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PREFACE.

The introduction of the study of agriculture into the public schools, in which the State Department of Education is keenly interested, raises a number of problems. One of these problems is the selection of material and subjects for study that are easily available, practical for study purposes, and of large economic value.

No agricultural subject, particularly in the State of Washington, meets these requirements better than dairying and the dairy cow. The industry is universally prevalent, capable of being made very profitable, and reaches all the people of the state. No phase of agriculture forms a more direct bond between our urban and rural population. The life and health of all our people, particularly the people of the cities, depends vitally on a plenteous supply of pure milk. That the industry is yet seriously undeveloped in Washington is proved by the large quantities of butter and cheese annually shipped in from other states.

This bulletin has been prepared by Mr. George Severance, Superintendent of the Western Washington Experiment Station. The photographs from which the cuts were made were furnished by Mr. R. C. Ashby, of the State Experiment Station at Pullman. The State Department of Education is issuing the bulletin and distributing it among the teachers in the hope that it may result in stimulating the study and promoting the knowledge of this important agricultural subject. We believe that any rural teacher can use the bulletin to the great profit both of himself and his pupils.

This is the first of three pamphlets which the State Department of Education expects to issue during the current year, all of them prepared by specialists connected with the State College of Washington. The succeeding bulletins will deal with elimination of smut in wheat and suggestions regarding home gardening.

HENRY B. DEWEY,
Superintendent of Public Instruction.

HOW TO CHOOSE A GOOD COW.

By GEORGE SEVERANCE, *Superintendent of Western Washington Experiment Station*, and R. C. ASHBY, *Superintendent of Extension Work, State College of Washington.*

INTRODUCTION.

To study the homely, commonplace cow is strictly in accordance with the spirit of the times. The growing tendency in education is to give a larger and larger proportion of time to the study of things that pertain to everyday life. Every man, woman and child uses in one or more forms the products of the dairy cow. In Western Washington many families and many communities depend upon dairying for their principal income, many others keep a family cow, and many depend upon buying all milk, butter, etc., consumed. In any case, all are interested in the most economical production of high class dairy products. Dairy cows vary greatly in the amount of milk and butter fat they will produce and in the economy of production. Many will yield a large profit but many will not pay for their feed with the best of care and are correctly termed "star boarders." The majority of dairy herds contain some "star boarders" eating up the profits produced by better members of the herd. Many dairymen realize they are not clearing much money but are unable to detect the boarders. There is no more important thing to be taught in a region as dependent upon dairying for its development and prosperity as Western Washington than the best method for selecting a good cow, and there is no better channel for the dissemination of this knowledge than through the public schools.

There are two methods in use for the selection of a dairy cow:

1. The use of the Babcock test and the milk scale.
2. Selection of a cow from physical makeup.

The first is the sure and final test and consists in keeping the weight of milk produced and determining the per cent. of butter fat in the milk. This furnishes the basis for determining the amount of butter fat produced per year. As the value of the butter fat practically determines the value of the milk produced, this data gives us the amount of income from the cow in question.

The second method consists in judging of the merits of a cow by noting any characteristics of form or appearance that dairymen have come to recognize as reasonable indications of an ability to produce well. This is the necessary method of selection when buying cows where no records of production are available and there is no time to

wait for records to be kept. The accuracy of this method depends upon the judgment of the purchaser and must be checked later by the Babcock test and milk scales.

This bulletin will take up these two methods of selection in as simple and specific a manner as possible. For more detailed information the teacher would do well to study "Modern Methods of Testing Milk and Milk Products" by L. L. Van Slyke, published by Orange

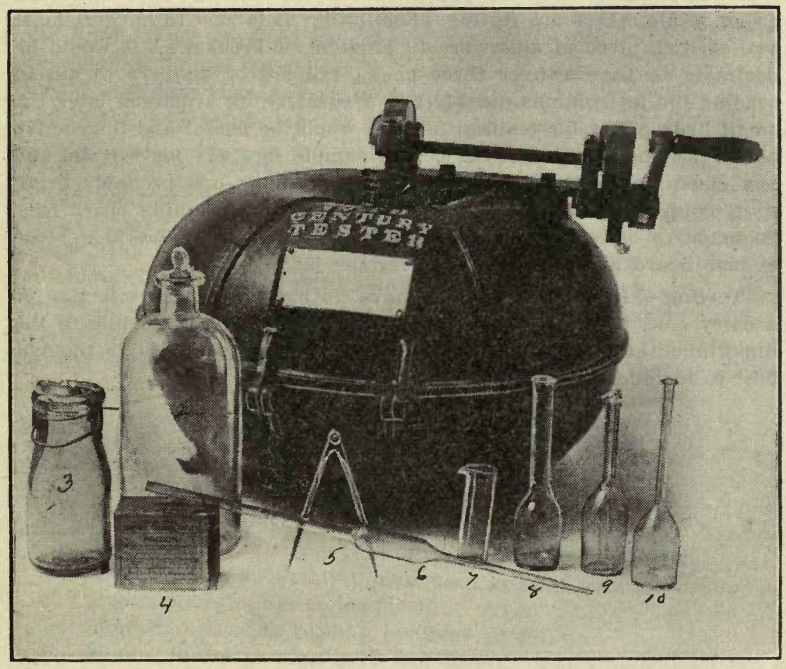

FIG. 1. APPARATUS FOR TESTING MILK, SKIM MILK AND CREAM.

Judd Co., Chicago, or "Testing Milk and Its Products," by Farrington and Woll, and published by Mendota Book Co., Madison, Wis. For more detailed information on the judging of dairy cows it would be well to secure "Judging Live Stock," by Craig, published by The Sanders Publishing Co., Chicago; also Farmers' Bulletin No. 106 on "Breeds of Dairy Cattle," and Circular No. 48, Bureau of Animal Industry on "Scale of Points for Judging Cattle of Dairy Breeds." For the two bulletins, write Secretary of Agriculture, Washington, D. C.

(The Experiment Station, Pullman, Wash., and the Western Washington Experiment Station, Puyallup, issue bulletins on various topics from time to time. These may be secured gratis by writing these institutions and asking for them.)

In securing apparatus it is possible with two or three pupils to get along with the equipment suggested in the first group under heading, "Apparatus and Supplies Needed," but it would be better in most cases to have as much equipment as is suggested in the second group. Much value is derived from comparing many tests, and a class soon loses interest if pupils must stand and wait for each other. The cream bottles and skim milk bottles are considerably more expensive than the whole milk bottles, so a very few of these bottles will suffice by letting the pupils take turns testing skim milk and cream while others are testing whole milk. It is best to have at least two of each piece of glassware to provide for breakage. It would be desirable to have two or three cheap calipers or dividers to aid in reading the fat columns quickly and accurately, as explained later. A small hydrometer for testing the acid would be useful and instructive but is not absolutely necessary. For sample jars any jar will do, and any cheap can will do to heat water in. Pupils can probably bring soap, gold dust, etc., from home, if necessary. A draining board may be made to hang the bottles in by boring half-inch holes in a piece of inch board big enough to set over the jar.

Testing skim milk and cream have no bearing on the selection of a dairy cow, but the exercises open up the eyes of the pupils to the importance of accurate methods in so many ways that it is thought best to include them.

PART I.

USE OF THE BABCOCK TEST.

Composition of Milk.

Cow's milk contains usually from 84 to 89 per cent. of water and from 7 to 11 per cent. of ash, casein, albumen and milk sugar. In this complex liquid the butter fat is suspended in minute globules. The fat is lighter than any other component of milk, hence gradually rises to the surface of standing milk and is recognized as cream.

Principle of the Babcock Test.

The Babcock Test hastens the process of separation of the butter fat in two ways: First, by the addition of sulphuric acid to a sample of milk, the casein, albumen, sugar and ash are dissolved, leaving the minute fat globules to move quickly through the liquid; second, by whirling the milk and acid in a bottle in a centrifugal machine called a tester, the fat is forced to the top very quickly, where the percentage may be read direct from the graduated neck of the bottle.

Apparatus and Supplies Needed.

Fig. I shows a full set of apparatus for testing whole milk, skim milk and cream.

1. 10 bottle 20th Century tester.
2. 9-lb. bottle sulphuric acid.
3. Sample bottle for collecting composite sample of milk.
4. Box corrosive sublimate tablets used to keep composite sample of milk from souring while collecting it.
5. Divider, for use in reading per cent. of fat.
6. Pipette for measuring milk and cream. The ring around the neck shows the point to which the pipette must be filled to hold the amount marked on the body of the pipette.
7. Acid cylinder for measuring out acid for the test.
8. Cream bottle for testing cream.
9. Skim milk bottle for testing skim milk.
10. Milk test bottle for testing whole milk.

For a very small school or class, the following equipment is suggested:

Four-bottle official tester, complete for milk; 6 extra milk test bottles; one extra 17.6 c. c. pipette; ½ doz. sample bottles; one extra acid cylinder; one 9-lb. bottle sulphuric acid; one box No. 2 corrosive sublimate tablets.

For a class of ten or twelve pupils, the following equipment is suggested:

A ten-bottle tester; 18 milk test bottles; 3 skim milk bottles; 3 cream bottles; four 17.6 c. c. pipettes; 1 doz. sample bottles; 2 cream pipettes; 2 acid cylinders; one 9-lb. bottle sulphuric acid; one box No. 2 corrosive sublimate tablets; two 4-inch dividers.

A leading dairy supply house has priced the first outfit for schools at $7.35 and the second at $19.75.

Directions for Making the Babcock Test.

1. **Sampling.** See that the sample to be tested is thoroughly mixed by pouring from one vessel to another several times; otherwise, the butter fat will not be evenly distributed at time of sampling. Using the 17.6 c. c. pipette, draw milk into it by sucking at the upper end and until it is filled a little above the mark on the neck, then slip the forefinger quickly over the end of the pipette before the milk runs

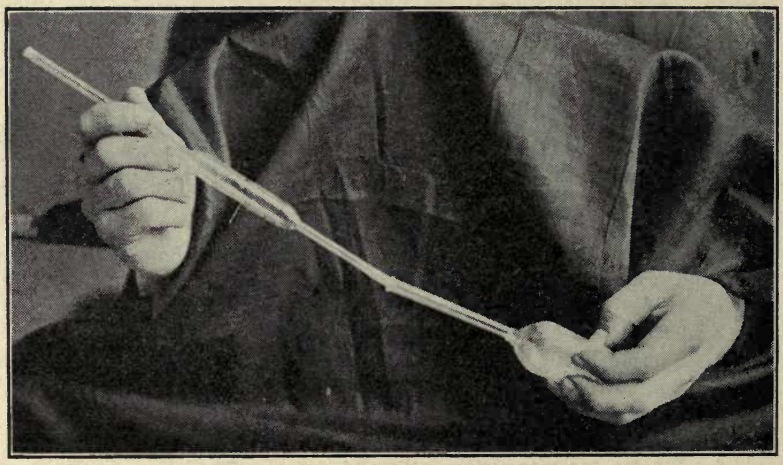

FIG. 2. THE PROPER WAY TO HOLD THE BOTTLE IN ADDING MILK FROM A PIPETTE.

below the mark. By releasing the pressure of your finger slightly, allow the milk to run out till it is lowered just to the mark, then hold by pressing finger tightly over the end of the pipette again. Empty the pipette of milk into a clean milk test bottle, holding pipette and bottle as shown in Fig. 2. This permits the air to escape from the bottle as the milk enters. The drop of milk remaining in the point of the pipette should be blown into the test bottle.

2. **Adding the acid.** Fill the 17.5 c. c. acid cylinder to the mark with sulphuric acid of specific gravity 1.82-1.83. Pour this slowly into the test bottle containing the milk, holding the bottle, the same

as in adding the milk so that the acid will follow down the neck of the bottle, allowing the air to escape from the bottle as the acid enters. Turn the bottle gently in the fingers as the acid is poured in, to wash the milk clean from the neck of the bottle. When the acid is all poured in it will be at the bottom of the bottle and distinctly separated from the milk. Mix the milk and acid at once by giving the bottle a rotary motion, keeping the bottle in motion till the mixing is complete. Be very careful not to point the neck of the bottle toward yourself or anybody else while mixing the milk and acid. The mixture will become very hot and will turn dark-colored, showing the effect of the acid on the casein, albumen and sugar of the milk.

3. **Whirling the bottles.** As soon as the milk and acid are completely mixed the bottles should be set in the tester and whirled full speed for four minutes. The speed required will vary with the diameter of the wheel. Farrington and Woll state that a ten-inch wheel should turn 1074 revolutions per minute; twelve-inch wheel, 980 revolutions; fourteen-inch wheel, 909 revolutions; sixteen-inch wheel 848 revolutions; eighteen-inch wheel, 800 revolutions; twenty-inch wheel, 759 revolutions; twenty-two inch wheel, 724 revolutions; and a twenty-four inch wheel should turn 693 revolutions per minute. To determine the speed to turn the crank on your particular machine, note the number of times the wheel revolves for one turn of the crank, divide this number into the number of times the wheel should revolve per minute and the quotient will be the number of times the crank should turn per minute. The speed should approximate this result but need not be absolutely exact.

4. **Adding hot water.** Stop the machine after four minutes' whirling at full speed and fill each bottle to the neck with hot water, 160° to 180° F.

5. **Second whirling.** Whirl for one minute again at full speed. This washes the fat clean.

6. **Second addition of hot water.** Add quickly enough hot water, 160° to 180° F. to each bottle to bring the fat all within the graduated scale on the neck of the bottle.

7. **Third whirling.** Whirl one minute. The column of fat should be perfectly clear with a clean-cut curve on both top and bottom of column.

8. **Reading the per cent. of fat.** Take readings at once. If you have no dividers read the scale at the lowest point of the curve at the lower end of the fat column and at the highest point of the curve at the upper end of the fat column and subtract the readings for the per cent. of butter fat. For example: Upper reading 5.4, lower reading 1.2; 5.4—1.2=4.2, the per cent. of butter fat contained in the sample of milk tested. 100 lbs. of such milk would contain 4.2 lbs.

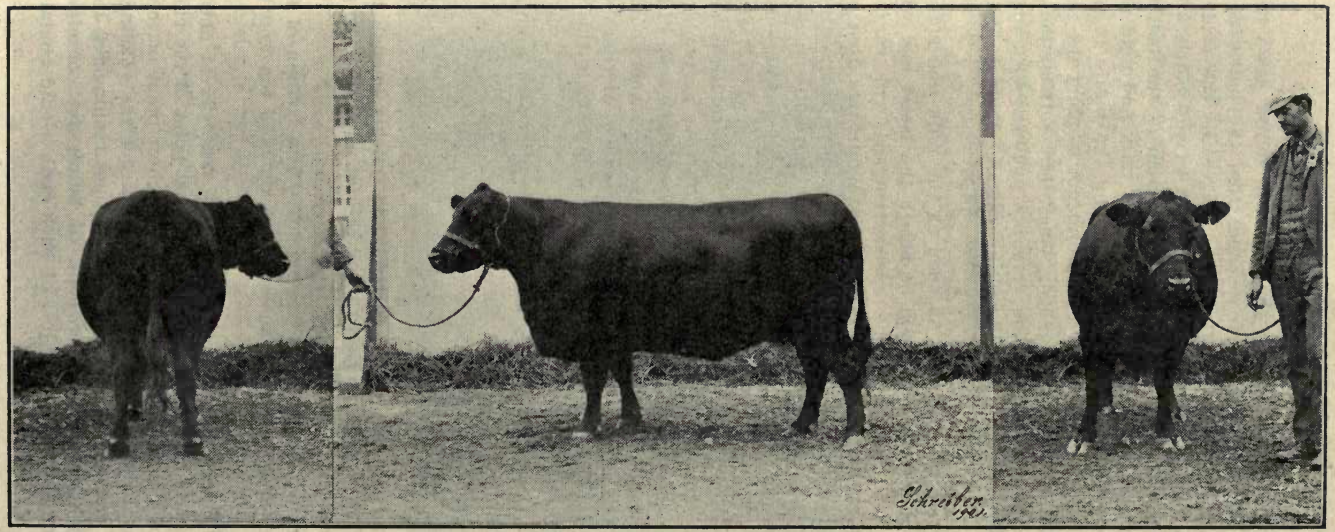

FIG. 4. A GOOD BEEF TYPE.

of butter fat. "Four per cent. milk" means milk that would test 4 per cent. and would contain 4 lbs. butter fat in 100 lbs. of milk.

It is simpler to take readings with a divider. Place one point of the divider at the lowest point of the lower curve of the fat column, and bring the other point to the upper edge of the upper curve of the fat column, then move the dividers down till the lower point rests at zero of the graduated scale, then the reading on the scale where the upper point touches will represent the per cent. of butter fat.

9. **Cleaning bottles.** The bottles should be emptied into an earthen jar, being careful not to spatter any liquid on perishable articles. A white deposit will be noticed on the bottom of the bottles. The bottle should be shaken vigorously, while emptying, to wash this off. Be sure that it is all washed off before the last of the acid is allowed to run out, as it is difficult to clean off the substance after the acid has drained out. For convenience in draining the acid from the bottles, an inch board bored full of half-inch holes may be placed over the waste jar and the bottles thrust neck down into the holes.

The bottles will clean best if emptied immediately after taking the reading while the liquid is hot. After the acid has drained out, the bottles should be rinsed with hot water. The bottles should be given an occasional thorough cleansing with gold dust or similar cleansing preparation. The pipettes should be kept thoroughly clean.

Exercises.

1. Let each pupil bring a sample of fresh morning's milk from home. The sample should be taken from the entire milking from one cow. If the milk is allowed to stand at all before taking the sample it should be thoroughly mixed by pouring from one vessel to another just before sampling. A small teacupful would be large enough sample. Weigh the milking that you sample: Determine the per cent. of butter fat in the sample, according to preceding directions.

From the weight of the milking and the per cent. of fat contained, determine the total weight of butter fat in the milking. Multiply the weight of butter fat by 7-6. The product will be the weight of butter that should be made from this butter fat when all operations are done properly. How much is this worth at the market price of butter?

2. Make a like test of the evening milking from the same cow. Is the per cent. of butter fat the same as in the morning milking? If not, do you find a similar difference between the fat content of night and morning milkings from cows tested by other members of the class?

3. Using the same cow as before, take the first milk drawn for one sample and the strippings for another sample. Determine the per cent. of butter fat in each sample. How do the results compare? Are the differences similar for the different cows?

4. Make another test of the night and morning milkings of the same cows tested in exercises one and two. Do you find just the same

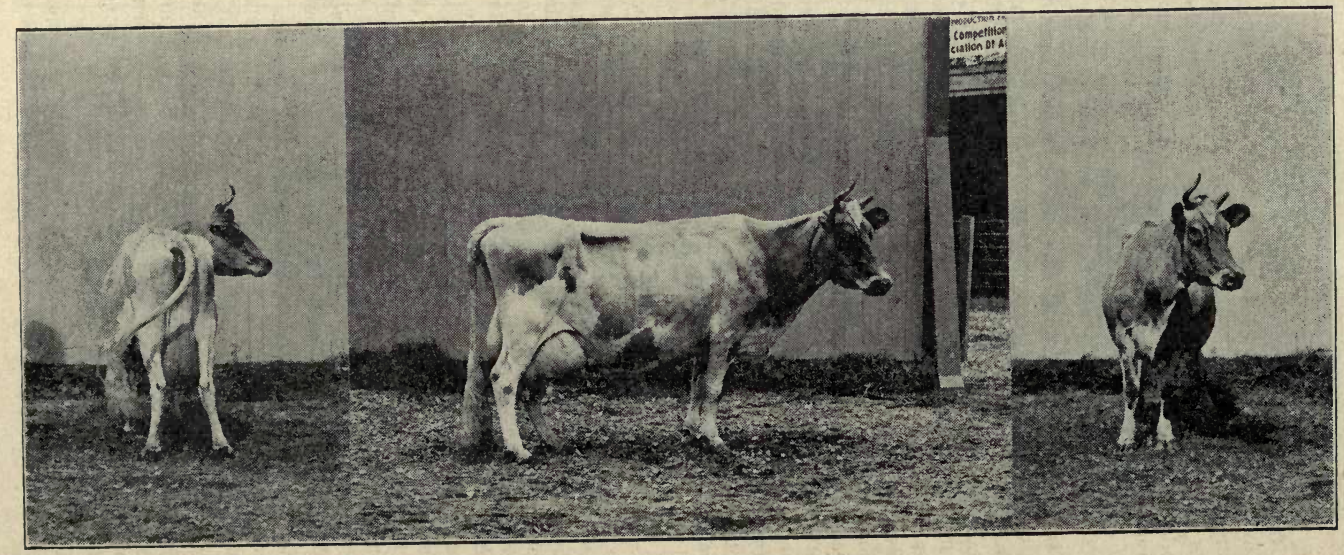

FIG. 5. A GOOD DAIRY TYPE.

per cent. of fat as in your first tests? Judging from the differences in tests shown in the above exercises, would you depend upon a single test to determine the average per cent. of butter fat in any cow's milk? A study of these differences has led to the practice of taking composite samples.

5. Collect a composite sample from one cow by placing in a sample bottle or fruit jar a very small sample of each milking for a week. Place a corrosive sublimate tablet in the bottom of the fruit jar to keep the milk from souring during the week. As a sample of each milking is added, give the jar a gentle horizontal rotary motion to mix the fresh milk with the preservative and to incorporate risen cream with the mixture. Care must be taken not to allow patches of cream to stick and dry to the sides of the jar, as it is almost impossible to mix it with the milk again, thus preventing an accurate test.

Be careful to take the same amount of milk from each milking for the composite sample. To be absolutely accurate, the same proportion or percentage of each milking should be taken. For example, if a cow gives nine quarts in the morning and twelve quarts in the evening, the evening sample should be one-third larger than the morning sample.

Weigh each milking during the week and keep a record of the weights.

Determine the per cent. of fat in the composite sample as you would in a fresh sample of milk, being sure that all cream is thoroughly broken up and distributed. It will mix more readily if warmed a little.

The per cent. of fat found will be the average per cent. of fat in your cow's milk during the week.

From the weight of milk and the per cent. of fat determine the amount of butter fat your cow produced during the week. Compute the weight of butter and its value at the regular market price.

Find out what and how much the cow has been fed daily and compute the amount she has eaten during the week. Find out the market price of the feed and determine the market value of her feed for the week.

Subtract this from the value of the butter fat for the week. Did the cow make money for the owner? Would any single week's test be an honest basis either for condemning a cow or for stamping her as a money maker?

Exhaustive studies in milk testing seem to warrant the following conclusions:

(a) The different portions of a single milking vary greatly in fat content, hence samples must always be taken from the entire milking, thoroughly mixed.

(b) With most cows the fat content of the milk varies considerably from morning to evening and from day to day. Nervous, excitable cows will vary more than quiet ones.

(c) Any irregularity in a cow or in her feed or care is apt to cause variation in the per cent. of butter fat. The test of a cow that is sick, half-starved, in strange quarters, on sudden change of feed, or badly excited from running or maltreatment or under abnormal conditions in any way is apt to be incorrect.

(d) The fat content varies considerably from the period of full flow to the period of drying up, usually growing richer.

These facts suggest the following general rules:

(a) A cow should be tested only when in normal condition.

(b) A composite sample, covering at least four consecutive milkings, is necessary for a fair test. A week is better.

(c) To determine the average fat content for an entire lactation period from one composite sample, it should be taken during the sixth

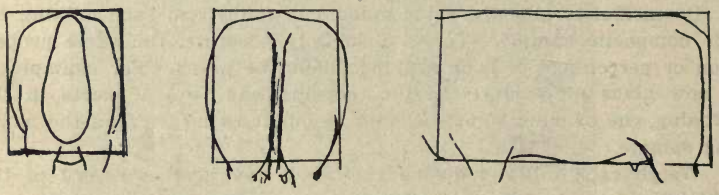

FIG. 6. SHOWING RECTANGULAR FORM OF THE BEEF TYPE.

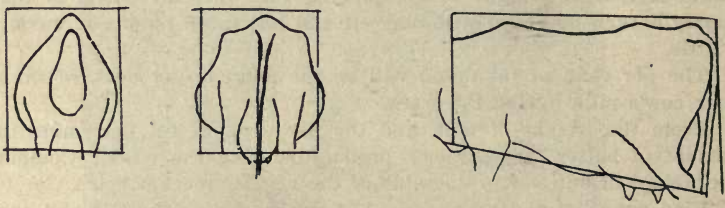

FIG. 7. SHOWING TRIANGULAR FORM OF THE DAIRY TYPE.

month from calving with spring-calving cows, from the third to the fifth month in case of summer-calving cows, and from the fifth to the seventh month with fall-calving cows.

It would be better to take two composite samples during the lactation period, taking the first from six to ten weeks after calving and the second from six to seven months after calving.

The weight of milk produced during the lactation period may be determined approximately by weighing the milk four days during the middle of each month and computing the product for that month from the average production for the four days.

If one composite test has been made for the lactation period, multiply the total weight of milk for the lactation period by the per cent. of butter fat shown in the test and the result will be the total amount of butter fat produced for the lactation period.

If two tests are made during the lactation period, use the per cent. obtained in the first test in computing butter fat in all milk produced to the halfway date between the first and the second tests. Use the second test in computing the balance.

The above methods will give a very good idea of what your individual cows are doing and should enable one to detect the boarders. Where very accurate records are kept, every milking is weighed and sampled for the entire lactation period.

6. Find out how many cow owners in your district keep a record of their individual cows. Find out how many know which cows pay and which are "star boarders." If any are found who keep records, find out their method of weighing, recording and sampling and report to the class. Compare the methods found in use. From your comparison, work out the simplest system of keeping such records.

7. Secure as many year records of individual cows as possible. Determine the market value of the product from each individual. Keep this data for further use. Secure the judgment of the owners as to what a satisfactory cow should produce. How many owners know what a good cow should produce? How many make a guess? How many have no idea?

8. Find out from the owners of the above cows as nearly as you can what and how much the cows were fed daily during different periods of the year. Find out the market value of the different feeds and determine the market value of the year's feed for the cow in question. How does this amount compare with the value of the product from the same cow? If the value of the butter fat is greater than the value of the feed, will the difference all be profit?

9. Find out probable cost of such cows as the better ones studied, if purchased when their first calf is born. Find out probable cost of raising same cow to same age instead of buying. Where is the pay for this expense to come from? Inquire how many years a cow may be depended upon to produce well. If a cow costs $75.00 and lasts five years, what is the owner really paying for the use of the cow each year? If the money were borrowed, what would the cow be obliged to pay back besides the bare first cost, or $75.00? With interest at six per cent., how much would be added to the annual charge for the use of the cow for interest on the investment? Suppose the owner furnishes his own money, should this interest charge be omitted in determining the profitableness of a cow?

10. Find out as nearly as possible the total amount of labor expended in each of three or four dairy herds in the community. Determine the cost for labor per cow per year in each case. Where must the pay for this work come from?

11. Determine approximately the cost of barns and dairy equipment in each of the dairies studied. Find out the average annual cost of repairing or renewing this equipment. Compute the interest on the cost of buildings and equipment at six per cent. Where is the interest on money invested in buildings and the cost of maintenance

to come from? What does this cost average per cow in the dairies mentioned?

12. In the preceding exercises you have worked out the principal annual charges against the dairy cow—cost of feed, portion of first cost (cost divided by probable years of service), interest on cost, cost of labor, interest on buildings and equipment, cost of maintenance and repair. Add these figures to determine the annual charge per cow for some of the better cows studied.

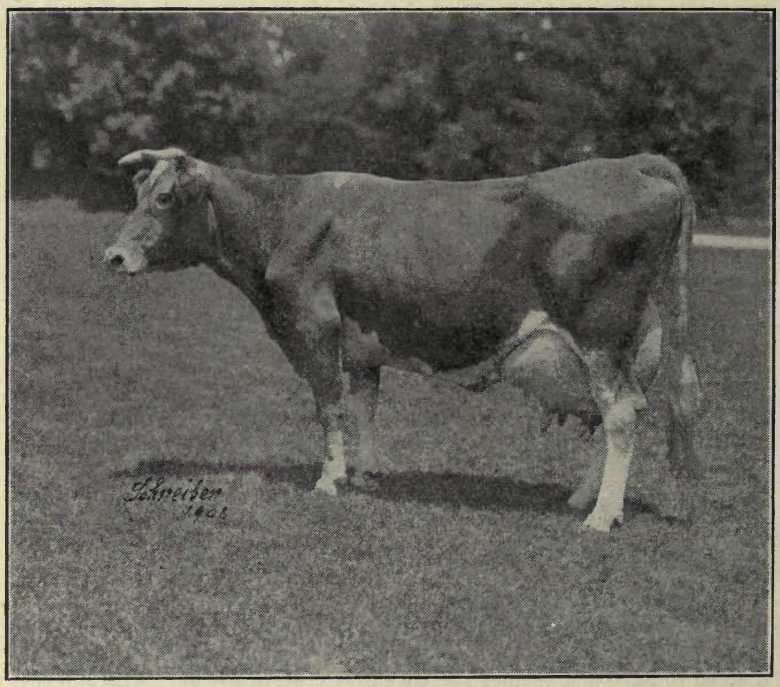

FIG. 8. AN EXCELLENT MODEL.

13. What will be done with a good cow when no longer a profitable producer? How much is usually received for such a cow in your vicinity? Divide this sum by the probable years of service and add to the value of butter fat determined in Exercise 7. Compare this amount with the total annual charge computed in Exercise 12. Is there a profit or a loss?

The exercises outlined are merely suggestive and may be increased or varied at the will of the teacher.

Testing Skim Milk and Buttermilk.

For this purpose a double-necked bottle is used. The milk, acid and water are added through the large neck, while the fat rises into

the small neck where small quantities may be read easily. Each division on the scale represents .05 per cent. (five-hundredths of one per cent.). The test is performed as with whole milk, except that 20 c. c. acid is used. Set the bottles in the tester with the large neck toward the center. The readings should be taken quickly when through whirling before the bottle has time to cool and the liquid contract, drawing the small fat column down the neck of the bottle, leaving it adhering to the sides and impossible to read.

Exercises.

1. Let each pupil test an average sample of skim milk from home. How much difference between the best and the poorest skimmed samples? What would this difference amount to in a year on a herd of ten cows, averaging 6,000 lbs. each per annum? Farmers frequently argue that this fat isn't lost because their calves or their hogs get it. Is this logical reasoning? Imagine for a minute the impossible. Imagine that the calf or pig could digest the fat eaten without loss and would increase in weight one pound for every pound of fat eaten. What would the pound of fat bring as pork? What would it bring as veal? What would it bring if recovered as butter fat by proper methods? Do you think it good farm economy to tolerate wasteful skimming because the calves or pigs get the fat?

2. Make a number of tests of milk skimmed after the cream has risen in pans or other receptacles. Compute the amount of butter fat lost per year in each case, assuming a production of 6,000 lbs. of milk per year.

3. Make a number of tests of milk skimmed by different cream separators, if available. How do these results compare with the results in Exercise 2. Subtract the average of these tests from the average of the tests in Exercise 2. At this rate how much butter fat would be saved in one year's time from the product of five cows, averaging 6,000 lbs. by using a cream separator, as compared to the old methods of skimming? At the current market price for butter, how long would it take to save the price of a $75.00 separator?

Is there considerable variation in the tests of different samples of separator skimmed milk? If so, try to find out the reason and try to find out the points necessary to observe in skimming properly with a cream separator.

4. Make several tests of buttermilk. What variations do you find? Why should more be lost in some cases than in others? Try to find out what might have been done to prevent the larger losses. Your nearest creameryman could give you much information along this line.

Testing Cream.

The details of cream testing are the same as testing whole milk, except in the following particulars:

1. A large-necked bottle made specially for testing cream is used,

as the fat in a cream sample would more than fill the neck of a milk test bottle.

2. For accurate work the sample of cream should be weighed, taking 18 grams. The weight of milk, skim milk or whey is so nearly constant that the error in measuring is insignificant, but the content of fat varies so widely in cream, depending upon the way the skimming is done, that the weight varies greatly, hence accurate testing cannot be done by measuring with a pipette. To illustrate the principle of

FIG. 9. A SPLENDID YOUNG GUERNSEY, 3½ YEARS OLD.
Official record for one year: 18,458.8 pounds of milk, containing 906.89 pounds of butter fat; equivalent to 1,058 pounds of butter.

testing in class work, the pipette may be used, bearing in mind that in practice it is permissible only when approximate results are sufficient. The use of the pipette for student use is suggested to save the expense of cream scales, which would cost practically as much as all the rest of the testing outfit.

3. In testing very rich cream it is sometimes necessary to divide the 18 grams between two bottles. In this case add enough water to each bottle to dilute to 18 grams before adding the acid. Add the readings of the two bottles for the per cent. of fat in the cream.

Two or three tests of cream should suffice to illustrate the test and show the pupils how widely the fat content of different samples will vary.

PART II.

SELECTING A DAIRY COW FROM PHYSICAL APPEARANCE.

For a great many years cattlemen have been selecting and breeding cattle for specific purposes, certain breeds being developed to produce more and better beef from a given amount of food, while others have been developed to become a machine for converting the largest possible amount of forage and grain into milk at the least cost. This course of breeding has given us the beef type and the dairy type of cattle. The beef type is well illustrated in Fig. 4 and the dairy type in Fig. 5.

A good beef animal should be approximately rectangular in general form, with all points well rounded and covered with flesh, while a good dairy cow presents a wedge-shaped appearance from any view and is sharp and angular at all points. The contrast in form as seen from side, front and hind views is shown in Figs. 6 and 7. Note how well the beef animal shown in Fig. 4 would fit into the rectangles shown in Fig. 6. Note how the form of the dairy cow shown in Fig. 5 corresponds to the forms shown in Fig. 7.

Looking at the dairy cow in Fig. 5 more in detail, note especially the following points, comparing each point with the "star boarder" in Fig. 11:

1. The great depth of body indicating a great capacity to consume food—the raw product from which the milk is made. This is one of the first essentials in a good dairy cow.

2. The splendid development of udder. See how well it is developed in front and behind and how evenly the quarters are developed and the teats placed. Study the forms of udders carefully in Figs. 8, 9 and 10. All are good models. The udder is not merely a sack where the milk is stored till milking time, but is a very highly developed gland where all the milk is manufactured from the blood, hence the importance of a large and perfectly developed udder.

3. Note the spareness of form throughout as seen in the thin neck, sharp lean shoulders, prominent hips and thin thighs.

4. Note the clean face, broad forehead and bright intelligent eye. Cows with coarse rough heads, dull eyes and coarse thick necks seldom make good milkers.

5. Note the prominence of veins on the face and limbs and the great development of milk vein extending from the udder along the abdomen toward the front legs.

Note the same features as above in Figs. 8, 9 and 10. Compare each carefully with Fig. 11. The forms in Figs. 5, 8, 9 and 10 should be carefully fixed in mind as good models. Very few cows will be fully as good but you should seek for cows approaching these models in form as nearly as possible.

To train students to examine animals critically in every detail, a score card is used as a guide in looking over an animal.

FIG. 10. A GOOD TYPE OF AYRSHIRE.

Following is the score card for dairy cows used in student work at the Washington State College:

1. Digestive Apparatus—

1. Abdomen deep and wide, giving the animal a triangular form, as seen from side and top view; ribs well arched (not dropping too soon after leaving the backbone).....20

Muzzle and jaw large, showing eating capacity..... 5

25

2. Temperament—

1. Thighs thin and in-curving..... 4
2. Hips wide and prominent but strong..... 3
3. Backbone well developed, not too deeply covered with flesh.. 3
4. Legs short, small and thin-skinned..... 4
5. Shoulders light, with sharp rather than round withers..... 4
6. Brisket V-shaped rather than U-shaped..... 2
7. Neck not fleshy..... 2
8. Skull wide in region of the brain, showing large brain..... 3

25

3. Constitution—

1. Chest deep and wide, forelegs not close together, nostrils wide and flaring. These points indicate large lungs and heart.. 8
2. Pelvic bones large, rump prominent clear to base of tail, tail long, switch well developed..... 7
3. Eyes bright, skin soft and pliant, hair smooth and glossy—all indicating health and vigor..... 5

20

4. Milk Organs—

1. Udder large, lower outline a semi-circle when distended, attachment to body long, extending far up behind and far out in front; plenty of glandular tissues within, but showing loose folds behind when empty, quarters even.....12
2. Teats good size, well shaped, easy to milk, not too close together 5
3. Milk veins, large and tortuous; veins on udder prominent, escutcheon wide and regular, extending far up (?)..... 8
4. Hips and loins wide, legs far apart, giving room for large udder 5

30

Total.....100

Fig. 12 gives the location of the various points of a dairy cow. The score card assumes a perfect animal, scoring 100 per cent. as a standard, and assigns to each point the per cent. that its importance in the makeup of a perfect cow demands. Note carefully the features that are given greatest weight. When a cow is examined on one point she is marked down from perfect just the per cent. she is thought to fall short of perfect.

The only way for a student to acquire an ability to tell how nearly perfect any given point may be is to compare a great many cows, being careful to take the best cows for a standard. Written description cannot convey an exact knowledge. For example: "Skin soft and pliable" is vague till the student has felt the hide of several good cows to know what a good cow's skin should feel like. Care should be observed not to overestimate the importance of certain minor points

listed in the score card. The following comments on the score card may be helpful:

"Abdomen deep and wide" does not mean a pot-bellied cow out of form because poorly nourished, but calls for a cow with big, broad hips, broad loin and well sprung ribs, carrying a normally large digestive apparatus, showing probable capacity to digest and consume a large amount of food. It takes a certain amount of food to keep the cow's body nourished from day to day. This may be called the food of maintenance and brings the owner no revenue. The cow that

FIG. 11. THE "STAR BOARDER."
A very undesirable type but one frequently found.

can consume the most food, in excess of the food of maintenance, and manufacture it into milk, is the most profitable cow. To assume, as many dairymen do, that it is just as well to own two mediocre cows to produce as much milk as one extra good one is a mistake. To illustrate: "A" owns two cows, each able to consume and manufacture into milk one half ton of feed for every ton consumed for maintenance. "B" owns one cow, able to consume and manufacture into milk one ton of feed for every ton consumed for maintenance. Both "A" and "B" have each the product of one ton of food to place upon the market, but to manufacture it "A" has been obliged to feed out two tons of feed to keep the machinery going, while "B" having the better manu-

facturing plant has been able to keep the necessary machinery going with one ton of feed. The lesson is plain.

In general, this desirable capacity is indicated by great depth and breadth of the abdominal region. Note that this point is given great weight in the scale of points on the score card.

Under "Temperament," points 1, 2, 3, 5, 6 and 7 are important insofar as they indicate the general tendency of the cow to throw all her surplus digested food into milk production instead of fattening her own body. None of these points help in making the milk but these characteristics are almost invariably observed on the best milkers and have come to be recognized as reasonably good indications when accompanied by equally satisfactory development of the essential

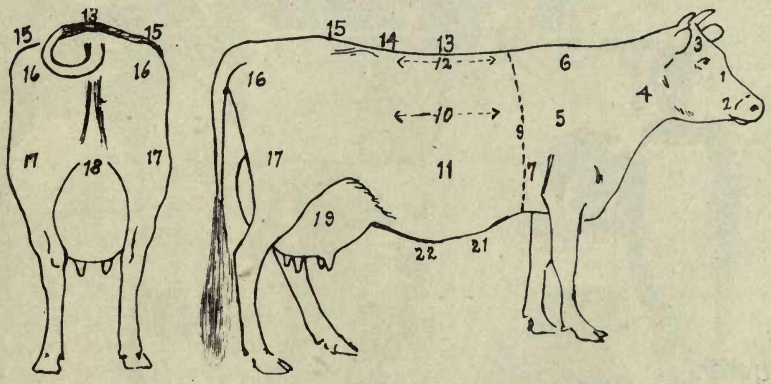

FIG. 12. LOCATION OF POINTS OF THE DAIRY COW.

1—Face. 2—Muzzle. 3—Forehead. 4—Neck. 5—Shoulder. 6—Withers. 7—Chest. 9—Girth. 10—Ribs. 11—Belly. 12—Back. 13—Chine. 14—Loin. 15—Hips. 16—Pin Bones. 17—Thighs. 18—Escutcheon. 19—Udder. 21—Milk Wells. 22—Milk Veins.

organs. Some cows have a thin neck and thighs and sharp brisket, without being good milkers, but on the other hand an extra good milker is seldom found with beefy neck and shoulders, round fat brisket and heavy thighs, or that tends to get fat as soon as fed well.

The above desirable characteristics need not be confused with a half-starved, emaciated condition. A fine dairy cow, in good working condition, will show all the spareness of form, yet will show by the brightness of her hair and eye that she is in thrifty condition. A little observation will fix this point.

"Legs short, small and thin-skinned" means not long, coarse and meaty. Very fine bone and papery skin are apt to indicate weakness of constitution and are to be avoided.

"Skull wide in region of brain, showing large brain" and "backbone well developed" are merely indications of probable strong, well controlled nervous organism. The condition of a cow's nerves determines very largely whether she will produce to the fullest of her possibilities

with proper feed. Many cow owners imagine a cow has a capacity to produce a definite amount of milk from a given quantity of feed and that she can't keep from it at milking time if she has eaten the required amount of feed. The fact is that a large part of the milk is manufactured from the blood while the cow is being milked. If the cow is worried by maltreatment, or undue disturbances about the stable, or does not like the milker, the secretion of milk will not go

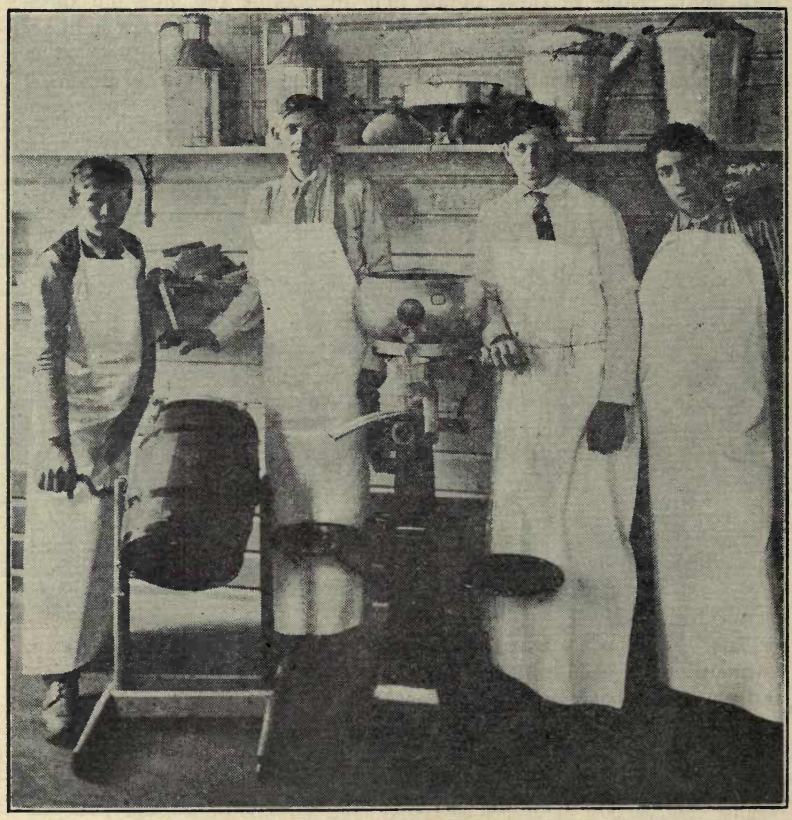

FIG. 13. DAIRY CLASS IN SNOHOMISH HIGH SCHOOL.

on properly, and a small milk flow will result. Cows vary in their own nervous control just as do human beings, and the cow with the strong brain and calm nerves is the preferable one, just as is the strong, calm-nerved man. The necessity for good heart and lung development is evident to all students of physiology.

"Pelvic bones large, rump prominent" is a further indication of ample room for the free working of vital organs and processes.

A clear eye and healthy skin are as good an indication of the health of a cow as of a human being. They indicate good digestion and assimilation so necessary to a good milk flow.

A large, well developed udder is an indication that the cow has a large development of milk secreting glands. Large milk veins generally indicate the proportion of blood, hence the proportion of digested nutriment that goes to the milk organs. Some cows with large udders are poor milkers. Their udders are meaty and do not really possess a very large gland development. Some cows with medium-sized udders are heavy milkers, because the gland development is excellent. A good udder should be flabby after milking.

The degree to which certain desirable characteristics are developed normally in a cow varies somewhat with different breeds, some showing the wedge form more prominently than others, some showing coarser bone, some a heavier skin, etc., but good milkers of whatever breed show the general characteristics outlined above.

Exercises.

1. Examine the nearest available herd and observe to what extent the different cows show the triple wedge form and large abdominal development. Select the cows that in your judgment come nearest to possessing the ideal general form. Compare notes with the owner and see whether the cows you selected are the best milkers.

2. Make a similar study of a herd for indications of correct "temperament" in the individuals.

3. Make a similar study of the herd for evidences of "constitution."

4. Make a similar study of "milk organs."

5. Select the best cow in the herd and score her with the student score card. Make liberal use of Figures 5, 8, 9 and 10 for standards.

6. Select the best, second best and third best cows in the herd and write reasons for placing them in the order that you have. Ask the owner whether your placings are correct. How much is each cow worth on the market? How does your judgment compare with the owner's judgment?

To the teacher: Repeat any or all of the above exercises as many times as time and the available material will permit. Use the score card only enough to accustom students to examine an animal in detail. Too constant use of the score card is apt to lead students to overestimate minor points. Do lots of comparing animals.