Countless studies have been made on beef carcasses with the result of a large number of factors being recorded for use in making carcass comparisons. A review has been made of many reports to determine what evaluating factors appear to be the most important from the standpoint of comparisons and yet keep the actual time required in making these observations to a minimum. It is important that more than just a small number of carcasses can be evaluated at any one time.

Numerous physical measurements can be made on the carcass. These have been covered by the paper presented by Mr. Naumann so I will endeavor to limit my remarks to physical measurements of the primal cuts.

The percentage of fat in a carcass is one of the more important factors to be determined. Berbella has stated that as the fat content of a beef rib increased, the desirability of the flavor of both lean and fat increased. The U. S. Dept. of Agriculture workers have also shown beef from fatter carcasses produced more juicy, desirable meat.

Hankins, Beard and Einer have shown that in carcasses of the same weight, the average thickness of external fat over the ribeye muscle is the best measure of grade. Mason has also stated that the quality of a carcass depends not only on the amount of fat but also on its distribution, for instance, the evenness of the subcutaneous layer, the relative proportion of subcutaneous and intermuscular fat, and the amount of marbling or intramuscular fat. He also stated that marbling should increase the cooking and eating properties of the meat.

The measurement for thickness of external fat is usually made on the cut between the twelfth and thirteenth rib and is taken at the three points on the eye muscle. The percentage of marbling can be measured accurately by ether extraction but this is not a practical proposition as a routine procedure. A visual estimation of marbling according to a standard grading system is possible and could be made on the cut surface of the eye muscle but it would require standardization to diminish the disadvantages inherent in all such subjective measurements.

Lush reported that the fat content of the entire live steer could be estimated from the percentage of fat in the edible portion of the wholesale rib cut. The estimating equation was as follows: Percentage of fat in entire live animal = 0.603 x percentage of fat in rib flesh + 3.92.

The percentage of lean and bone in the carcass are of equal importance to fat, especially as far as the consumer is concerned.

Hankins and Howe in their bulletin on the estimation of the composition of beef carcasses and cuts have shown the importance of the relationship between the ninth, tenth, and eleventh rib cut and the remainder of the carcass. Fortunately the correlation between the separable fat, lean and bone of this one sample of a carcass and the fat, lean and bone of the
entire carcass is high enough so that an approximate comparison may be made between carcasses by the use of such sample determinations.

The amount of fat could be determined by the use of chemical analysis, but this is time consuming and requires that portions of the carcass be sacrificed and rendered unsuitable for food.

Brown, Hillier, and Whatley have been conducting successful research on the use of specific gravity as a measure of the fat content of pork carcasses. Perhaps research along this line could be adapted to determining the fat content of beef carcasses as well.

Other physical measurements which may be made and are of some importance, particularly from the consumers standpoint is color of lean and color of fat.

Considerable work has been done by MacKintosh, Guilbert and others on color of beef. The use of Munsell color discs to determine color of lean, after thirty minutes exposure to air, is a measurement which requires time but could probably be adapted for most beef carcass studies. Color of fat can also be determined by the use of discs designed by Beall.

The area of the ribeye muscle is also a measurement that can be readily made either by a tracing or by determining the approximate area with two measurements as developed by Mackintosh. The latter method is by far the more rapid.

Palatability of meat is probably the most complicated factor to determine as it consists chiefly of flavor, tenderness, juiciness and odor. Tenderness is a highly desirable quality of beef and therefore should be considered in evaluating the carcass. The shear method of determining tenderness as developed by Warner and Ratzler is one of the better objective tests for tenderness.

Hall in his research on the electrical resistance of beef ribeye as a possible index to tenderness and quality came to the conclusion that palatable tender beef has a low electrical resistance. Another correlation was made at the Kansas Station by Mackintosh, Hall and Vail between ether extract of the ribeye and tenderness as judged by a palatability committee. The results indicated there was a relationship between tenderness and the amount of fat in the ribeye.

Results of Ramsbottom, Strandine, and Koonz indicate there is a variation in tenderness in different regions of the same muscle, and a variation in tenderness of different muscles within a standard wholesale cut. There is also a correlation between the shear readings and amount of collagen and elastin in the muscle. A correlation between the organoleptic tests and the amount of collagen and elastin in the muscle was also made.

From a review of literature available no objective test has been developed for satisfactory determination of flavor. To most consumers the flavor of meat is of utmost importance. If some manner of evaluating beef carcasses for flavor could be made, other than by the use of a committee, we would then have something which would mean a great deal to the meat industry.
Juiciness has been measured objectively by many meat research workers by the use of the Carver press with varying amounts of success. Satoris and Child found no difference between the press fluid from medium and good grades of heifers; however, Tannor, Clark and Hankins found a coefficient of correlation of 0.92 between the volume of press fluid and the juiciness as determined by a palatability committee. This leaves a question as to whether press fluid is a true indication of juiciness of the various beef grades.

At the present there seems to be no satisfactory method of determining odor objectively with the result that if we wish to make tests on beef we must use a palatability committee in order to assign scores for flavor and odor. If a committee is used for these two factors, then I would suggest using the committee also for scoring tenderness and juiciness.

Since the use of meat palatability committee was so well reviewed by Miss Lowe in 1949 at our conference, I will not review her paper except to say the use of such a committee is one of the most complicated of all subjective tests to make. In 1937 a committee report was made by several U. S. Department of Agriculture workers on the results of using a palatability committee to determine if there was a correlation between grades of beef and palatability. The relationship was found to be disappointingly low. The quantity of published material recording recent studies by palatability committees on beef, which could be used in evaluating beef carcasses, is indeed small.

Chemical studies that may be used in evaluating beef carcasses are few. Most chemical studies have been made on the composition of beef in determining the percentage of ether extract, ash, nitrogen compounds and moisture. Chemical determinations do not readily lend themselves to the problems of carcass evaluation and most are highly correlated to the separable lean, fat and bone of the ninth, tenth, and eleventh rib sample.

Texture of lean was found to be an indication of tenderness by Brady in his study of the factors influencing tenderness and texture of beef. The finer textured lean was more tender and the texture was dependent upon size of the fiber bundles.

In the article, "Performance Recording in Beef Cattle" by Mason, reference was made to a judging system by McMeekan and Walker of New Zealand. Beef carcasses are judged by measurement and by eye judgment as follows:

<table>
<thead>
<tr>
<th>By Measurements</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fullness of meat (width of ribeye).</td>
<td>20</td>
</tr>
<tr>
<td>2. Fat cover (thickness over outside of ribeye taken at each end and added).</td>
<td>15</td>
</tr>
<tr>
<td>3. Blockiness (length of leg in crutch).</td>
<td>20</td>
</tr>
<tr>
<td>4. Balance of carcass (forequarter minus hindquarter).</td>
<td>10</td>
</tr>
<tr>
<td>5. Weight suitability.</td>
<td>5</td>
</tr>
</tbody>
</table>
By Eye Judgment

<table>
<thead>
<tr>
<th>Points</th>
<th>By Eye Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Rib cover (muscle and fat distribution and evenness of fat distribution).</td>
<td>10</td>
</tr>
<tr>
<td>7. Color and texture of muscle.</td>
<td>5</td>
</tr>
<tr>
<td>8. Color and texture of fat.</td>
<td>5</td>
</tr>
<tr>
<td>9. Marbling of muscle.</td>
<td>5</td>
</tr>
</tbody>
</table>

Points are calculated for the measurements as follows:

1. 450-475 lb. carcass. 66 mm. maximum. 2 points off for each 3 mm. less than maximum. 1 mm. increase in maximum for each 25 lb. over 475 lb.

2. 450-475 lb. carcass. 19 mm. optimum. 1 point off for each 1 mm. over or under. 1 mm. increase in optimum for each 25 lb. over 475 lb.

3. Length of leg in distance from point of tibia to the cut edge of fat in the crutch. 450-475 lb. carcass 12 3/4 in. maximum. 1 point off for each 1/4 in. more. 1/4 in. increase in maximum for each 25 lb. over 475 lb.

4. 450-500 lb. carcass. 5 lb. maximum difference. 1 point for each 5 lb. more. For each 50 lb. increase in carcass weight the difference must be 5 lb. less, thus a 750 lb. carcass must have forequarters weighing 25 lb. less than hindquarters in order to gain 10 points.

5. Most suitable carcass weight for baby and heifer beef is given as 461-520 lb. For each 10 lb. deviation below and above these limits 1 point is lost. For chilled beef the optimum weight is 581-640 lb. and 20 lb. deviation results in a 1 point loss.

There is some merit to using a scoring system for evaluating beef carcasses such as this from New Zealand. First of all, actual measurements are made and evaluated and should give reliable information about the carcass. The measurements chosen seem to be those which could be made rapidly. Perhaps the area of the ribeye would be more suitable than its width however. Secondly, the eye judgment factors for scoring are those with which most meats men are familiar and have been used by the U. S. D. A. graders for many years and are more or less standardized. At least McMeekan and Walker have arrived at a numerical number to be assigned to a carcass which imbibes both physical measurements and subjective observations.

From the material reviewed for methods of carcass evaluation, the following have been found to be of primary importance:

1. Area of ribeye muscle.
2. Thickness of external fat.
3. Color of lean and fat.
4. Separable lean, fat and bone of ninth, tenth and eleventh rib cut.
5. Marbling grade of ribeye muscle.

Evaluations of secondary importance:

1. Tenderness score by mechanical shear.
3. Palatability rating by committee.
   
a. Tenderness.
b. Flavor.
c. Juiciness.

These evaluations are the ones which I feel we are the most justified to use as measuring sticks. No doubt many of you will not agree with my judgment. Until we can make more practical use of some of the chemical and organoleptic methods of evaluation, I think we should use as many of the physical measurements as are suitable for the desired result. They are the least time consuming, which should give an opportunity for the evaluation of more carcasses in a given time, and yet most of them have been significantly correlated with the results of palatability committees to show their importance.

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CHAIRMAN MACKINTOSH: I appreciate the manner in which this information has been collected and presented; and also, I appreciate that there are numerous questions that are in the minds of all of you which would result in further suggestions.

I would like to see included, among other things, a chart, say, in color.

Mr. Tomhave has just drawn my attention to the fact that we are encroaching seriously on the time of another committee, so we will have to forego discussion for the present, and hope that we will have time later to get the opinions and suggestions of the various members present.

Since I always forget to express my appreciation, and it should be done, I want, at this time, to express my appreciation to the members of the Committee who have done this work, and you know things always turn out better than you expect.

We talked about having the reports mimeographed. Part of this was mimeographed and was there in front of you, without my worrying about it at all.

By the time it is prepared for the report, I hope we may be able to include the various suggestions from the floor.

(Mr. W. H. Tomhave assumed the Chair.)

CHAIRMAN TOMHAVE: Thank you, Mac.
I am sure we could continue the discussion of the project of this Committee for quite some time, but we have to operate by the clock, not that we expect to be able to adhere to it absolutely, but in order to complete the program today as scheduled, it will be necessary for us to move along.

Before we go on to the report of the next Committee, I think it would be a good idea to declare a ten minute recess.

(Short recess.)

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