25.13 lb. butter fat in the amount shown by the two days' tests. This is shown in the following table:

Patrons.	Pounds milk for the week.	Per cent. Fat.	Pounds fat.
No. 2.	805	× .04, "test" on April 10th,	= 32.20
	805	× .032, "test" on April 9th,	= 25.76
	Difference		6.44
No. 9.	4188	× .046, "test" on April 12th,	= 192.65
	4188	× .04, "test" on April 9th,	= 167.52
	Difference		25.13

Table 1, p. 507, shows the total pounds of milk brought by each patron for the week, an average of the seven daily tests,* and the pounds of butter fat found by multiplying the milk for the week by this average test, also the pounds of butter fat found by adding together the amounts found by testing the milk each day.

To obtain the results in the last column requires seven times as much work as to get those in column next to the last, for it necessitates making a test of the milk brought by each patron each day. The small difference in the pounds of fat given in these two columns is due to the mathematical error from averaging percentages. If the test of the composite samples corresponds to the average of the seven daily tests, paying for the milk by using the composite test is practically as accurate and takes but

* The average has been found by dividing by seven the sum of the seven per cents.

about one-seventh as much work as calculating from a daily test the pounds of butter fat supplied by each patron.

Test of the "Composite" Samples.

At the end of the week the jars in series A, B, and C contained a portion of the milk brought by each of the 20 patrons each day of the week.

These composite samples were each tested and the results are given in table 2.

TABLE 2. Comparison of the per cent. of Butter Fat, or "Tests," of the "Composite" Milk Samples collected for one Week in three different Ways, with the Average of seven daily Tests of the Milk used in making the composite Samples.

Patron.	Average of the seven daily tests.	Per cent of butter fat or test of "composite" sample. Series A, B, and C.		
		Same measure of milk each day.	Constant proportion of pounds of milk.	Same measure of milk each day.
		Series A, poisoned.	Series B, poisoned.	Series C, *not* pois'n'd
1	3.62	3.6	3.6	3.6
2	3.71	3.8	3.7	3.7
3	3.75	3.7	3.7	3.7
4	3.63	3.8	3.6	3.7
5	3.95	4.	4.1	4.1
6	3.64	3.7	3.6	3.7
7	3.82	3.9	3.8	3.8
8	4.10	4.1	4.	4.1
9	4.30	4.3	4.4	4.3
10	4.16	4.2	4.2	4.3
11	3.96	4.	3.9	3.9
12	4.52	4.6	4.6	4.6
13	4.22	4.4	4.4	4.4
14	3.77	3.9	3.9	3.9
15	3.82	3.8	3.9	3.9
16	3.77	3.8	3.8	3.8
17	3.63	3.7	3.6	3.7
18	3.71	3.8	3.7	3.7
19	4.11	4.	4.	4.1
20	3.90	4.	4.	3.9

The milk had not soured in jars A and B, to which the preservative had been added. The cream had separated to some extent but was easily mixed with the milk by first giving the jar a circular motion that causes the milk to revolve in the jar and clean off any cream that sticks to the glass; and then by pouring a few times from one jar to another this milk that was seven days old was as thin and as easily tested as new milk.

In the jars of series C, to which no preservative had been added, the milk of the composite samples was sour and curdled; the whey and curd had separated. The butter fat of the milk was of course not destroyed; but a pipette filled with sour, curdled milk will not contain a fair proportion of all the constituents of the milk, and consequently such milk cannot be tested until it is thoroughly mixed and contains no lumps of cream or curd.

After some investigation I found that the sour, curdled milk could be safely made for this purpose as thin and homogeneous as new milk by adding to the sour milk about one-half a teaspoonful of "powdered lye" (98 per cent. caustic soda). This lye is sold by grocers in small cans for making soap by dissolving and mixing with grease. By the action of this concentrated alkali the acid of the sour milk is neutralized and the curd dissolved so that by pouring the milk from one jar to another it soon becomes completely mixed and can be successfully tested. The action of the lye on sour milk is hastened by adding it to the milk in small quantities so that the lye is dissolved. If one-half a teaspoonful of the lye is thrown into the milk at once, it collects together in a hard lump which is dissolved with difficulty. The whole process of thinning the thick, sour milk with lye is aided by warming the milk at a temperature of 100° to 140° F., and by letting it stand for an hour or more. The time and heat both help the solvent action. Pouring from one jar to another is also an important factor in getting the milk thoroughly mixed.

Methods of Sampling Milk for Testing.

Table 3 gives the tests of the same milk from which samples were taken in two or three different ways, by a dipper, by the milk "thief," a small tube, and by a tube in the conductor spout (described in *Bulletin No. 14, of this Station, p. 462*). The last is perhaps the most nearly automatic, but in some places may be inconvenient.

TABLE 3. Test of Milk Samples taken from large weighing Can at a Creamery by Dipper, Milk "Thief," Tube in Conductor Spout.

Patron.	Dipper.	Milk "thief."	Tube in conductor spout.	Patron.	Dipper.	Milk "thief."	Tube in conductor spout.
1	3.6	3.5	.....	11	4.5	4.5	.....
2	4.1	4	.....	12	4.2	4.2	.....
3	4.4	4.2	.....	13	4.4	4.5	.....
4	4	3.9	.....	14	3.8	3.8	3.8
5	4	4.4	.....	15	4	3.8	3 9
6	3.5	3.5	.....	16	4.4	4.5	4 4
7	4.4	4.4	.....	17	3.8	3.6	3.6
8	4	3.9	.....	18	4	3.9	3.9
9	4.1	4	.....	19	4	3.9	4
10	4.5	4.6	.....	20	4.3	4.2	4.1

The results of this trial indicate that there is practically no difference in the methods of taking a sample of milk for testing, if proper care is used.

All the results given in this bulletin were obtained by the use of the Babcock "milk tester."

Application of the Composite Test to the Dairy.

This plan of testing composite samples of milk brought to a creamery by its patrons has the same practical value to the dairyman, who may use it in testing each of his cows.

Recording the weight of milk produced by each cow at each milking, saving a little of the milk in a fruit jar (labeled with the name or number of the cow), and testing this composite sample at the end of a week will furnish data from which to calculate the amount of butter fat produced by each cow.

The following record of observations made with five cows shows that the test of each cow made once for the week on a composite sample was practically as accurate as a daily test.

TABLE GIVING DESCRIPTION OF COWS USED, APRIL 24, 1891.

No.		Weight, ap'r'xim'te	Age, years,	Calved.	Expected to calve.
1	A young Jersey.....	650	3	Over 1 year ago.	September 15.
2	Belle, Jersey.....	800	13	April, 1891.	.....
3	Med, Holstein.....	1000	10	Over 1 year ago.	October 31.
4	Jock, Holstein.....	1200	10	February 15, 1891.	November 31.
5	Med 3d, Holstein ...	800	2	March, 1891.	.....

Good pasture was the only feed the cows had.

The milk of each cow was weighed at each milking, and these weights of milk are given in the following table. After weighing the milk from a cow it was thoroughly mixed with a long-handled tin soup ladle and a small quantity, about 1-20 of a quart, poured into a bottle; at the next milking this was repeated, so that the bottle contained equal quantities of the a. m. and p. m. milk from the cow. One exception was made to this rule. In the case of cow No. 2, the a. m. milk was not mixed with the p. m. milk; but each collected in a separate bottle, in order to observe the difference, if any, in the test of the morning and the night milk. For each cow there was a different bottle labeled with the name or number of the cow, cow No. 2 having two bottles.

In this trial the milk in each bottle was tested every day and a portion of it was also poured into a quart glass fruit jar labeled with the name or number of the cow. The table on the next page shows the daily tests of the mixture of a. m. and p. m. milk for four of the cows and the separate tests of the a. m. and p. m. milk of cow No. 2.

At the end of the week the jars contained a portion of the milk given by the cows every day of the week. This milk was sour and curdled, but it was completely mixed by the use of the lye as before described in this article. These composite samples of milk were tested at the end of the week and the results are given herewith, compared with the average of the seven daily "tests" of the milk from which was made up the composite sample.

These figures show that in this trial the test of these cows was practically as accurate when the milk was tested once a week by a composite sample as when a test of the milk was made every day.

TABLE SHOWING WEIGHT AND PER CENT. OF BUTTER FAT, "TEST," OF MILK GIVEN BY FIVE COWS FOR ONE WEEK.

Date, 1891.		Jersey No. 1.	Belle, No. 2 a.m.	Belle, No. 2 p.m.	Med, No. 3.	Jock, No. 4.	Med 3rd, No. 5.
	Daily weights of milk and	*per*	*cents*	*of*	*butter*	*fat.*	
April 27.	Milk lb. Night	6	.....	11	5	21	13½
	Morning	5	11	.....	5	19	9
	"Test" of mixed milk	4.8	4.4	4	3.8	2.6	2.8
April 28.	Milk lb. Night	6½	.....	10½	6	21½	11½
	Morning	5¾	9¾	.....	5	18¾	9½
	"Test" of mixed milk	4.4	4.4	3.8	3.4	2.8	2.7
April 29.	Milk lb. Night	6¼	.....	11	6	23	10
	Morning	5	11	.....	5½	19	9
	"Test" of mixed milk	4.8	4 4	4	3.3	2.6	3
April 30.	Milk lb. Night	5½	.....	10	5½	21	10
	Morning	5¾	10	.....	5	21	10
	"Test" mixed milk	4.7	4.8	4.4	3.4	2.9	2.7
May 1..	Milk lb. Night	5½	.....	10	5½	20½	10½
	Morning	5½	9	.....	5	19	9
	"Test" of mixed milk	4.9	4.4	4	3.2	2.6	3
May 2..	Milk lb. Night	5½	.....	9	5	21	9½
	Morning	6	12	.....	5½	22	10
	"Test" of mixed milk	4.6	4.4	4	3.3	2.6	3.2
May 3..	Milk lb. Night	6	.....	9	5½	20	9½
	Morning	5½	10½	.....	5½	20	10
	"Test" of mixed milk	4.7	4.8	3.6	3.3	2.6	3
	Total weight of milk for	*the*	*week.*				
	Milk lb. Night	41¼	.....	70½	38	148	74½
	Morning	38¼	73¼	.....	36	138	66½
	Total	79½	143¾		75	286	141
	Per cent. of butter fat.						
	Average of the seven daily "tests"	4.7	4.5	3.97	3.4	2.67	2.9
	Composite sample "test"	4.8	4.6	3,95	3.5	2.70	3
	Pounds of butter fat, calculated—						
	From daily weight of milk and daily test	3.73	3.30	2.80	2.53	7.65	4.10
	From total weight of milk and average test	3.73	6.10 3.29	2.80	2.55	7.65	4.09
	From total weight of milk and composite test.	3.81	6.09 3.38	2.78	2.62	7.72	4.23
			6.16				

The table opposite shows the pounds of butter fat produced by each cow during the trial, as ascertained by using the daily weights of the milk and both the daily and weekly "test."

TABLE SHOWING POUNDS OF BUTTER FAT IN MILK PRODUCED BY EACH COW EACH DAY AND DURING THE WEEK CALCULATED FROM DAILY TESTS AND WEIGHTS OF MILK. ALSO POUNDS FOR THE WEEK CALCULATED FROM WEEKLY TEST AND DAILY WEIGHTS OF MILK.

Date, 1891.	Jersey, No. 1. Pounds	Belle, No. 2. a.m. Pounds	Belle, No. 2. p.m. Pounds.	Med, No. 3. Pounds.	Jock, No. 4. Pounds.	Med 3d. No. 5. Pounds.
Calculated	*from*	*daily*	*tests.*			
April 27	0.528	0.484	0.44	0.38	1.04	0.63
" 28	0.528	0.420	0.39	0.374	1.127	0.567
" 29	0.54	0.484	0.44	0.379	1.092	0.57
" 30	0.528	0.48	0.44	0.357	1.218	0.54
May 1	0.539	0.396	0.4	0.336	1.027	0.585
" 2	0.529	0.528	0.36	0.346	1.118	0.624
" 3	0.54	0.504	0 32	0.363	1.04	0.585
		3.3	2.8			
Total	3.73	6.10		2.53	7.65	4.1
Calculated	*from*	*the* 3.38	*comp'site* 2.78	*sample*	*test.*	
Total	3.81	6.16		2.62	7.72	4.23

Further Trials of the "Composite" Test.—The milk from these cows has been weighed every day and tested daily for butter fat; a "composite" sample of the milk from each cow has also been saved during the same time and tested every week. Up to date [*June 22d*] seven comparisons have been made with each of these five cows of a seven-days-old composite test with the average daily tests for each of the seven weeks. The temperature of the room in which the composite samples of milk have stood, has ranged from 64° to 91° F.

Space will not permit giving the tabulated results of these comparisons; they have, however, been as favorable as the one already given; in only one case did the test of the composite sample differ more than two-tenths of one per cent. from the average of the seven daily tests for the same time; and the average variation was 0.05 of one per cent.

By the daily test for butter fat of the milk of each cow, very striking variations are noticed from day to day in the same cow. The composite sample test, as here described, gives an average figure which is demonstrated to be an accurate one, and thus furnishes a method that can be used with great advantage to save time in testing cows, either in comparison with each other or for the influence of feed on the amount of butter production.

COMPOSITE MILK SAMPLES TESTED FOR CASEIN.

An investigation has also just been made to determine the casein in the composite samples of milk; and to compare this result with the average seven determinations of casein in the portions of milk which make up the composite sample. The results for one week were as follows:

TABLE SHOWING PER CENTS. OF CASEIN IN MILK; COMPARISON OF AVERAGE OF DAILY TESTS FOR ONE WEEK WITH TEST OF COMPOSITE SAMPLE.

	Jers'y, No. 1.	Belle, No. 2. a. m.	Belle, No. 2. p. m.	Med, No. 3.	Jock, No. 4.	Med 3d, No. 5.
Per cent. of Casein in—						
Average of the seven daily "tests"	4.02	3.6	3.3	3.93	3.07	2.92
Composite sample "test"	3.83	3.51	3.21	4.04	3.19	2.92

In all of this work on composite milk samples no preservative was added. The milk soured and separated; but when the test was made, a small quantity of "powdered lye" was used to put the soured milk into a proper condition for testing.

AUTOMATIC PIPETTE.

The automatic pipette (*see opposite*), for measuring the acid into each test bottle was used with good satisfaction. Illustrations of two of these pipettes were given in *Bulletin No. 14, of this Station, pp. 466-467.*

After extended practical use of the two, we find that the one given herewith is the best to recommend. By connecting the pipette with a bottle or carboy of the acid, measuring the acid into each test bottle is very much more convenient than by the use of a graduated cylinder; and the pipette seems to wear well. The inside diameter of the tube connecting the bottle of acid with the pipette should be 3-16 in.; the holes through the glass cock ⅛ in.; and the delivering tube from the pipette to the test bottle should have an inside diameter of ⅛ in., and an outside diameter of 7-32 inches.

It has been suggested by Dr. S. H. Peabody that a lead tube be substituted for the glass tube connecting the bottle of acid with the pipette. For making connections between the lead tube and the pipette, a rubber tube or hose with walls at least 3-16 in. thick should be used and tightly wound with copper wire.

STAND FOR HOLDING COMPOSITE-SAMPLE JARS.

Support two or more circular shelves, upon a central upright standard so that they will revolve. Make the whole movable. It will facilitate handling the apparatus to set the base of the standard on heavy casters. Put the jars for the composite samples on the outer edge of the shelves so that the labels for the patrons' names are in sight. When milk is to be sampled, move the stand with its jars near the weighing can, and the weighman can easily revolve the shelves until the jar he wants is within reach.

CONCLUSIONS.

The results in tables 1, 2, and 3 show:

First. That in this trial testing the "composite" sample once each week was practically as accurate as testing the milk every day.

Second. That one dish can be used for dipping out all the samples of milk that make up the composite sample.

Third. That it is not necessary to use a poison for preserving the milk; but that satisfactory results can be obtained by allowing the composite sample to sour, and thinning the sour milk by use of "powdered lye" when a test is to be made.

Any dairyman wishing to ascertain the value of any cow for butter-making can, with practical accuracy, make use of the composite test in this way:

Get a pint or quart glass fruit jar, with cover, for each cow to be tested; mark it with name or number of the cow; into each jar put about ½ teaspoonful of powdered concentrated lye, or use the lye in the way already described on p. 509 for thinning the milk after the composite sample has been collected. Record the weight of the milk given by each cow at each milking; after weighing the milk, mix it thoroughly and dip out a small quantity, say about 1-20 qt., and pour this into the jar containing the lye. Repeat this weighing and saving of the sample as many days as desired; every seventh or tenth day carefully mix the milk collected in the jar and test the milk for the per cent. of butter fat it contains. This "test" together with the weight of the milk given by each cow during the time this composite sample was accumulating will furnish very accurate data for calculating the amount of butter fat produced by each cow during the time covered by the test.

It seems hardly necessary to say that the longer such testing as this is carried on, the more intimately acquainted the owner becomes with his cows.

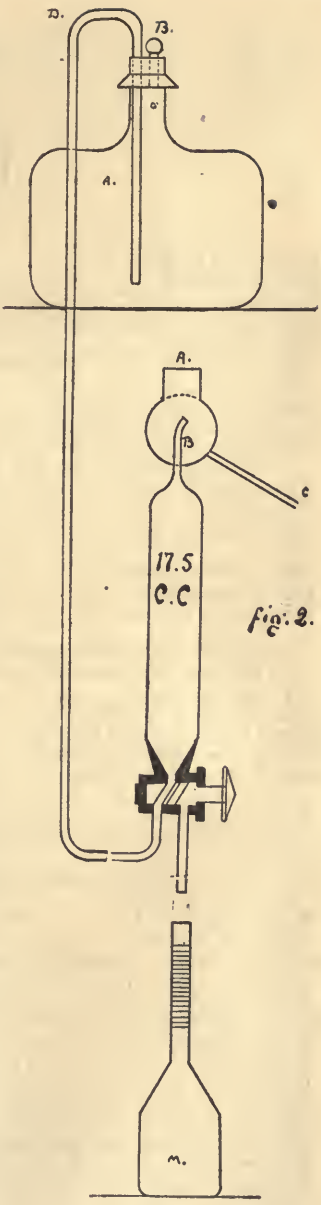

Fig. 2.

E. H. Farrington, M.S., *Chemist*

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All communications intended for the Station should be addressed, not to any person, but to the

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The bulletins of the Experiment Station will be sent free of all charges to persons engaged in farming who may request that they be sent.

This bulletin closes a volume, and a title page and index are sent herewith, so that those who wish may preserve the bulletins by having them bound. The same plan will be pursued in the future.

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