

AN EVALUATION OF CATTLE AND MEAT GRADES AND GRADING

by

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B. S., University of Buenos Aires, 1960

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A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

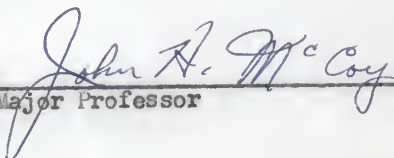
MASTER OF SCIENCE

Department of Economics and Sociology

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1963

Approved by:

  
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## INTRODUCTION

### Meaning of Commercial and Official Grading

In considering the matter of grading in relation to cattle market, it is desirable, at the outset, to define "grading".

"Grading is the sorting of products into lots, each of which has substantially homogeneous quality characteristics."<sup>1</sup>

There are two types of grading: commercial grading and official grading.

Commercial grading is the sorting of products of the same class into groups according to degree of desirability and the use of those as a basis of trading. Buyers of cattle in stockyards will vary the price they pay according to weight, finish, and their estimate of dressing percentage. That is an example of commercial grading.

Official grading is the establishment of grades by government authority, with the grades done or supervised by some governmental agency. Its purpose goes beyond the establishment of categories to serve as a basis of trading. It has as its objective the improvement of marketing conditions.

In livestock, commercial and official grading are both utilized. In the United States, a commercial grading system is used largely in the purchases of live cattle and official grades in the sale of beef.<sup>2</sup>

As the place of commercial grading in the marketing process is pretty well self-obvious, the time of this report will be spent in official grading in relation to cattle marketing.

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<sup>1</sup>Frederick Lundy Thomsen, Agricultural Marketing, (New York, 1951), p. 262.

<sup>2</sup>S. C. Barry, "The Importance of Grading in Relation to Livestock Marketing," J. Farm Econ., 33:1019, November 1951.

## The Problem

The controversy over the quality of the beef being sold to consumers that started in 1924 did much to stimulate the publication of the first Federal grade standards for beef in 1927 and the establishment of the Federal Meat Grading Service in 1928.<sup>1</sup> Since then these grades have been revised periodically, and their use has been voluntary except for the duration of World War II and the Korean War.

During and after World War II a controversy developed over the use of Federal grade standards for beef. In 1956 most of the national and a number of the independent meat packing firms wanted to abolish all federal grades. On the other hand, a substantial number of independent wholesalers, independent retailers and retail chains would have made the use of federal grading of beef compulsory.

No topic is more controversial among people concerned with livestock and meat marketing than grade standards and grading.<sup>2</sup>

As evidence of this, a two-day meeting was held in Kansas City in November 1960, which was attended by about 250 cattle producers, feeders, packers, government officials, retailers, educators and others for the sole purpose of discussing the U. S. grade standards for beef.

Some statements at this meeting will be quoted:

The rapid increasing discrimination against highly finished beef carcasses makes it mandatory for us to take immediate action to revise present standards to meet these changing conditions. (Brunel Christensen, President California Cattlemen's Association)

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<sup>1</sup>v. James Rhodes, "How the Marking of Beef Grades was Obtained," J. Farm Econ. 42:133-149, February 1960.

<sup>2</sup>Willard F. Williams, "The Role of Grade Standards and Grading in Live-stock and Meat Marketing," Oklahoma Current Farm Economics, Vol. 33, No. 4, December 1960, p. 95.

Table 1. Preference or attitudes on grading: Number of firms reporting and percentages preferring compulsory grading, the present voluntary system of Federal grades and private brands, by type of respondent, 1956.<sup>1</sup>

Type of firm	Preference on Federal grading*					Total
	Firms	Compulsory grading	Present voluntary system	Present system with improvement	Abolish	
	No.	%	%	%	%	%
National packers	6	0	0	17	83	100
Independent packers	46	9	43	13	35	100
Independent wholesalers	59	35	44	7	14	100
Jobbers....	38	45	34	8	13	100
Breakers...	21	19	62	5	14	100
Independent retailers	172	41	56	1	2	100
Retail chains	39	44	41	15	0	100

\*A few respondents, mostly independent retailers, expressing indifference were counted among those expressing preference for the present system. In the opinions of the interviewers the number of respondents who actually were indifferent was very small.

We just keep government grading about like it is and then through production, testing and breeding and selection, we would produce the type of animal, the consumer wants. (Bob Haigler, National Livestock Feeders' Assn., Bloomingburg, Ohio)

...the government beef grading system does not reflect the consumer's preference for tenderness and flavor of the different qualities of beef, that it serves little useful purpose to cattle producers and cattle feeders or to beef consumers, and that it is unrealistic and unenforceable and should not be promoted and exploited the way it is being done. (George M. Lewis, American Meat Institute, Chicago, Ill.)

<sup>1</sup>W. F. Williams, E. K. Bowen, and F. C. Genovese, "Economic Effects of U. S. Grades for Beef," U. S. Department of Agriculture Marketing Research Report No. 298, January 1959, p. 160.

We believe grading has served well the public interest and has contributed to the over-all efficiency of our marketing system." (Seth T. Saw, Safeway Stores, Inc., Oakland, California)

The present official grades standard for beef obviously are useful to the industry. This is evident from the fact that, although grading is a voluntary service, about 50 per cent of the total commercially slaughtered beef is now federally graded. (David M. Pettus, Director Livestock Division, Agricultural Marketing Service, USDA)

In such controversies, among segments of the industry and even within the same segment, which usually are concerned with immediate problems and objectives, sight of longer term considerations and of basic underlying economic goals and objectives often is lost.<sup>1</sup>

The problem is if either the abolishment of federal grades for beef animals and beef or making the use of these grades compulsory or another course of action, would create a more desirable economic environment within the industry.

### Scope of This Analysis

The objectives of this study are as follows:

- A. To trace the development of grade standards for cattle.
- B. To describe their present form.
- C. To examine the arguments against Federal cattle grading.
- D. To present the economic effects of U. S. grades for beef.
- E. To review several methods that have been used to evaluate the accuracy of grading livestock and to describe a proposed method for comparing and diagnosing the abilities of individuals to grade cattle accurately.
- F. To develop economic criteria for evaluating grading.

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<sup>1</sup>Ibid.

- G. To study the "dual" grading.
- H. To remark some conclusions.

## THE HISTORY AND DEVELOPMENT OF FEDERAL GRADES AND GRADING

### The Development of Grades and Standards

Little attention was given to the problem of classifying and grading livestock until the first decade of the 20th century. In colonial times, cattle were described by a few terms as "fat steers", "stock steers", and "cows and calves". Terms indicating origin such as "Wyoming steers", "Native cattle", and "Texas stock" appeared later. At the same time, more descriptive terms began to be used such as "export cattle", "shipping steers" and "butcher steers". There was a lack of uniformity. After 1870, the terms "Choice", "Prime", "Fair", "Medium" and "Common" were in use at some markets but definitions varied considerably.<sup>1</sup>

A series of five bulletins dealing with market classes and grades was published by the Illinois Agricultural Experiment Station during the period 1901-1908. Following these works, the USDA initiated work in developing grade standard for livestock and meat in 1916. The main purpose was to develop a market news service for livestock.

Tentative grade standards were applied by the U. S. Department of Agriculture from 1916 to 1923 in reporting livestock and meat prices. The U. S. Department of Agriculture, various agricultural State Colleges, the Chicago Livestock Exchange, packers, and several trade journals cooperated in the

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<sup>1</sup> A. A. Dowell and K. Bjorka, Livestock Marketing, (New York, 1941), pp. 285-312.



development of these tentative standards. They were used by the Armed Services during World War I.<sup>1</sup>

The tentative United States beef carcass were first published in 1923. In 1925 the National Livestock and Meat Board agreed to cooperate with the government in developing a grading service to be conducted under Government supervision. In June 1926 the tentative standards for beef with minor revisions were promulgated as official United States grades of carcass beef.

Rhodes credits Alvin Sanders, as the leading spokesman in the better beef campaign of the 1920's. Sanders argued that many customers would buy better quality beef if they knew how to get it but many eating places and retailers to not carry better quality and/or palm off very poor quality meat instead.<sup>2</sup>

In July 1926 a Better Beef Convention was held in Kansas City, Missouri, to form an organization for sponsoring a beef grading service and to consider the advisability of grading and stamping the two grades, Prime and Choice. The group formed an organization and adopted the name "Better Beef Association".

This Kansas City Better Beef Convention elected a nine-member Board of Directors. These included Thorne (New York breeder and financier), Sanders (editor of Breeder's Gazette), Tomhave (of the Aberdeen-Angus Breeders' Assn.), Harding (of the Shorthorn Breeders' Assn.), Knizer (of the Hereford Breeders' Assn.), Blayney (a Denver packer), Kleberg (manager of King Ranch and president of the Texas and Southwestern Cattle Raisers' Assn.),

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<sup>1</sup>Ibid., pp. 290-292.

<sup>2</sup>James Rhodes, op. cit., p. 134.

Shallenberger (Nebraska Congressman and Shorthorn breeder) and Told (Kansas cattle breeder and feeder). A triangular conflict arose in the grade marking controversy among the producer-promoters of well-fed, well-bred beef, other beef-type producers, and packers.<sup>1</sup>

Following this meeting, the Secretary of Agriculture agreed to provide a beef grading and stamping service for one year on an experimental basis if producers and packers could arrive at an agreement. A meeting of representative producers and packers called in December 1926 achieved general agreement. Principal features of the agreement are as follows:<sup>2</sup>

A. Prime and Choice grade steer and heifer carcasses and cuts were to be graded by the government on request.

B. Official graders were to be stationed in 10 particular cities in the Midwest and East.

C. Packers were to give the service a fair trial and assist in correcting weaknesses or deficiencies that might develop.

The official grading and stamping of beef was inaugurated May 2, 1927, and was established on a continuing basis on July 1, 1928. This was followed in the same year by official U. S. standards for grades of live slaughter cattle.

Until July 1939, the grade stamp included both the grade and the class. The official standards were revised at that time to provide a single standard of grading for all beef without consideration of the sex of the animal. Beef produced from bulls and stags must be identified by class.

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<sup>1</sup>Ibid., pp. 139-141.

<sup>2</sup>Williams, Bowen and Genovese, op. cit., p. 5.

The early grades for beef: Prime, Choice, Good, Medium, Common, Cutter and Low Cutter, were changed in the revisions of 1939 to Prime, Choice, Good, Commercial, Utility, Cutter and Canner.

Additional revisions were made effective in December 29, 1950. Prime was made a useful grade by combining the former Choice grade with the former Prime grade. The old Good grade was renamed Choice, and the higher quality young cattle previously graded Commercial became Good. The previous Commercial grade was retained for beef from older cattle previously so graded. Utility, Cutter and Canner grades were not affected by revisions. The cattle feeder was benefitted by the revisions as he was able to sell a larger portion on his grain-fed steers and heifers as Prime and Choice. The revisions also made it possible for retailers to make wider use of the Federal grades.<sup>1</sup>

The standards for live steers, heifers, and cows were combined into a single standard in 1950. Prior to the consolidation, the grades for slaughter steers and heifers were: Prime, Choice, Good, Medium, Common, Cutter and Canner. Changes were made in that year to make them coincide with reviewed standards for grades of beef.

In accordance with changes made effective June 1, 1956, the Commercial grade was split again into two grades, Standard and Commercial, on the basis of maturity. All younger cattle in the former Commercial grade not transferred in the 1950 revision to the Good grade were changed to Standard grade. It was impractical to merchandise, under the same designation, beef from these animals with only a small quantity of fat along with beef from older

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<sup>1</sup>Stewart H. Fowler, *The Marketing of Livestock and Meat*, Danville, Illinois, 1957, pp. 117-118.

animals with a much greater degree of fatness.<sup>1</sup>

The present Federal grades of live slaughter steers, heifers and cows, and beef under the "single" grading system are: Prime (cows are not eligible for this grade), Choice, Good, Standard, Commercial, Utility, Cutter and Canner.

The USDA is now studying the feasibility of making important revisions of the meat grading system. "Dual" grading of beef was started on July, 1962, on a trial basis for a one-year market test. One grade consists of the quality designations as already used, while the other part of the grade consists of yield grades ranging from 1 to 6.

#### The Growth of the Federal Grading Service

Acceptance of beef grading, following initiation of the services on a voluntary basis in May 1927, was slow. Few packers elected within the first year or two to have their beef graded and stamped with the official grades. One major packer began grading its beef with its own private brands three months after initiation of the government service.

In 1932 there were 27 qualified graders in the government service. The work had been expanded at each of the original 10 cities and had been extended to include San Francisco.<sup>2</sup>

By 1935 the city of Seattle had inaugurated compulsory regulation providing for the compulsory grading of meat according to the official U. S. standards.

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<sup>1</sup>Ibid., p. 118.

<sup>2</sup>Williams, Bowen and Genovese, op. cit., p. 8.

By 1938 nearly 9 per cent of all commercially produced beef was graded. As of December 31, 1940, there were 58 full-time and 7 part-time graders.<sup>1</sup>

Except for the two periods when price controls on meat were in force—September, 1943 to October, 1946, and May, 1951 to February, 1953—Federal grading has been strictly voluntary and performed only on request and on a self-supporting basis. Mandatory requirements for grading in both World War II and the Korean conflict gave grading the biggest boost it has ever received.<sup>2</sup>

In the postwar years, beginning in 1946, the proportion of beef federally graded dropped. The percentage of beef so graded reached an average of 24 per cent in the period 1947-50.

In 1951, compulsory grading was reestablished but in 1953, the official grading of all meats was again restored to a voluntary basis. Federal beef grading leveled off in 1954-55 at about 44 per cent of total slaughter and increased to more than 48 per cent in 1946.<sup>3</sup>

Since the end of the Korean period of compulsory grading about half of all beef has been graded. As grading is principally used for beef for fresh sale, it appears that a very high percentage of all beef of Good, Choice and Prime quality is now given Federal grading. The data refer to quantity as graded at wholesale and they should not be interpreted in terms of how much beef is actually sold by Federal grade at retail.<sup>4</sup>

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<sup>1</sup>Ibid.

<sup>2</sup>Harold F. Breimyer, The Purpose of Grading, paper at Natl. Beef Grading Conf., Kansas City, Nov. 14-15, 1960.

<sup>3</sup>Williams, Bowen, and Genovese, op. cit., pp. 9-10.

<sup>4</sup>Breimyer, op. cit.

## PRESENT FORM OF GRADE STANDARDS FOR CATTLE AND BEEF

## "Single" Grade Names

The present grades for cattle and beef, under the "single" grading system, are as follows:<sup>1</sup>

<u>Product</u>	<u>Grade Names</u>
<b>Live Animals</b>	
<b>Cattle</b>	
Bulls-----	Choice, Good, Commercial, Utility, Cutter, Canner.
Stags-----	Choice, Good, Commercial, Utility, Cutter, Canner.
Steers, heifers, and cows*-----	Prime, Choice, Good, Standard, Commercial, Utility, Cutter, Canner.
Vealers and calves-----	Prime, Choice, Good, Standard, Utility, Cull.
<b>Feeder and Stocker Cattle</b> (tentative grades)	
Cows-----	Fancy, Choice, Good, Medium, Common, Inferior.
Heifers-----	Fancy, Choice, Good, Medium, Common, Inferior.
Steers-----	Fancy, Choice, Good, Medium, Common, Inferior.
<b>Meat</b>	
<b>Beef, calf, and veal</b>	
Bull-----	Choice, Good, Commercial, Utility, Cutter, Canner.
Stag-----	Choice, Good, Commercial, Utility, Cutter, Canner.
Steers, heifer and cow**-----	Prime, Choice, Good, Standard, Commercial, Utility, Cutter, Canner.
Veal and calf-----	Prime, Choice, Good, Standard, Utility, Cull.

\* Slaughter cows are not eligible for the Prime grade.

\*\* Cow beef is not eligible for the Prime grade.

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<sup>1</sup> USDA Marketing Information Division, Grades Names, Agricultural Handbook, No. 157, Revised, February 1961.

## Factors That Determine Grade Under the Single Grading System

The present Federal grade standards for beef indicate that they are based on conformation, quality and finish. It might be more correct to say that the grades are based on conformation, quality, and maturity.<sup>1</sup>

Quality--that is, juiciness, tenderness, and flavor--is judged on the basis of marbling, color, texture, and firmness of the lean, all in relation to the maturity of the animal from which the carcass was derived.

Conformation means thickness of muscling and the proportionate development of the various parts of the carcass. The conformation of a slaughter animal influences the percentage of carcass weight in proportion to the live weight of the animal (dressing percentage), the percentage relationship of wholesale cuts to the carcass (yield in the primal cuts), and the percentage of lean, fat and bone of the carcass (boning percentage).

Finish refers to the fatness of an animal and it includes the fat on the outside surface of the carcass and on the inside of the abdominal and thoracic cavities as well as the intermuscular and intramuscular fat.

Finish, or fatness, is not used as a grade factor, though it is commonly and mistakenly believed to be. Quality of beef is judged, instead, primarily on the basis of marbling, firmness and color of lean, and maturity or age of the animal from which the carcass was derived. While marbling is associated to some degree with finish, it is much more closely associated with the fats on the inside of the carcass than the thickness of surface fat.<sup>2</sup>

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<sup>1</sup>Williams, Bowen and Genovese, op. cit., p. 7.

<sup>2</sup>"What's Ahead for Beef Grading", American Cattle Producer, Vol. 40, No. 9, February 1959, p. 20.

Therefore, in the present single grading system carcasses are given a single grade based on both conformation and quality.<sup>1</sup>



#### A Theoretical Interpretation of the Single Grade Standards

A description is presented here of the factors that determine beef grades and interrelationship among these factors. The following should be considered only as a theoretical analysis or interpretation of the standards.

Attention is focused in this analysis on (1) assumed relationships between marbling and maturity under the assumption that these are the only important factors affecting quality grade, and (2) assumed grade determining relationships between quality grade and conformation. The effects of color, texture, and firmness of lean are neglected in this theoretical interpretation.

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<sup>1</sup> USDA Livestock Division, "USDA Reports Studies on Beef Grades and Carcass Yields"--AMS-416, November 1960.

<sup>2</sup> Williams, Bowen and Genovese, *op. cit.*, pp. 194-199.



Quality Grade<sup>1</sup>. Three maturity groups are considered in the lower portion of Fig. 1: Very young, Intermediate and Maximum. The very young and the group approaching maximum maturity are mentioned directly in the standards; the "intermediate maturity" group is referred to regularly in interpretations of the standards.

Within each maturity group certain minimum marbling requirements are established for each of the grades. These requirements provide relationships between (1) marbling for each of the maturity groups, the lower scale along the bottom of the chart, and (2) "quality grade", the upper scale along the bottom of the chart.

The absolute minimum level of quality permitted in each grade is indicated by the vertical lines aa', bb', cc', and dd'. Low Prime quality is required under all circumstances for the Prime grade and low Choice quality is required for the Choice grade. Under certain conditions top Standard quality is permitted in the Good grade and top Utility quality in the Standard grade.

Conformation<sup>2</sup> Degrees of conformation associated with each of the grades and the descriptive terms for conformation are shown on the left scale of Fig. 1.

The length of the lines aa', bb', cc' and dd' represents the range of conformation allowed at the indicated absolute minimum level of quality. Prime conformation, aa', is required for the Prime grade at the minimum level of quality in the grade. Choice through Prime conformation, bb', is permitted in the Choice grade at the absolute minimum quality level for

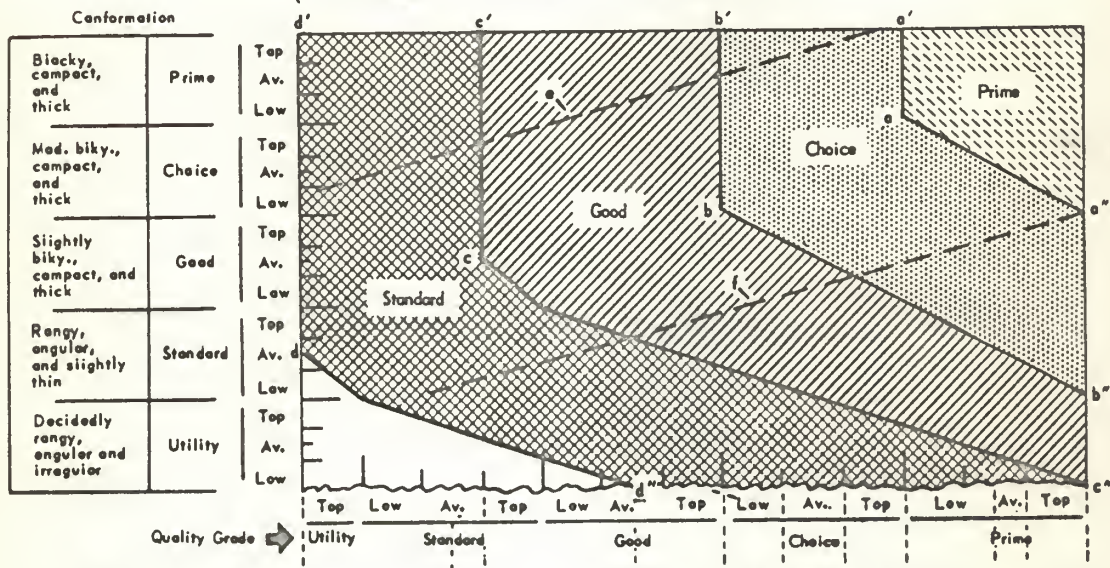
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<sup>1</sup>Ibid., pp. 184-186.

<sup>2</sup>Ibid., p. 186.

# AN INTERPRETATION OF FEDERAL GRADE STANDARDS FOR BEEF

Showing Theoretical Relationships Among Factors That Determine Grades  
(With Normal Color, Texture, and Firmness of Lean)



Degrees Of Marbling By Maturity Group	Quality Grade									
	Very young	12	11	10	9	8	7	6	5	4,3,2,1
Intermediate	12, 11	10	9	8	7	6	5	4	3, 2, 1	
Maximum	12, 11, 10	9	8	7	6	5	4	3	2, 1	

- 1. Extremely abundant
- 2. Very abundant
- 3. Abundant
- 4. Moderately abundant
- 5. Slightly abundant
- 6. Moderate
- 7. Modest
- 8. Small
- 9. Slight
- 10. Traces
- 11. Practically devoid
- 12. Devoid

a-e, b-b', c-c', d-d' indicate range of conformation at minimum levels of quality for the grade indicated  
 a-a', b-b', c-c', d-d' indicate rates of compensation within grades between conformation and quality  
 e. Practical upper limit of conformation by grade (illustrative only).  
 f. Practical lower limit of conformation by grade (illustrative only).

Figure 1

the grade. Midpoint Good through Prime conformation, cc', is acceptable at the minimum quality and top Utility quality is acceptable in the Standard grade if associated with at least midpoint Standard conformation.

Permissible Rates of Compensation Between Conformation and Quality.<sup>1</sup>

Conformation and quality are permitted to compensate for one another within certain limits at specified rates.

The line aa'' indicates the permissible rate of compensation in the Prime grade. Carcasses exhibiting low Prime conformation and low Prime quality are permitted in the Prime grade (point a). To the right of this point a half-grade increase in quality compensates for a half-grade reduction in conformation.

The line bb'' represents the permissible rate of compensation in the Choice grade. Low Choice conformation and low Choice quality are permitted in the Choice grade (point b). To the right of this point a half-grade increase in quality compensates for a half grade reduction in conformation.

The line cc'' indicates the rate of compensation in the Good grade. Carcasses exhibiting low Good conformation and low Good quality are permitted in the Good grade. This is represented on the line cc'' where the slope changes. To the left of this point an increase of a half-grade in conformation to midpoint Good is permitted to compensate for a one-third grade drop in quality to top Standard. To the right of that point compensation may take place indefinitely at the rate of a half-grade of quality for a third of a grade in conformation.

The line dd'' represents the permissible rate of compensation in the

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<sup>1</sup>Ibid., p. 187.

Standard grade. Low Standard conformation and low Standard quality is permitted in the Standard grade. To the left of this point an increase of a half-grade in conformation to midpoint Standard is permitted to compensate for a one-third grade drop in quality to top Utility. To the right of that point compensation may take place indefinitely at the rate of a half-grade of quality for a third of a grade in conformation.

In the Utility and lower grades, the rate at which quality and conformation are permitted to compensate is the same as in the Standard and Good grades, according with the established practice.

Some Implications.<sup>1</sup> 1. Theoretically the beef grade standards provide for less variation with respect to quality as the grade level increases.

2. Theoretically the variation in conformation progressively decreases as the grade level increases.

3. The dashed lines "e" and "f" indicate one assumption concerning the range of conformation ordinarily encountered within grades at particular level of quality. The area enclosed by the dashed lines may be somewhat wider or narrower than that indicated. As drawn, the lines "e" and "f" impose practical limits on both conformation and quality.

4. Differences in degrees of marbling observed in particular grades or variations in conformation within particular grades do not mean, necessarily, that the carcasses have been misgraded.

5. There is much overlapping in visual characteristics of marbling and conformation among the grades.

6. It would be more correct to say that the Federal grades for beef

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<sup>1</sup>Ibid., pp. 188-189.

are based on conformation and quality, than to say that they are based on conformation, finish and quality such as it is generally stated. No mention of finish was necessary in this discussion. Finish varies more or less directly with conformation and marbling.

7. It is logical that primal cuts of a carcass after breaking may grade differently, since in the standards excellence in one characteristic may offset deficiencies in another.

#### The Role of Marbling in Present Single Beef Grading

Marbling plays the leading role in quality measurements. The other three quality measurements, color, texture, and firmness of the lean meat play a less important role.<sup>1</sup>

Figure 1 shows the minimum marbling requirements - with normal color, texture and firmness of lean - for the prime, choice, good, standard and commercial grades of beef, by specified degrees of conformation and maturity.

The minimum marbling requirements (with normal color, texture and firmness of lean for applicable grade and maturity) for the Choice grade of beef by specified degrees of conformation and maturity, are:<sup>2</sup>

Carcass grade	Conformation equivalent	Maturity groups		
		A	B	C
	Minimum Choice or better	Small	Modest	Moderate
Choice	Mid-Point Good*	Modest	Moderate	Slightly Abundant
	Mid-Point Standard*	Moderately Abundant	Abundant	Very Abundant

\* Example only. Illustrates the extent to which more than minimum quality must be present to compensate for less than minimum conformation.

<sup>1</sup>Brunel Christensen, President California Cattlemen's Assn., paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960, p. 2.

<sup>2</sup>Ibid, p. 3.

### Maturity Groups:

- A. Red, porous chine bones, soft pearly white cartilages.
- B. Intermediate maturity for prime, choice, good or standard grades.
- C. Approaching maximum maturity for prime, choice, good or standard grades.

This shows that higher degrees of marbling can be substituted to compensate for lower degrees of conformation, but higher degrees of conformation cannot be substituted for lower degrees of marbling. In the Choice grade, for example, higher degrees of marbling can be substituted for conformation as far down as the middle of Standard. This brings to the surface that conformation is considered an important quality factor in determining present grade standards for carcass beef.<sup>1</sup>

The present single beef grades demand high degree of finish, particularly in carcasses from younger cattle, in order to secure the minimum marbling requirements.<sup>2</sup>

### New Approach to Carcass Grading. Dual Grading

This new system is available, in addition to the single system, to members of the beef trade on an optional basis for one year commencing July 1, 1962. The new system, as in the old Government grading, is entirely voluntary, to be paid for on a fee basis.

The dual grading system sets up two grade identifications, one for quality of its meat, and another for its "cutability" or yield of retail cuts.

The quality grade of a beef carcass is determined from a composite

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<sup>1</sup>Ibid.

<sup>2</sup>Ibid.

evaluation of the color, texture, firmness, and marbling of the rib eye muscle and the ossification of the bones and cartilage.

The yield grade of a beef carcass is determined by considering four characteristics: (1) the amount of external fat, (2) the amount of kidney, pelvic and heart fat, (3) the area of rib eye muscle, and (4) the carcass weight.

Marbling

Color

Texture

Firmness

Ossification of bone (maturity)

Quality grade  
(Prime, Choice, Good, Standard,  
Commercial, Utility, Cutter,  
Canner)

Fat over rib eye

Kidney and pelvic fat

Area of rib eye

Carcass weight

Yield grade  
(1, 2, 3, 4, 5, 6)

Dual grading will be treated at detail later in this report.

#### OBJECTIONS TO THE FEDERAL GRADE STANDARDS

Because grading has been a matter of intense controversy, it is worthwhile to examine some of the arguments that have been raised against the official grading of cattle and beef.

A. Federal grading is said to be an improper government intervention or encroachment on the prerogatives of business. It has been said that it interferes with the free enterprise system or that it is another form of socialism.

The Government maintains standards of length, weight and measure and no one calls this socialism. These standards aid business and add to confidence in trading. The use of the Federal grading for beef is voluntary and it is not financed by tax revenue. The only reason any carcass is graded is because some one wants to have it graded.<sup>1</sup>

B. Federal grading is said to be a form of price control because the grader actually prices the product when he puts the grade stamp on it. The grader defines the product but he does not determine the supply of the grades of beef nor the demand for them. The grader places the carcasses within broad categories and helps the formation of prices which are determined by the conditions of supply and demand.<sup>2</sup>

C. It is sometimes argued that private packer brands can be more easily adjusted and more carefully attuned to the needs of the marketplace. Private packer brands could be used to meet the specifications of certain buyers but they have not been used essentially for that purpose. Private packer brands are sold in competition with government grades, usually at a discount and if their use were applied within the Federal grading system to account for the special needs of certain types of demands, the packer brands would be expected to sell at a premium above the corresponding Federal grades. Each system of private grades is a separate language and if Federal grading were removed, markets would be narrowed, competition would be less effective and market news would be made virtually ineffective.<sup>3</sup>

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<sup>1</sup>Gerald Engelman, Issues and Problems in Beef Grading, Statements to the 11th Stockmen's Short Course, Washington State College, December 11-16, 1961 (Washington, D. C., :USDA Marketing Economic Division, 1961) p. 10.

<sup>2</sup>Ibid., pp. 10-11.

<sup>3</sup>Ibid., p. 11.



D. Some have argued that although they accept the functions of the Federal government in setting up the grade standards, the actual application of these standards is a job for employees of the packing firm where meat is slaughtered. The Federal grader has no financial interest in the meat he is called on to grade and that provides impartiality.<sup>1</sup>

E. It is said that Federal grades do not accurately sort carcasses out according to their general acceptability to consumers. It is often concluded that grades are not oriented to consumer preferences.

Virtually all taste tests indicate that some meat from Good grade carcasses scores higher than some meat from Choice grade carcasses and the same is true for other grade comparisons.

Most criticism arises from confusion about the concepts of indicators and attributes of quality in grading. The indicators of quality (finish, conformation, marbling, backfat thickness, etc.) are the visible factors that are used to segment the supply of beef into groupings. These physical factors are not the end purpose in grading. They are the external indicators of other hidden variables that are the attributes of quality (tenderness, juiciness, flavor, aroma, lean-fat ratio, etc.). The segmentation of the scale of physical indicators does not result in a segmented scale of the quality attributes. Within each grade there is a distribution of attribute scores, and the distribution for each grade overlaps the distribution of other grades. The overlap is not as serious a charge as is often implied. It is a universal characteristic of all grading. Nevertheless, the preponderance of statistical evidence available today indicates that grades are

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<sup>1</sup>Ibid., p. 12.

related to eating quality.<sup>1</sup>

Since quality in beef is a complex structure of many variables, the industry must be prepared to accept some degree of variation within the grades with respect to physical attributes of meat and some overlapping among the grades with respect to each of the various quality attributes.<sup>2</sup>

F. The grades are subjective rather than objective and this leads to many problems. (a) There is possibility of human error in grading; (b) It is difficult to trade by description when the terms used do not convey the same meaning to all concerned in the negotiations; (c) Grades are difficult to understand and the job of educating the consumer and the producer is a large one; (d) It is difficult to maintain price differentials throughout the trade channels and to the extent that the grading is imperfect the producer does not have the proper price incentive to produce those types and kinds of products that the consumer prefers.<sup>3</sup>

For most agricultural products, the development, adoption and general use of objective grade specifications would be desirable. The development of these standards is difficult, because the satisfaction that the consumer gets from the consumption of any product is subjective. The problem is how these subjective values can be transformed into objective measurements. One possible solution is to determine factors which can be described by objective measures, and which are so closely correlated with the subjective evaluations that they can be used to describe accurately these subjective values.<sup>4</sup>

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<sup>1</sup>Ibid., p. 12-16.

<sup>2</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," p. 104.

<sup>3</sup>E. S. Clifton and Geoffrey Shepherd, Objective Grade Specifications for Slaughter Steer Carcasses, Iowa State College Res. Bul. 402, Nov. 1953.

<sup>4</sup>Ibid., p. 549.

G. It is difficult to determine what characteristics designate the dividing points between grades. It is understood that those characteristics which designate grade are continuous variates, and that the dividing point between grades is some arbitrary point. However, it is essential that those using the grades use the same dividing point between grades.<sup>1</sup>

H. The names given the different grades are such that the consumer must memorize their position. The words Prime, Choice, Good, Commercial, etc., do not necessarily convey to the consumer the idea that a Good beef carcass is better than a Commercial beef carcass. In fact, it may not be better for all purposes. The grades are not so designated that any consumer who is not familiar with the grade terminology can look at the titles of the grades and understand which is the better grade.<sup>2</sup>

However, it could be assumed that grades should tell consumers and the trade only that the quality represented by one grade is different, rather than better or worse, than the quality represented by another grade. It simply would be pointed out that grades are indicators of quality differences, not levels.

I. The characteristics are not homogeneous within grades.<sup>3</sup> Each grade must have within it some degree of uniformity in order to be acceptable. Ideally the meat sorted within a grade should be interchangeable, one carcass for another.

It is an unrealizable idea. The basic requirement is that the

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<sup>1</sup>Ibid., p. 546.

<sup>2</sup>Ibid.

<sup>3</sup>Ibid.

heterogeneity within grades is less than the heterogeneity of the total supply in some particular quality attributes that are economically significant. A measure of the effectiveness of a grading system is the degree to which the heterogeneity of the total supply has been lessened by the grading process but it is not possible to realize the ideal that each carcass within a grade be perfectly substitutable for other carcasses.<sup>1</sup>

J. It is necessary to define Federal grades broadly enough to give the firms that want to use them an opportunity to sell new and improved products at a premium. This premium should be sufficiently large to constitute an incentive for firms to finance research and the advertising of products that have been differentiated on the basis of physical attributes, but not large enough to destroy all price competition and enable firms to earn monopoly's profits by differentiating the demand, i.e., selling the same product under different brand names.<sup>2</sup>

The maintenance of an economic environment in which there are incentives for producers to develop new and improve old products is an economic goal that Americans strive to achieve. However, Farris has stated the possibility that uniform grading and product differentiation may be compatible from a theoretical standpoint.<sup>3</sup>

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<sup>1</sup>Gerald Engelman, Livestock and Meat Grading-The Economic Whys and Wherefores (Washington, D. C.: USDA Marketing Economic Division, 1961), Issues in Grading Livestock and Meats, p. 3.

<sup>2</sup>W. K. McPherson, L. V. Dixon, and H. L. Chapman, Jr., An Economic and Statistical Evaluation of Grading Cattle, University of Florida Technical Bulletin 632, September 1961, p. 12.

<sup>3</sup>Paul L. Farris, "Uniform Grades and Standards, Product Differentiation and Product Development," J. Farm Econ. 42:854, November 1960.

K. It has been said that it is in the area of purchasing that the present beef grades have their greatest weakness. For example, Shaw says, there is usually a \$2 or \$3 per cwt. spread between Prime and Choice, and between Choice and Good, but there may be as much as \$12 per cwt. difference in value within the Choice grade. According to this author, the standards have served the retailer very well so far as his advertising, merchandising, and customer acceptance are concerned but they need augmenting by retailer specifications for purposes of pricing at wholesale.<sup>1</sup>

Grade standards can determine the relative importance of the attributes and estimate effects of variations in these attributes on prices and values. It is seldom possible or practicable to include all quality factors and other factors affecting price differentials among those selected as criteria for grade definition. Accordingly, Williams says, the "weakness" mentioned by Shaw with respect to use of beef grades in buying exists not so much in the grade standards as in the people who expect grades to explain all price differences.<sup>2</sup>

#### ECONOMIC EFFECTS OF UNITED STATES GRADES

In this chapter an attempt is made to describe the economic effects of Federal grades for beef. This study helps to understand much of the controversy associated with Federal grading.

Such effects are grouped into effects on (1) consumption and preferences of consumers, (2) organization and structure of the livestock and meat industry, (3) pricing efficiency, (4) operational efficiency and intrafirm

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<sup>1</sup>Willard F. Williams, Discussion: A Merchandiser's View of the Function of Grades," J. Farm Econ. Vol. 43, No. 4-5, pp. 1406-1407, December 1961.

economic relationships of firms in the market, and (5) effects on producers.

Federal grading of beef has been functioning in a dynamic industry wherein many factors have been at work to effect changes. With few exceptions, therefore, the Federal grading system for beef has not been the sole influence involved but rather it has been one of a number of factors in a generally changing scene.<sup>1</sup>

The analysis of the economic effects will be preceded by a brief consideration of general policies and attitudes on grading and grades.

#### General Policies and Attitudes on Grades and Grading

Economic effects of uniform grades and grading are expressed through the policies and decisions of the firms operating in the market.

A. General Policies on Grading. Table 2 shows policies about grading.

In each major respondent category, except national packers, 69 per cent or more of the block beef handled was stamped with U. S. grades.

The policy of national packers was to sell and to promote the sale of beef under their packer brands. On the other hand, chains generally had a policy of buying and handling federally graded beef.

B. Policies on Grades Handled. Table 3 shows the distribution among grades of federally graded product handled.

Most of the federally graded product handled by each respondent group was U. S. Choice. This is particularly true of the food chains.

The predominance of the Choice grade appears to stem from established policies at the retail level. These policies also appear responsible, to

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<sup>1</sup>Williams, Bowen and Genovese, op. cit., p. 158.

Table 2. Number of firms reporting and percentage of block beef sold federally graded, packer branded, and ungraded, by type of respondent, 1955.<sup>1</sup>

Type of firm	: Firms	: Type of Grading :			: Total
		: U. S. : : graded :	: Packer : : graded :	: Ungraded :	
	No.	%	%	%	%
National packers*	6	27	50	23	100
Independent packers	42	77	2	21	100
Independent wholesalers	53	78	1	21	100
Jobbers	32	85	2	13	100
Breakers	21	75	-**	25	100
Independent retailers	183	69	18	13	100
Retail food chains	28	94	5	1	100

\*Averages for national packers based upon only a few specific plants.

\*\*Less than 0.5 per cent.

a large extent, for the widespread practice of Federal grading. This introduces the question of the extent to which policies and practices at the retail level reflect desires and preferences of consumers.

#### Effects on Consumption and Preferences of Consumers

In combination with other factors, the Federal grading of beef may have tended to increase consumer demand for beef and to stimulate beef production.

One of the principal functions of grades is to channel each unit of a commodity into the form and use for which it is best suited. Certain changes

<sup>1</sup>Ibid., p. 159.

attributable to Federal grading may have led to cost saving in the procurement and distribution of beef. Furthermore, the policies and practices of retailers, in which Federal grading has played an important role, appear to have contributed to an up grading of the beef diet of many consumers. In combination, these factors over a period of time would have a tendency to increase consumer demand for beef, to stimulate beef production, and to increase total beef consumption.<sup>1</sup>

Table 3. Number of firms reporting and percentage distribution among grades of federally graded block beef handled, by type of respondent, 1955.<sup>2</sup>

Type of firm	: Grades of federally graded block beef handled						
	: Firms	: Prime	: Choice	: Good	: Commercial	: Other	: Total
	No.	%	%	%	%	%	%
National packers*	6	3	27	35	16	19	100
Independent packers	43	13	53	17	8	9	100
Independent wholesalers	51	18	64	8	9	1	100
Jobbers	32	14	75	8	2	1	100
Breakers	19	20	59	8	13	**	100
Independent retailers	166	7	63	23	5	2	100
Retail food chains	27	1	84	8	3	4	100

\* Percentages for national packers refer to all block beef handled in specific plants rather than the Federally graded product alone.

\*\* Less than 0.5 per cent.

The quality of beef consumed and the relative consumer demands among the grades have changed in recent years. Beef equivalent in quality to

<sup>1</sup>Ibid., p. 165.

<sup>2</sup>Ibid., p. 162.



Choice increased from 27 per cent in 1947 to 33 per cent in 1956. It has been estimated that in the former year 51 per cent of the beef consumed in the Nation consisted of qualities equivalent to Prime, Choice, and Good, while in the latter one this had increased to an estimated 58 per cent.<sup>1</sup>

Incomes of consumers have increased and consumers tend to increase the quality of food products consumed as their incomes increase. Merchandising activities of the food chains have had some effect. In addition, either basic preferences of consumers may have changed or greater use of the Federal grade standards may have permitted consumers to express existing preferences more effectively in retail markets.

It would appear that advertising and merchandising policies and practices of chains and other retailers along with increases in consumer incomes are the factors that have had the greater effect.

Researchers have already established the general similarity in acceptance of Good and Choice beef.<sup>2</sup> Most consumers, however, apparently have not been influenced in a direction contrary to their basic desires and preferences by policies and practices of retailers. For many consumers the Choice grade appears to represent the most satisfying compromise from among the Federal grades.<sup>3</sup>

The range for free expression of preferences and opportunities for selection probably has been restricted and inhibited to some extent by the merchandising practices of many retailers but the Federal grades have

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<sup>1</sup>E. S. Miller, "Beef Production by Grade," The Livestock and Meat Situation, LMS - 94 U.S. Dept. Agr. Mktg. Serv., March 1958, p. 21.

<sup>2</sup>V. James Rhodes, "Acceptance and Yield of Choice and Good Beef: Research, Results and Implications," J. Farm Econ., Vol. 43 No. 2, May 1961, p. 192.

<sup>3</sup>Williams, Bowen and Genovese, op. cit., p. 167.

assisted consumers in selecting the particular qualities or grades most desired from a wide variety of quality or grade differences.<sup>1</sup>

#### Effects on Organization and Structure of the Beef Industry

Federal grades for beef have contributed to many changes in the organization or structure of the beef wholesaling industry. Independent packers and independent meat wholesalers increased in number and volume of meat handled while packer branch houses declined greatly in number. The retail chains developed mass buying procedures and specifications tied to Federal grades. The bargaining strength of the national packer declined.

The widespread adoption of the Federal grade standards had the following types of structural effects.<sup>2</sup>

A. They tended to intensify effects resulting from growth of retail chains by contributing to development of mass buying on a specification basis. The grades encouraged the growth of independent packers which were provided with a national market.

B. They contributed to a depreciation of the packer brands of the national packers and to the decline of the packer branch house. This, however, might have happened in the absence of Federal grade standards for beef if, instead, the chains had developed their own grades or brands.

C. In providing chains with a framework for the establishment of quality specifications, they encouraged many independent packers to begin specializing by function and in the grades and qualities most desired by chains.

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<sup>1</sup>Ibid., p. 168.

<sup>2</sup>Ibid., p. 170.

D. They resulted, indirectly, in the vigorous growth of breakers and beef wholesalers. The indirect effects of grading on wholesalers more than offset the direct effects of retail chain growth on direct buying from packers. Breakers increased their business volumes mainly as a result of the growth of independent shipper-type packer in surplus meat producing areas who often rely upon independent wholesalers in deficit areas for distribution of their beef and the increased degree of specialization among independent packers.

E. Through encouraging adoption by retail chains of specifications calling for higher quality fed beef, they contributed to the development of a commercial feeding industry in the West.

#### Effects on Pricing Efficiency

Pricing efficiency refers to the accuracy, ease, and effectiveness of prices in reflecting values and value differences at each stage in the marketing system.

There seems to be some general agreement that the Federal grade standard for livestock and meat improve pricing efficiency.

A. Grading provides a more accurate language for price quotations.<sup>1</sup>

U. S. grades provide a common language, not always precise, which has become the property of all classes of firms. They are used as a basis for all principal market price reports and by some more than others in the bargaining and pricing process.

B. Grading increases the level of competition in the market.<sup>2</sup> Partially

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<sup>1</sup>Engelman, op. cit., p. 5.

<sup>2</sup>Ibid.

as a result of the increased use of Federal grades for beef, independent packers and wholesalers have increased in number, concentration in the meat-packing industry has declined and knowledge has increased. These factors have tended to increase competition.

On the other hand, the level of concentration at retail and the bargaining strength of the chains and group retailers with central buying programs have increased. As a result, some deterioration may take place in pricing efficiency. However, Federal grade standards for beef have been only one among a large number of factors contributing to the growth of large volume retailers and their contribution to the bargaining strength probably had little effect on the ultimate course of events.<sup>1</sup>

Another factor that has contributed to greater efficiency in pricing beef is the reduction of the degree of quality competition among firms tending to center this competition on price.

C. Grading enables the marketplace to more systematically allocate the available supplies of each kind and quality of meat along the various demands to the highest order of use for each.<sup>2</sup> The Prime grade, for instance, is channeled into the restaurant trade; Choice is sold predominately by retailers in medium and high income areas; the Good and Standard grades are sold principally to retailers in low and medium income areas and to highly price-conscious customers while the remaining grades are directed primarily to processors and manufacturers of prepared meats.

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<sup>1</sup> Williams, Bowen and Genovese, op. cit., pp. 173-174.

<sup>2</sup> Engelman, "Livestock and Meat Grading--The Economic Whys and Wherefores," p. 5.

D. Grading helps in achieving a measure of standardization and quality control in the merchandizing process.<sup>1</sup> Grading provides an effective available means to get as much quality control and standardization as is possible in fresh meats.

E. Within and between grade price differences.<sup>2</sup> The Federal grade standards of beef appear to have resulted in relatively narrow price differentials within the grades, and relatively wide price differentials between carcasses of equal weights in adjacent grades. One reason for this is that suppliers ordinarily do not find it financially advantageous to merchandise individual carcasses identified with U. S. grades. It appears possible, nevertheless, to merchandise federally graded beef, when so desired, and to obtain premium prices for top-of-the-grade quality.

#### Effects on Operational Efficiency and Changes in Intrafirm Economic Relationships

Operational efficiency refers to the technical input-output processes of production and the efficiency with which these processes are performed.

Standardized grading of meat has a beneficial effect on operational efficiency by:<sup>3</sup>

A. Increasing the extent of buying and selling by description. This has reduced much of the need for inspecting each carcass before purchasing and has helped to reduce the relatively costly branch house distribution

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<sup>1</sup>Ibid., p. 6.

<sup>2</sup>Williams, Bowen and Genovese, op. cit., p. viii.

<sup>3</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," p. 96.

system. Direct movement of meat to the ultimate retail outlets has been promoted.

B. Eliminating time and expense associated with arguments regarding quality. Grading has eliminated much of the time and expense in the bargaining process in arguing about the level of quality of the particular product being traded.

C. Increasing the market potential of suppliers previously operating on a local or regional basis and permitting them to sell most advantageously in a national market.

D. Widening the procurement territory of large-volume wholesalers and retailers and permitting them to buy most advantageously from among a larger number of suppliers. The enlarged market area for both buyers and sellers, which grading provides, encourages a more efficient movement of cattle and meat to ultimate outlets.

E. Encouraging specialization among suppliers by function and type of product handled and type of outlet. Grading has increased specialization. This specialization has probably increased operational efficiency.

F. Reducing the pressure among suppliers for large expenditures on competitive brand advertising. Grading has reduced the expense of competitive brand advertising and high pressure salesmanship, providing a widely known brand which becomes a common denominator.

G. Affecting the location of the processing industry by encouraging the shift of functions. Slaughtering and packing are shifting from areas of primary consumption to the areas of concentrated production and thereby eliminating the necessity of shipping hides, horns and waste products to markets where only the meat is needed.

H. Increasing the emphasis upon technological innovation, improved marketing practices, and other means of reducing costs through intensifying competition on a price basis. Federal grading of beef has resulted in numerous within plant or intrafirm changes (number of establishments, location of plants, combination and volumes of product produced, and buying and selling practices) and has tended to stimulate technological innovations. Use of the grade standards has tended to intensify competition and this, in turn, has focused attention on production and marketing costs and on means of reducing these costs.<sup>1</sup>

#### Effects on Producers

Marketing advantages obtained from grading accrue to the benefit of producers, but the benefits are obscured by a number of factors, such as imperfections in the pricing system at the retail level (merchandises policies and practices of retailers cause more or less of particular grades to be consumed than if consumers were well informed and all grades were available to them) and wholesale levels of trade (prices paid by consumers are not accurately reflected in prices obtained by packers and in price relationships at wholesale within and between the grades).

The number and degree of error in estimating age, dressing percentages, and grades of live animals also tend to dilute the direct influence on producers of carcass grading.

Nevertheless, reduced marketing costs and increased sales of higher quality beef associated with Federal grading redound to the benefit of producers.<sup>2</sup>

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<sup>1</sup>Williams, Bowen and Genovese, op. cit., p. vii.

<sup>2</sup>Williams, Bowen and Genovese, op. cit., p. viii.

## AN EVALUATION OF MEASURES OF GRADING PERFORMANCE

It may be well that the controversy over Federal grades reflects dissatisfaction with the qualities of the Federal standards being used rather than an effort of a group of firms to enhance their economic position.

If this were so, every effort should be made to determine (1) the degree of precision with which graders can use grade standards to classify beef and beef animals into homogeneous products and (2) the extent to which the grade standards themselves can be improved. Point (1) is considered in this section and (2) in the remainder of this report.

### Techniques for Measuring the Performance of Graders

The techniques that have been used to measure the accuracy with which individuals separate the parts of a heterogeneous commodity into grades fall into two general classifications--economical and statistical.<sup>1</sup>

A. Economic Measures. Price is the most commonly accepted measure of economic value. To the extent that grades provide an effective means of differentiating either products or the demand for any one product, each grade has a unique demand function.<sup>2</sup> Since price is determined by the relationship between the supply of and demand for a product and the characteristics of supply and demand functions of products differ, the relationship between the price of different grades will vary over time. For example, the spread between the prices of U. S. Good beef and U. S. Choice beef will change in response to a change in per capita income of consumers, the price

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<sup>1</sup>McPherson, Dixon, and Chapman, op. cit., p. 15.

<sup>2</sup>Ruby Turner Norris, The Theory of Consumer Demand, (New Haven: Yale University Press, 1952).



of other products, etc.

Since the price spread between product differential by grade varies in both time and space, the difference in price of two grades is not a reliable measure of the errors graders make in classifying a heterogeneous commodity with grades.<sup>1</sup>

B. Statistical Measures. Quantitative measures of the live animal graders' performances have their origin in records of estimates of the grades of carcasses expected from particular animals and the official grades of the carcasses actually produced from the same animal.<sup>2</sup>

Practically all of early investigators used some variation of regression or correlation analysis to evaluate the performance of graders.

1. Regression. The relationship between perfectly accurate live-animal grade estimates and carcass grades can be described graphically by an unbiased linear regression line  $Y = X$ . Likewise, the relationship between an individual's live-animal grade estimates and the carcass grades can be described by a biased linear regression line  $Y = a + bX$ .

A linear regression line assumes a linear relationship between the variables. However, there is no compelling reason to believe that the relationship should be linear between a grader's estimates of several grades of animals and their official carcass grades.<sup>3</sup>

2. Correlation. A correlation coefficient measures the ability of a live animal grader to rank the animals in the same order as the meat grader regardless of the accuracy of either the live-animal or carcass grades. A coefficient of correlation of 1 indicates a degree of correspondence that

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<sup>1</sup>McPherson, Dixon and Chapman, op. cit., p. 18.

<sup>2</sup>Ibid., pp. 18-19.

<sup>3</sup>Ibid., p. 20.

is represented on a graph by a straight line passing through all the points. However, this straight line would indicate a perfect grading performance only if it were identical with the unbiased regression line.<sup>1</sup>

Neither conventional regression nor correlation provides a very satisfactory technique for measuring the accuracy of graders.<sup>2</sup>

### Evaluation of Four Statistical Measures of Grading Performance<sup>3</sup> (See Appendix I for a numerical example)

The four statistical measures of grading performance compared are:

A. Percentage of correct estimates.

$$\frac{\text{Number of correct estimates}}{\text{Total number of estimates}} \times 100 = \text{Percent correct estimates.}$$

B. Percentage of estimates falling within a range of one-third of a grade below to one-third of a grade above the official carcass grade.

$$\frac{\text{Number of estimates within one-third grade above and below the official carcass grade}}{\text{Total number of estimates}} \times 100 = \text{Percentage of estimates within one-third of official carcass grade.}$$

C. Mean absolute error. The average of the absolute differences between the live grade estimates and their corresponding official carcass grades.

Algebraically:

$$\bar{d}_i = \frac{\sum_{j=1}^n (y_{ij} - X_j)}{n}$$

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<sup>1</sup>Ibid., p. 20-22.

<sup>2</sup>Ibid., p. 22.

<sup>3</sup>Ibid., pp. 22-28.

where:

$\bar{d}_i$  = the mean absolute error calculated for the  $i^{\text{th}}$  grader,

$Y_{ij}$  = the live grade estimate of the  $j^{\text{th}}$  animal by the  $i^{\text{th}}$  grader,

$X_j$  = the official carcass grade of the  $j^{\text{th}}$  animal and

$n$  = number of animals on which live grade estimates were made by the  $i^{\text{th}}$  grader.

D. Index of precision in grading. The square root of the squared differences between the live-grade estimates and their corresponding official carcass grades.

Algebraically:

$$I_p = \sqrt{\frac{\sum_{j=1}^n (Y_{ij} - X_j)^2}{n}}$$

where  $I_p$  is the index of precision, and the other symbols are defined above.

In the study "An Economic and Statistical Evaluation of Grading Cattle" conducted by the University of Florida, 3 lots of animals (A, B, C) and 26 grading performances (a grading performance is comprised of the estimates one individual makes of the grades of animals or carcasses in one lot) were used:

The array of scores by percentage of correct estimates, percentage of estimates within one-third of a Federal grade of the carcass grade, mean absolute error and index of live grading precision are given in Table 5.

The performances arranged in order of rank according to index of precision scores and compared with ranks according to scores by the three other measures are given in Table 6.

Table 4. Number of animals and number of individual grading performances by three selected lots of cattle.<sup>1</sup>

Lot	: Number of animals	: Number of Grading Performances
A	128	5
B	119	11
C	236	10
Total	483	26

The differences between ranking by the percentage of correct estimates and percentage of estimates within a third of a grade of the Federal grade originate largely from the number of estimates considered correct.

It appears that any score calculated on a portion rather than all of a grader's estimates is arbitrary and fails to adequately describe the performance.

The ranking of index of live animal grading precision and the mean absolute error evaluate all of the estimates in a performance and differ from each other only in their weighing of errors of different magnitudes (the former places more weight on large errors than on small errors and the latter gives the same weight). The fact that the ranking are almost identical tends to support a priori logic that a score evaluating all the estimates is more informative and reliable than one using only a portion of them.

If a larger number of small errors is more desirable than a smaller number of larger errors, the index of grading precision provides a better measure of a grader's ability than does the mean absolute error. Besides,

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<sup>1</sup>Ibid., p. 24.

Table 5. Array of scores by percentage of correct estimates, percentage of estimates within one-third of a federal grade of the carcass grade, mean absolute error and index of live grading precision, for 26 grading performances.<sup>1</sup>

Percentage of Correct Estimates	Per- form- ance	Percentage of Correct Estimates Within + or - 1/3 of a Federal Grade	Per- form- ance	Mean Abso- lute Error	Per- form- ance	Index of Pre- cision	Per- form- ance
33.6	5A	77.3	3A	1.03	1A	1.38	1A
31.4	8C	76.6	1A	1.05	3A	1.39	3A
29.7	1A	71.6	4C	1.06	5A	1.44	5A
29.2	6C	70.3	5A	1.11	8C	1.47	2A
28.8	9C	69.5	8C	1.12	2A	1.49	4C
28.8	1C	69.5	2A	1.13	4C	1.50	8C
28.1	2A	67.8	1C	1.16	1C	1.53	1C
27.5	7C	65.7	9C	1.24	4A	1.62	4A
27.1	4C	64.4	6C	1.25	6C	1.68	2C
26.6	4A	64.1	4A	1.28	9C	1.69	6C
26.6	3A	63.9	5C	1.30	5C	1.70	5C
25.8	5C	62.7	10C	1.32	2C	1.73	9C
25.4	10C	61.4	2C	1.34	10C	1.76	10C
25.2	7B	61.0	7C	1.38	3C	1.77	3C
22.7	10B	60.6	3C	1.39	7C	1.86	7C
22.5	2C	49.6	10B	1.59	7B	2.01	7B
22.1	6B	48.7	7B	1.62	10B	2.04	10B
21.8	2B	44.5	1B	1.70	4B	2.09	4B
21.0	4B	43.7	4B	1.74	1B	2.14	1B
20.3	3C	42.9	11B	1.73	2B	2.15	2B
20.2	8B	42.9	2B	1.76	8B	2.17	8B
20.2	1B	42.0	8B	1.82	6B	2.21	6B
19.3	9B	38.7	5B	1.87	5B	2.25	5B
17.6	5B	36.97	9B	1.91	11B	2.33	11B
16.8	11B	36.97	3B	1.99	3B	2.39	3B
16.0	3B	36.8	6B	2.08	9B	2.56	9B

<sup>1</sup>Ibid., p. 25.

Table 6. Twenty-six grading performances arrayed in order of rank according to index of precision scores, and comparison of ranks according to scores by mean absolute error, percentage of correct estimates, and percentage of estimates within + or - one-third of a federal grade.<sup>1</sup>

Performance	Index of Precision	Mean Absolute Error	Percentage of Correct Estimates	Percentage of Estimates Within + or - One-third of a Federal Grade
1A	1	1	3	2
3A	2	2	10.5	1
5A	3	3	1	4
2A	4	5	7	5
4C	5	6	9	3
8C	6	4	2	6
1C	7	7	5.5	7
4A	8	8	10.5	10
2C	9	12	16	13
6C	10	9	4	9
5C	11	11	12	11
9C	12	10	5.5	8
10C	13	13	13	12
3C	14	14	20	15
7C	15	15	8	14
7B	16	16	14	17
10B	17	17	15	16
4B	18	18	19	19
1B	19	20	21.5	18
2B	20	19	18	21
8B	21	21	21.5	22
6B	22	22	17	26
5B	23	23	24	23
11B	24	24	25	20
3B	25	25	26	25
9B	26	26	23	24

<sup>1</sup>Ibid., p. 26.

the index of precision appears to be the more useful measure because it can be broken down into two components that reveal useful information about the nature of the errors.

### A Method of Diagnosing Grading Performances<sup>1</sup>

The two components of the index of precision that describe the nature of grading errors are the mean error and the standard deviation of errors.

$$I_p = \sqrt{\frac{\sum_{j=1}^n (y_{ij} - x_j)^2}{n}} = \sqrt{\bar{d}_i^2 + s_{d_i}^2} \quad (\text{See Appendix II on a numerical example})$$

where:

$\bar{d}_i$  = the sample mean or average error of estimates or the difference between the mean of a live-grader's estimates and the mean of the official carcass grades on a lot of animals.

$s_{d_i}^2$  = a sample variance of errors of estimate around the sample mean error.

The variance  $s_{d_i}^2$  computed as a scoring formula is the sample variance in which the divisor is  $n$  (the same sample variance used as an estimate of a population variance requires a divisor of  $n-1$ )

$$s_{d_i}^2 = \frac{\sum_{j=1}^n (d_{ij} - \bar{d}_i)^2}{n}$$

A. Mean Error of Estimate. The mean error is simply a measure of the average difference between a grader's estimates of live animals and the grades

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<sup>1</sup>Ibid., pp. 29-39.

of the carcasses.

A zero mean error score ( $\bar{d}$ ) indicates that, on the average, the individual estimated the average grade of the carcass produced from a lot of animals exactly.

Since errors of over and underestimation offset each other in the calculation, the mean error scores measures only the ability of an individual to estimate the average grade of a lot of cattle correctly.

The mean error scores and ranks of 26 grading performances on the three lots of cattle are given in Table 7.

The possibility of using these mean error scores to diagnose the performance of graders is illustrated by McPherson, Dixon and Chapman in the analysis of scores made by several individuals on cattle (a) in different lots, (b) fed different rations, (c) of different breeds and (d) of different grades.<sup>1</sup>

In the case of lots, for example, the substantially smaller range of the three lots (less than 0.59) suggests that the size and composition of a lot of animal (Lots A and B consisted of steers selected for experiments designed to study the response of different breeds of cattle to different rations and lot C was made up of animals offered for sale on a single day in 1 stockyard) and/or the conditions under which they are graded may affect the mean error scores of graders appreciably.

B. Standard Deviation of Errors of Estimate. The standard deviation of error score ( $s_d$ ) around the mean error is a measure of how consistently a grader arrives at this mean error. A grader who is able to place all

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<sup>1</sup>Ibid. pp. 32-34.



Table 7. Mean error scores and rank of 26 grading performances on three lots of cattle.<sup>1</sup>

Rank	Performance	Mean Error*		
1	10C	.13		
2	4C	.16		
3	1C	.20		
4	6C	.26		
5	2C	.30		
6	5C	.34		
7	8C	.36		
8	9C	.43		
9	7C	.44		
10	2A	-.47		
11	3C	.48	A .....	-.47 to -1.06 .59
12	3A	-.49	B .....	1.29 to 1.83 .54
13	5A	-.50	C .....	.13 to .48 .35
14	1A	-.77		
15	4A	-1.06	All Lots.....	-1.06 to 1.83 2.91
16	10B	1.29		
17	2B	1.43		
18	8B	1.445		
19	7B	1.454		
20	11B	1.54		
21	4B	1.55		
22	1B	1.57		
23	6B	1.72		
24	5B	1.74		
25	3B	1.81		
26	9B	1.83		

\* Thirds of a federal grade.

animals with the same characteristics into the same grade would achieve a standard deviation of error score ( $s_d$ ) of zero regardless of how accurately he is able to estimate the correct grade of the entire lot of animals, that is, regardless of his mean error score ( $\bar{d}$ ).

The standard deviation of errors of estimate evaluates the consistency

<sup>1</sup>Ibid., p. 31

of a grader's performance. In addition to this, it also establishes the range within which 68 per cent of the errors fall on either side of what the grader considered to be an average or mean grade of the lot.

For instance, grader 5A scored a mean error ( $\bar{d}$ ) of  $-.50$  thirds of a grade above the average official grade (Table 7). The errors of over and under estimation in this mean error score resulted in a standard deviation of error score ( $s_d$ ) of  $1.35$  thirds of a grade.

For grader 5A the range within 68 per cent of grading errors fall is of  $2.70$  ( $2 \times 1.35$ ) thirds of a grade. This range is established as being from  $-1.85$  ( $-.50 - 1.35$ ) thirds of a grade below the estimated average grade of the carcasses to  $+.85$  ( $-.50 + 1.35$ ) above.

A grader who records a low standard deviation of error score ( $s_d$ ) will probably find it easier to learn how to interpret the grade standards more accurately than a grader whose errors vary widely.

McPherson, Dixon and Chapman illustrate the use of the standard deviation of error scores to diagnose the performance of graders on (a) animals in different lots, (b) animals fed different rations in lots A and B and (c) animals of different breeds comprising lots A and B.

In the case of lots, for example, the standard deviation of error scores on the animals in lot A were generally lowest, while the scores in lot C were highest, suggesting that the graders recognized animals with similar characteristics in lot A more accurately than in lot C.

Table 8. Standard deviation of error scores and rank compared with mean error rank on three lots of cattle.<sup>1</sup>

Per- form- ance	:Standard :Deviation :of Errors :Score*	: Rank on : Basis of : Standard : Deviation : of Errors	: Rank : on : Mean : Error : Score
1A	1.15	1	14
4A	1.23	2	15
3A	1.30	3	12
5A	1.35	4	13
7B	1.394	5	19
6B	1.3970	6	23
2A	1.3972	7	10
4B	1.40	8	21
5B	1.43	9	24
1B	1.45	10	22
8C	1.46	11	7
4C	1.49	12	2
1C	1.52	13	3
3B	1.57	14	25
10B	1.58	15	16
2B	1.61	16	17
8B	1.62	17	18
2C	1.66	18	5
5C	1.671	19	6
6C	1.672	20	4
9C	1.68	21	8
3C	1.71	22	11
10C	1.76	23	1
11B	1.777	24	20
9B	1.78	25	26
7C	1.81	26	9

Range of Standard Deviation of Error Scores Within Lots		
A.....	1.15 to 1.3972	.24
B.....	1.394 to 1.78	.39
C.....	1.46 to 1.81	.35
All Lots		
	1.15 to 1.81	.66

\*Thirds of a federal grade.

<sup>1</sup>Ibid., p. 37.

## Potential Uses of the Index of Precision

A. Quantitative Evaluations.<sup>1</sup> The index of precision and its two components may be used in several ways:

(1) The scores achieved by individuals on a given lot of cattle provide a basis for ranking the individuals according to their ability to estimate the average grade of a lot correctly and consistently classify animals with similar characteristics into the same group. The range in the magnitude of the mean error and standard deviation of error scores provides scale upon which the grading abilities of graders may be evaluated.

(2) The index of precision scores provides an over-all measure of ability of individuals to grade an entire lot of animals or any stratum within the lot.

It would be possible to establish a maximum value that cannot be exceeded by individuals seeking certification of graders. The index of precision provides those responsible for training graders with a practical tool.

(3) Quantitative measures of grading performances achieved by the same individuals on a specific lot of cattle provide tools for evaluating the usefulness of alternative grade standards.

It is possible to evaluate quantitatively how effectively each standard will facilitate the estimate of carcass grades having the same individuals estimate the grade of the same animals by the use of different criteria.

(4) Quantitative measures of grading performance can be used to evaluate the performance of meat graders.

The same measures used to evaluate the performance of live-animal

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<sup>1</sup>Ibid., pp. 39-44.

graders can be used to establish a standard of performance of meat graders and measure the consistency with which meat graders can recognize carcasses and cuts with similar characteristics.

B. Inferential Analysis.<sup>1</sup> A general model that takes the several components of grading errors into account might be:

$$E = f(W, X, Y, Z)$$

where:

E = the differences between estimates of grades of live animals and the final grades assigned to the carcasses.

W = interpretation of the attributes of the grade standards for live animals (age of animal, degree of conformation, finish, bone structure, etc.).

X = characteristics of external attributes of animals (color, breed, ration fed, distance hauled).

Y = characteristics of the environment in which the live grade is estimated (time available, time of day, light, temperature, angle of vision of the grader).

Z = interpretation of the attributes of the grade standards for meat (degree of marbling, cover, etc.).

Experiments are needed to determine how much of a grader's performance can be explained by the characteristics of W, X, Y, Z and how much remains in the unexplicable causes of grading errors. When estimates of the parameters of these unexplicable terms are established, it will be possible to analyze

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<sup>1</sup>Ibid., pp. 44-45.

the variance of any grader's performance and make probability statements regarding the range within his grading errors will fall. It will be possible to use confidence limits to define the minimum performance an individual must get to be certified as a grader.

More studies are needed (a) to make statistically valid statements about the accuracy with which it is possible to estimate the grade and hence, the price of cattle, (b) to establish standards for the certification of livestock and meat graders and (c) to measure the accuracy with which individuals can recognize the characteristics that are used in grade standards.<sup>1</sup>

#### ECONOMIC CRITERIA FOR EVALUATING GRADING STANDARDS

It is the purpose of this section:

- (a) to trace the effects of variations in basic assumptions;
- (b) to show the basic problem in establishing grade standards;
- (c) to set out the economic and ethical basis for developing and adapting grade standards and the minimum requirements of such grades;
- (d) to define optimum grade standards; and
- (e) to indicate the implications of optimum criteria.

#### Effects of Variations in Basic Assumptions

Part of the controversy regarding grade standards for livestock and meat stems from differences in implicit assumptions regarding the nature of quality in meat and the manner in which one grade should be related to another.

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<sup>1</sup>Ibid., p. 46.

There has been debate as to whether or not the final criterion of grading should be the consumer's preferences. Some persons argue that grades are primarily product descriptions for industry-use and that this use for consumer information is a distortion of their original purpose. Meat grades were developed with reference to consumer use, and with provision to transmit the price-expression of consumer preference back to the farmer, breeder and feeder through a system of matching grades for live animals.<sup>1</sup>

Most statements on quality in meat and grading assume implicitly that any grading system should tell consumers which grade or quality is "best", which "second best", etc. When, in this sense, grades are considered as vertically oriented, it must also be assumed that quality can be described as a single continuous variable running from some presumed "low" level of quality to some presumed "high" level.<sup>2</sup>

With this type of vertical orientation, the industry becomes much concerned with results of consumer preference studies indicating that some but not all consumers preferred the "highest" grade, or that the one of the lower grades received the most consumer votes.

Another set of assumptions could be adopted. It could be assumed that grades should tell consumers and the trade only the quality represented by one grade is different, rather than better or worse, than the quality represented by another grade. With this type of an orientation which might be termed "horizontal", it would not be necessary to assume that quality is

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<sup>1</sup>Shaw, *op. cit.*, p. 1041.

<sup>2</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," p. 99.

a single continuous variable, or that value systems of consumers are similar.<sup>1</sup>

The beef grades were originally conceived as quality standards. They attempted to classify beef carcasses into categories of eating quality. They were not called #1, #2, #3, or A, B, C, etc., because this would imply that #1 was better than #2 or that A was better than B. It was recognized that Prime was different from Choice beef, and so forth, but not necessarily better, except that certain cuts were better for certain uses. It was also recognized that it costs more to make Prime beef than Choice; therefore, it would not be produced unless someone wanted it enough to pay the higher price.<sup>2</sup>

The horizontal orientation leads to concern regarding grade names. If the grades are to be represented simply as different, neutral grades names that do not imply that one grade is "better" than another should be adopted. This might be difficult to achieve but there is little reason to think that it is an impossible task.<sup>3</sup>

#### The Basic Problem in Establishing Grade Standards

The establishment of grade standards for any commodity is essentially a problem of classification. Any system of classification is a compromise between minimizing the variation within each grade or class increasing the usefulness of the system and minimizing the cost in terms of time, effort or dollars required in making and maintaining the segregation.<sup>4</sup>

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<sup>1</sup>Ibid., p. 100.

<sup>2</sup>Shaw, op. cit., p. 1402.

<sup>3</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," p. 100.

<sup>4</sup>Ibid.



## The Economic and Ethic Basis and Minimum Requirements for Grading

A. The Economic Basis for Grading. The economic functions of a grading system relate to the abstract concepts of perfect market and perfect knowledge. Perfect market calls for uniform prices in any given market area for a given commodity at a given point in time. Perfect knowledge refers to knowledge about the demand and supply forces in the market place and about the nature of the commodity being traded for all buyers and sellers.

Grading makes its contribution to knowledge about the nature of the commodity and helps price incentives play their role in the free-market pricing system. This system is one in which the consumers are able to demonstrate their choices freely in the market place through the medium of prices.

The price signals of consumers are usually called first at the retail level. They are then reflected through the wholesale and processing levels back to producers. The pricing system operates more effectively if both parties to the trade are well informed than if they are ignorant. In this setting, the basic job of a grading system is to provide more information to all parties of the trade and to provide the means by which the level of information about the article being traded can be more nearly equalized between buyer and seller.<sup>1</sup>

The principal objective of an ideal standard should be to aid the consumer in telling the producer what he considers desirable in a produce for the particular use to be made of it.<sup>2</sup>

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<sup>1</sup>Engelman, "Livestock and Meat Grading--The Economic Whys and Wherefores," p. 4.

<sup>2</sup>Richard L. Kohls, Marketing of Agricultural Products (New York: The MacMillan Co., 1955), p. 139.

B. The Ethical Basis for Grading. Included in making markets more perfectly competitive is what Duddy and Revzan call the "ethical basis for marketing transactions...As long as no objective standard prevails there is opportunity for the strong to take advantage of the weak, for the clever and unscrupulous to outwit the unwary and trusting."<sup>1</sup>

If buyers and sellers are unequally informed, the party to the trade having less information stands the possibility of being exploited by the party having more information. The equity notion says that if a man produces a better kind of beef, he should be rewarded for it. A system of grades provides a mechanism for sending more effective price signals up and down the production-distribution line. Higher prices for the kinds of beef which consumers favor become a stimulus for producing more of these kinds. The ethical basis for grading is an extension of the philosophy underlying the development of standard weights and measures by which all trade is conducted.<sup>2</sup>

C. The Minimum Requirements. There are three principal minimum economic criteria for grading.

1. The grading system must significantly reduce the variation in basic quality attributes within at least some of the grades.<sup>3</sup>

The requirement is that the heterogeneity within grades is less than

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<sup>1</sup>Edward A. Duddy and David A. Rezan, Marketing, New York: McGraw-Hill Book Co., 1947, p. 59.

<sup>2</sup>Engelman, "Livestock and Meat Grading-The Economic Whys and Wherefores," p. 4.

<sup>3</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," p. 102.

the heterogeneity of the total supply in some particular quality attributes that are economically significant.<sup>1</sup>

2. The grading system must reflect some significant differences between at least some of the grades in basic physical quality attributes.

This ensures that two or more grades will not include precisely the same range or combination of basic physical attributes but this does not mean that there will not be some overlapping or that the grades should differ significantly in value to consumers.<sup>2</sup>

3. The grading system must result in at least some net social gain. It must provide enough increase in satisfaction or utility to more than offset the increase, if any, in costs associated with grading.

It can be said with some degree of confidence that the present grade standards for beef meet these minimum requirements and, therefore, are better than none whatever because (a) variation in quality within each of the grades probably is less than variation in the entire population of the product, (b) the grades seem to differ significantly in basic physical attributes and (c) reductions in marketing costs and revenue increases that can be attributed to grading, it appears, greatly exceed any associated direct or indirect cost increases.<sup>3</sup>

#### Requirements of an Optimum System

Clifton and Shepherd say that there are important characteristics that

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<sup>1</sup>Engelman, "Livestock and Meat Grading-The Economic Whys and Wherefores," p. 3.

<sup>2</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," p. 102.

<sup>3</sup>Ibid., p. 103.

need to be met before a grade standard could be considered an optimum grade standard. These are economic significance, consistency, simplicity, and practicality.<sup>1</sup>

A. Economic Significance. The terminology used should convey some concept to the individual of the relative value of the grades. In other words, a grade labeled Choice should have more desirable characteristics for consumption than a grade labeled Good.<sup>2</sup>

The effects of variations in basic assumptions were already discussed. Since value systems of all consumers are not the same and usefulness or value of any particular grade will differ among different uses, an effort should be made to develop neutral grade names and recognition should be given to the fact that the price of meat or livestock in any particular grade need not bear any particular relation to the price in another grade. Price is determined by supply and demand which frequently change seasonally and in other ways over periods of time.

B. Consistency. The grades should be designated in such a way that any two individuals who grade a particular group of objects would always place common attributes in the same classification.

C. Simplicity. All individuals concerned should be able to interpret the characteristics of a particular grade and to distinguish that grade from other grades. Simplicity would also indicate that a grader could quickly perform the function of grading without being forced to use complex grading methods.

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<sup>1</sup>Clifton and Shepherd, op. cit., pp. 544-545.

<sup>2</sup>Ibid.

D. Practical. It should conform as closely as possible to the existing trade practices and still be consistent with the objectives sought. The number of grades and the relative difference between the specifications of two consecutive grades should be reasonable for practical use in the market.

Williams mentions four principal criteria of an optimum system.<sup>1</sup>

A. The standard should separate units of the commodity into groups such that the within-grade variation in quality attributes will have been minimized. B. The standard should maximize differences in attributes between grades which means that overlapping should be reduced to a minimum. C. The standard should separate units of the commodity into groups such that the net social gain has been maximized. This means (a) maximizing the difference between costs of grading and the additional value of the graded product to consumers or (b) maximizing any net reduction in marketing costs. D. The final criterion is that, insofar as possible, the first three should be satisfied simultaneously; in addition, the system must be (a) simple, easily, widely and uniformly understood, (b) fixed and unchanging in a short-term sense, and, at the same time, subject to change as warranted by long-term considerations, and (c) workable in the market place.

#### Implications of Optimum Criteria

The principal relevance of the optimum criteria is in pointing the way to the kinds of research that are needed. More information is needed about the attributes that are found in meat and attributes which are important to consumers. Research is needed to delineate quality categories that are both

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<sup>1</sup>Williams, "The Role of Grade Standards and Grading in Livestock and Meat Marketing," pp. 103-104.

reasonably homogeneous with respect to physical attributes and meaningful to consumers and to derive the sets of grades that might be considered for practical workability in the market place. The net revenue received by producers would be increased by selecting the standards that minimized marketing costs and thereby increased the total consumption of the product, or increased the prices consumers were willing to pay without reducing their consumption, or had some combination of these effects.<sup>1</sup>

The development of objective grade specifications is desirable but difficult because the satisfaction that the consumer gets from the consumption of any product is subjective. The problem is how these subjective values can be transformed into objective measurements. The adoption of objective carcass grade specifications for slaughter cattle should accomplish the following objectives: (a) make possible a more accurate determination of values; (b) make market reports more intelligible; (c) assist producers in determining the kind of livestock desired by consumers; (d) aid farmers in marketing their livestock more intelligently; (e) aid consumers in the purchase of meats; (f) facilitate trading on description; and (g) aid in the maintenance of price differentials throughout the trade channels.<sup>2</sup>

#### "DUAL" GRADING

The USDA is offering the livestock and meat industry an opportunity to evaluate a new approach to beef grading. The dual grading is available from July 1, 1962, on an optional and trial basis. The present "single" grading continues to be available also.

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<sup>1</sup>Ibid., pp. 105-106.

<sup>2</sup>Clifton and Shepherd, op. cit., pp. 548-549.

## Opinions About Dual Grading

Dual grading is a controversial issue. Some opinions about this topic will be quoted:

We can see where it will definitely benefit the producer who is raising fast growing, high yielding calves that will cut out more red meat and have less wasty fat, chiefly because of superior body conformation.

Calves going through auction rings, individually, have long been graded on this basis to some extent by buyers. Often calves of outstanding conformation will bring as much as 3 cents per pound more than other calves of equal grade in finish. Producers, under our present system of USDA grading receive no premium credit for this kind of outstanding calf. Our local butchers, who buy, process, and sell calves that are never graded, do practice this kind of selection.....

We think that the basic idea of the proposed system of dual grading set up by the USDA working with the Agricultural Colleges and other Research Authorities is good.<sup>1</sup>

Since there is frequent disagreement between the packer and the government grader - and even between government graders, especially between graders in different regions of the country - these conditions and inconsistencies will become even more greatly accentuated as further demands are made to enlarge the number of divisions of each of the grades, such as contemplated under the dual-grading proposal.<sup>2</sup>

Naturally, we are opposed to dual grading and I think nobody has mentioned the fact of the cost of this situation. If we have dual grading...this is going to entail about triple the amount of the cost of grading.<sup>3</sup>

Dual grading represents the greatest possible improvement in beef grade standards that has ever been suggested during the 35-year history of beef grading.<sup>4</sup>

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<sup>1</sup>Central Texas Slaughter Calf Producers Assn., paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960.

<sup>2</sup>George M. Lewis, paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960.

<sup>3</sup>C. A. Buscher, paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960.

<sup>4</sup>Engelman, Issues and Problems in Beef Grading, p. 17.

It is proper for the segments of the meat industry to advance their side of the dual grading controversy with all the vigor they command. This section examines the new system in light of the public interest.

#### Dual Grading Sets up Two Grade Identifications

The new grading system provides two separate grades for each carcass. The two separate grades measure the two factors that determine the acceptability and value of beef:

1. The quality of the meat; and
2. The percentage of saleable meat a carcass will yield.

In the traditional beef grading system the yield of saleable meat is measured only by conformation. While conformation is an important measure of cutability, its effect can be more than offset by the effect of another factor that in current beef grading is given no direct consideration - the amount of fat over the outside of a carcass and the amount of kidney and pelvic fat.

So here are two factors - conformation and the amount of fat on a carcass that bear heavily on the yield of saleable meat, but are not necessarily related to the quality of the meat. It seems obvious they should be evaluated separately, apart from quality. And that is what dual grading does.<sup>1</sup>

#### Quality Grade Under Dual Grading

The new quality grades are essentially the same as the old "single" grades. They are based on the same factors, indicators of beef tenderness,

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<sup>1</sup> John C. Pierce, USDA Offers Dual Grading, American Cattle Producer, May 1962, p. 6.



juiciness, and flavor. These factors are:

1. Marbling (Particles of fat interspersed within the lean)
2. Color
3. Texture
4. Firmness
5. Ossification of bone (maturity)

The same grade names are used for the new quality grades. The only difference between them and the old grades bearing the names of Prime, Choice, Good, Standard, Commercial, Utility, Cutter and Canner, is that conformation will no longer be considered together with quality but will be considered separately. Conformation, as reflected through muscling, is one of the factors used to grade yield or cutability.

There is no change in the grade mark nor in the way it is rolled on the carcass in a ribbon-like imprint, but a red color is used instead of purple to distinguish between the two types of grading during the trial period.

As far as eating quality is concerned, the grade names and the grade mark will mean the same thing as always.<sup>1</sup>

#### Yield Grade

The yield grades provide the industry with a new measure of beef value, an indication of how much of the carcass weight can be sold as trimmed retail cuts.

Yield grades are based on four factors that have proved reliable

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<sup>1</sup>U. S. Department of Agriculture, Agricultural Marketing Service, "Better Marketing for Beef with a New USDA Grading System," Washington, D.C., April 1962, this publication supersedes AMS 416.

indicators of yield:<sup>1</sup>

1. Thickness of fat over the rib eye.
2. Size of the rib eye muscle.
3. Amount of kidney and pelvic fat; and
4. Carcass weight.

The greater the amount of fat over the rib eye and the greater the amount of kidney and pelvic fat, the lower the cutability. The greater the size of the rib eye in relation to weight and the more thickly muscled the carcass, the higher the cutability.

Graders can grade for yield at the same time they grade for quality, even though they determine each of these grades separately, independent of each other.

The shield-shaped yield grade mark is stamped in red on each quarter of the carcass, but it is not necessarily stamped in such a way as to show upon retail cuts as the quality grades do, since this is mainly of interest to trade.

There are six numerical yield grades, with No. 1 indicating the highest yield and No. 6 the lowest.

Each of the yield grades indicates the percentage of saleable meat the retailer can expect to cut from the carcass, or, to be more precise, the percentage of carcass weight there will be in boneless, closely trimmed retail cuts from the round, loin, rib and chuck. These four major wholesale cuts account for more than 80 per cent of the total value of the carcass.

Regardless of its quality grade, a typical carcass in, for example,

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<sup>1</sup>Ibid.

yield grade 2 could be expected to yield 2.3 per cent more of its weight in those four major cuts than a typical yield grade 3 carcass. No matter what their quality grade, all carcasses in, for instance, Yield Grade No. 2 can be expected to yield the same percentage of their weight in trimmed retail cuts.

#### Comparisons of Cutability

The combination of the four carcass characteristics already mentioned, gives an estimation in predicting the yield of lean cuts. An increase in fat thickness over the rib eye will decrease the yield of lean cuts, as well as increase in the per cent kidney fat. However, as the area of rib eye increases, there will be an increase in the yield of lean cuts. The fourth factor, carcass weight, will decrease the yield of lean cuts as carcass weight increases.

A measure of carcass muscling obtained easily is the area of the large muscle called the "rib eye", which is exposed on quartering the beef carcass between the twelfth and thirteenth rib. An average 1,000 pound slaughter steer has about 1 square inch of rib eye area per hundred weight alive. The USDA has shown that each increase of 3 square inches in rib eye area increases the carcass yield of retail cuts by about 2.0 per cent among carcasses of the same weight and fatness, which increases the carcass value about two cents per pound.<sup>1</sup>

The USDA has concluded that the negative effect of fatness is approximately twice as great as the positive effect of muscling. They found

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<sup>1</sup>Evaluation of Steers for Carcass Grade and Cutout. Texas Agricultural Progress. Vol. 6, No. 3, p. 6.

that each 0.3 inch increase in average fat thickness over the rib eye at the twelfth rib reduced the yield of retail cuts by 2.6 per cent.<sup>1</sup> Other factors remaining constant only .20 inch of additional fat over the rib eye decreases the yield of boneless retail cuts from the round, loin, rib, and chuck slightly more than 1 per cent.<sup>2</sup>

Studies indicate that each one per cent variation in kidney fat affects the yield of retail cuts from the round, loin, rib and chuck from 1 to 1 1/4 per cent.<sup>3</sup>

Weight and structure of an animal are important factors influencing the yield of retail cuts. As the animal matures it accumulates fat at an increasing rate while the growth rate of muscles declines. Because of this an increase in carcass weight lowers cutability.

Each yield grade has a range of 2.3 per cent yield of boneless round, loin, rib and chuck. "At recent prices for Choice grade beef, this range in yield of cuts within each grade represents a range in retail sales value of about \$3 per hundred."<sup>4</sup>

The effect of variation in cutability within the quality grade is quite significant.

...similar weight Choice grade carcasses ranged in yields of trimmed boneless cuts from the round, loin, rib, and chuck from 55.0 down to 40.6 per cent of their carcass weight. The significance of these variations is indicated by the fact that, at the present time, each 1 per cent change in cutability is equal to

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<sup>1</sup>Ibid.

<sup>2</sup>David M. Pettus, Director, USDA Livestock Division, paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960.

<sup>3</sup>Philip D. Weiner, "Dual Grading for Quality and Quantity," The Kansas Agricultural Situation, Vol. 39, No. 3, August 1962, p. 7.

<sup>4</sup>Pettus, op. cit.

about \$1.25 per hundred difference in the value of Choice grade carcasses, or about 75 cents per hundred on a liveweight basis. This means we found a variation in retail value between some thousand-pound Choice cattle of over \$100. While it should be emphasized that such a variation in value is unusual, many Choice carcasses of similar weight have varied in total cutout value by more than \$25.<sup>1</sup>

A report of the USDA presents an example of two steers that weighed the same - 1150 pounds - and graded the same - U. S. Choice. They brought their producers the same price but the difference in value to retailer was more than \$70.<sup>2</sup>

Table 9 is a comparison of the cutability of two carcasses. This shows how dual grading is used to estimate the difference in major boneless cuts. The yield grade finder places carcass A in yield grade 2 and carcass B in yield grade 6. The use of a retail sales value difference of \$3.00 per hundred weight for each yield grade would make carcass A worth \$12.00 more per hundred weight than carcass B.

#### Dual Grading and Conformation

The quality grade under the dual grading is determined by considering the marbling, color, texture, firmness of lean and ossification of bone (maturity).

Conformation is not considered as a factor in determining the quality grade but it is given consideration in the yield grade.

In the Choice grade, for example, conformation is not used to determine the grade of the carcass on the basis of the quality of its meat. The dual

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<sup>1</sup>Ibid.

<sup>2</sup>U. S. Department of Agriculture, Livestock Division. "USDA Reports Studies on Beef Grades and Carcass Yields," AMS-416, November 1960.

Table 9. Comparison of cutability of two carcasses.<sup>1</sup>

	: Carcass A	: Carcass B
Carcass quality grade	U. S. Choice	U. S. Choice
Rib eye area	13 square inches	9 square inches
Fat thickness over rib eye	.3 inch	1.2 inch
Weight kidney fat	16 pounds	28 pounds
Carcass weight	700 pounds	700 pounds
Yield grade	2	6
Per cent major boneless cuts (from round, loin, rib and chuck)	50.9	42.9
Per cent other retail cuts	18.9	17.1
Per cent fat	16.6	26.9
Per cent Bone	13.6	13.1
Retail value of carcass	\$517.72	\$444.07

system opens the gate to the Choice grade to carcass having the lowest and highest degrees of conformation provided they have the minimum marbling, color, texture and firmness of lean.

#### Dual Grading and Marbling

The role of marbling in the single grading system was already considered. It was showed that the marbling requirements for the "A" maturity group in the choice grade, for instance, ranged from "small" for the conformation equivalent of minimum Choice or better to "moderately abundant" for the

<sup>1</sup>Ibid.

mid-point Standard.

Since conformation is not used under the dual system to determine the quality grade, the minimum marbling requirements in each maturity group are those in the highest conformation equivalent. For the Choice grade the minimum is "small" for the "A" group, modest for the "B" group and "moderate" for the "C" group.

This means that the minimum marbling requirements are lowered several degrees in each maturity group at the expense of carcasses with minimum Choice or better conformation.<sup>1</sup>

Research is beginning to find that high finish and marbling are not the only criteria that assure good eating beef. It is now believed that genetic differences account for a large part of the difference in tenderness. Research carried on by the Department of Agriculture at Beltsville, Maryland, for example, indicates that tenderness is around 60 per cent heritable.

Dr. Kiehl reported, on the basis of a consumer survey completed at the University of Missouri designed to determine the eating evaluation of beef loin steaks from cattle of intermediate maturity, that there was virtually no correlation between the marbling scores and eating acceptability. The average eating acceptability was similar for all degrees of marbling except for the very extreme.

The University of California found 18-month-old steer carcasses more tender than 30-month-old steer carcasses having more marbling, higher finish and higher composite grade scores.<sup>2</sup>

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<sup>1</sup>Western Beef Producers, paper at Natl. Beef Grading Conf., Kansas City Nov. 14-15, 1960, p. 6.

<sup>2</sup>Ibid., p. 8.

These research indicate that marbling requirements of the "single" grading system could be lowered slightly without sacrificing quality.<sup>1</sup>

#### Some Probable Effects of Dual Grading

A. Producers, Breeders, Feeders. For producers, breeders and feeders, there is opportunity to identify and expand production of meat-type beef cattle - to receive more money for meatier cattle.<sup>2</sup>

Dual grading encourages price differential between kinds of carcasses that have been selling at the same price but have differences in cutability. For instance, at today's prices, a carcass with choice quality would be worth approximately \$3 more per cwt. for each increase in yield grade.<sup>3</sup>

If retailers start to buy carcasses on the basis of yield as well as quality grade, meat packers are going to start buying slaughter cattle on the same basis. Cutability can be recognized in live cattle with a very workable degree of accuracy.

The typical beef steer with high cutability (and Choice quality) is one with good conformation - thick muscling over the back; deep, wide, plump rounds; full, meaty rumps and full ribs. It has a thin fat covering, a trim brisket and a firm finish. The low-yielding animal is thinly muscled, has a thick fat covering, is often patchy with a heavy brisket and has very full flanks.<sup>4</sup>

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<sup>1</sup>Ibid.

<sup>2</sup>U. S. Department of Agriculture, Livestock Division. "Better Marketing for Beef with a new USDA Grading System," Washington, D. C., April 1962, this publication supersedes AMS-416.

<sup>3</sup>Pierce, op. cit., p. 7.

<sup>4</sup>Ibid.



Science has come to the aid of the livestock judge. Characteristics of live animals which denote meat quality can be determined with an ultrasonic device, called the sonoscope. It measures the thickness of the fat over the 12th rib and indicates the size of the loin eye muscle. The instrument also indicates the amount of fat that is intermingled within the lean. The machine is not yet perfected but has been tested to be 93 per cent accurate. If perfected, the sonoscope could mean a great deal to livestock producers. Since herd replacement prospects cannot be slaughtered to determine their desirability, the device would be of tremendous value for selecting breeding stock.<sup>1</sup>

Dual grading provides a much more accurate language for price quotations and for conducting trading activities. It helps to provide more effective price incentives for ranchers and feeders to produce beef animals yielding a higher proportion of the lean meat that consumers want at the several different levels of beef quality.<sup>2</sup>

It has been said that:

Dual grading will penalize the producers of long fed cattle.

Dual grading if instituted will discourage long fed cattle and thus the government will be guilty of issuing an edict that will create further surpluses of corn that could run into millions of bushels.

.....it is our considered opinion that a monetary loss for the cattle feeders over a period of time is inevitable with dual grading.<sup>3</sup>

However, the high-yielding animal is the product of breeding rather

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<sup>1</sup>Thomas Kay. "Ultrasonic Device Measures Beef Quality," Ag Student, Manhattan, Kansas: Kansas State University, May 1962, p. 9.

<sup>2</sup>Engelman, Issues and Problems in Beef Grading, p. 17.

<sup>3</sup>Lester B. Bookey, paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960.

than any special type of feeding. The meat-type steer simply seems to be able to convert more of its feed to quality meat than can others that may eat the same amount but convert a lot of their feed to excess fat. The meat-type steer with high-quality meat is not simply a product of a shorter turn in the feed lot. A shorter feed for beef cattle could, in fact, jeopardize the present high acceptability that beef enjoys.<sup>1</sup>

B. Market Agencies. For market agencies there is opportunity to render better service to producers, to obtain prices more closely commensurate with values.<sup>2</sup>

Dual grading might accelerate the necessity for buying livestock on a grade and yield basis and might develop a trend away from buying at auction markets and terminal yards.<sup>3</sup>

C. Meat Packers. For meat packers there is opportunity for better merchandising, to create more widespread demand for all kinds of carcasses.

The cost of grading carcasses would appear to be very small and of little consequence. However, the packers are reluctant to adopt any change which represents a cash outlay for them with little chance of recovering this outlay.<sup>4</sup>

The dual grading standard provides a method of grading the carcass that is more consistent over time and geographical areas than the single system.

Evaluating carcasses for variations in factors used to determine yield

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<sup>1</sup>Pierce, op. cit., p. 7.

<sup>2</sup>USDA, "Better Marketing for Beef with a New USDA Grading System."

<sup>3</sup>Fred Doehne, paper at Natl. Beef Grading Conf., Kansas City, November 14-15, 1960.

<sup>4</sup>Clifton and Shepherd, op. cit., p. 565.

grade may sound somewhat complicated. This is undoubtedly because it is a new approach to grading. The experience in testing this procedure has not indicated it to be a difficult one. These tests have indicated that practically no carcasses actually have to be measured to determine their yield grade. On most carcasses graders were able to estimate these factors and combine them into a yield grade with a satisfactory degree of accuracy and speed. However, in case of disagreement these factors can be measured and the yield grade determined very accurately.<sup>1</sup>

D. Wholesalers, Retailers, Institutional Buyers. There is opportunity for wholesalers, retailers and institutional buyers to order and to price more efficiently, save on marketing costs and offer consumers the kind of meat they want to buy.<sup>2</sup>

To the retailer, the cutability of a carcass has a real monetary significance. Variation in carcass within the Choice grade which result in differences in yield of the preferred retail cuts (trimmed cuts from the full loin, rib, square cut chuck, and round) is of as much as 9 per cent. Translated into monetary terms, this means a difference in carcass cut-out realization of approximately 10 cents per pound at current retail price levels.<sup>3</sup>

Under the dual grading system each carcass is given a separate identification for cutability whereas in the single grading system variation in this factor is masked because of the necessity of combining it with quality into a single grade designation.

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<sup>1</sup>Pettus, op. cit.

<sup>2</sup>USDA, "Better Marketing for Beef with a new USDA Grading System."

<sup>3</sup>"What's Ahead for Beef Grading," American Cattle Producer, Feb. 1959, p. 20.

It has been said that, for example, two chains can advertise USDA Choice beef though one chain bought Choice No. 1 with all the desirability at 43¢ per pound and the other chain bought Choice No. 6 at 37¢ per pound. However, the quality is more uniform under the dual grading system than under the single system and differences in purchase prices are offset by differences in yields of retail cuts.

E. Consumers. There is opportunity for consumers to buy beef of more consistent quality, with less waste fat. Saving in marketing system could help hold down prices.<sup>1</sup>

Under the dual grading system all meat of the same quality is in the same grade. In the single grading system there is a considerable amount of overlap in quality between grades particularly in Good and Choice and it is not unusual to have some carcasses in the Good and Choice grades with Choice and Prime quality, respectively, because they have an inferior development of conformation.

Widespread production of the meat-type steer will mean saving in the marketing system - less waste fat to be transported, trimmed off and disposed of, more lean meat.

Dual grading offers a means to help fulfill consumer desires for high quality beef with a minimum of trimmable fat.

#### CONCLUSIONS

In this section some remarks are made on the most important conclusions presented earlier. Additional conclusions can be found in the respective

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<sup>1</sup>USDA, "Better Marketing for Beef with a New USDA Grading System."

sections in the text.

I. No topic is more controversial among people concerned with livestock and meat marketing than grade standards and grading. In such controversy sight of long term considerations and of economic goals and objectives often is lost.

II. The marking of federal grades was born in controversy generated by conflicting economic interests. A review of the factors behind the first marking of federal grades of beef dispels any notion about a neutral role of grades in the economy. To show the non-neutrality of grades is not synonymous with criticizing grades. Neutral grades would be useless.

Greater use of grading following periods when it was mandatory could be partly interpreted as the carryover effect of familiarity or as mere inertia. A more complete explanation requires consideration of the growth of mass retailing by supermarket and large chains stores that have sponsored use of Federal grading.

III. There are two systems available to the industry on the same voluntary basis. The traditional single beef grading is a reliable measure of quality. It also includes an evaluation of conformation. Its major shortcoming in today's market is that it gives no consideration to the amount of excess fat that must be trimmed from retail cuts to meet consumer demands, the most important factor affecting yield of saleable meats. Consideration of the new dual grading is deferred to point VIII.

IV. Because grading has been a matter of intense discussion, it was worthwhile to examine some of the arguments that have been raised against the official grading. One of the most important is that grades are not "oriented to consumer preferences." Since quality in beef is a complex

structure of many variables, the industry must be prepared to accept some degree of variation within the grades with respect to physical attributes of meat and some overlapping among the grades with respect to each of the various quality attributes. It is necessary to distinguish the concepts of indicators and attributes of quality in grading.

V. The Federal grades for beef have tended to improve the competitive positions of independent packers, retail food chains and other large grocery retailers relatively to the positions of the national packers, their sale branches and other packers that depend heavily on private brands. They have contributed to the shift in the location of slaughter towards producing areas and to decentralizations of slaughter within those areas.

The range for free expressions of preferences and opportunities for selection probably has been restricted to some extent by the merchandising practices of many retailers but the Federal grades have assisted consumers in selecting the particular qualities or grades most desired from a variety of quality or grade differences. For many consumers the Choice grade might represent the most satisfying compromise from among the Federal grades. It is doubtful that the promotional efforts of the retailers would have been so successful if this were not true.

VI. It may be that some of the controversy over Federal grades reflects dissatisfaction with the degree of precision with which graders can use grade standards to classify beef and beef animals into homogeneous products. The personnel of the grading service must thoroughly be schooled in the interpretation of the specifications and techniques such as those studied in this report should be tried in the training and selection of graders.

VII. Most statements on quality in meat and grading assume implicitly

that any grading system should tell consumers which grade or quality is "best", which "second best", etc. It could be assumed, instead, that grades should tell consumers and the trade only that the quality represented by one grade is different, rather than better or worse, than the quality represented by another grade.

One of the nation's most highly valued economic objectives is an economic environment in which there is a high degree of price competition. The abolition of Federal grades would enhance economic power and hence the profits of the firms having the initiative and resources to establish private brands. The laws designed to curb monopolies and establish rules for fair trading seem to justify the assumption that the public will hesitate to abolish the use of Federal grades.

It can be said with some degree of confidence that the present grade standards for beef meet minimum requirements and, therefore, are better than none whatever, because (1) variation in quality within each of the grades is less than variation in the entire population, (2) the grades seem to differ significantly in basic physical attributes, and (3) reductions in marketing costs and revenue increases that can be attributed to grading, it appears, exceed any associated direct and indirect cost increases.

The implications of optimum criteria suggest that if the present grade standards satisfy the minimum economic requirements, the emphasis should be on ways and means of improving their usefulness. Some improvement in the marketing of livestock that would arise from the development and use of objective grade standards include: (1) more intelligible market news information, (2) a more accurate determination of the value of individual animals, and (3) a change in production toward those types and classes of

livestock preferred by the consumer.

VIII. The dual grading system which separate variations in quality from variations in cutability represents an improvement provided that carcasses can be classified as to cutability accurately and inexpensively. The separation of quality and cutability factors reduces the unknown variations in physical attributes within each grade that must be considered in buying and selling carcasses. Assuming that official graders can accurately classify carcasses as to cutability dual grading would improve the usefulness of grading and reduce marketing costs (or increase values) sufficiently to pay for the associated extra cost and inconvenience of grading.

For cattlemen, the new grading system could be significant. It could mean more money for "meat-type" cattle, a greater share of the consumer's meat dollar, and, as a long range prospect, a means of holding on to and increasing the leading position that beef occupies in today's market, because: (1) dual grading offers a way to identify, not only quality of meat, but also yield or percent of trimmed retail cuts from a carcass, thus a way to pay the producer a price which more nearly reflects the true market value of his cattle, (2) dual grading should encourage the production of meatier cattle, thus reducing some of the marketing cost of trimming and transportation of waste fat, a saving that should reflect back to the producer, and (3) dual grading offers a means to help fulfill consumer desires for high quality beef with a minimum of trimmable fat, thus a way to retain and even increase the popularity that beef enjoys today.



## ACKNOWLEDGMENT

The author wishes to thank Dr. John H. McCoy, his major instructor, for his help and encouragement in work on this problem.

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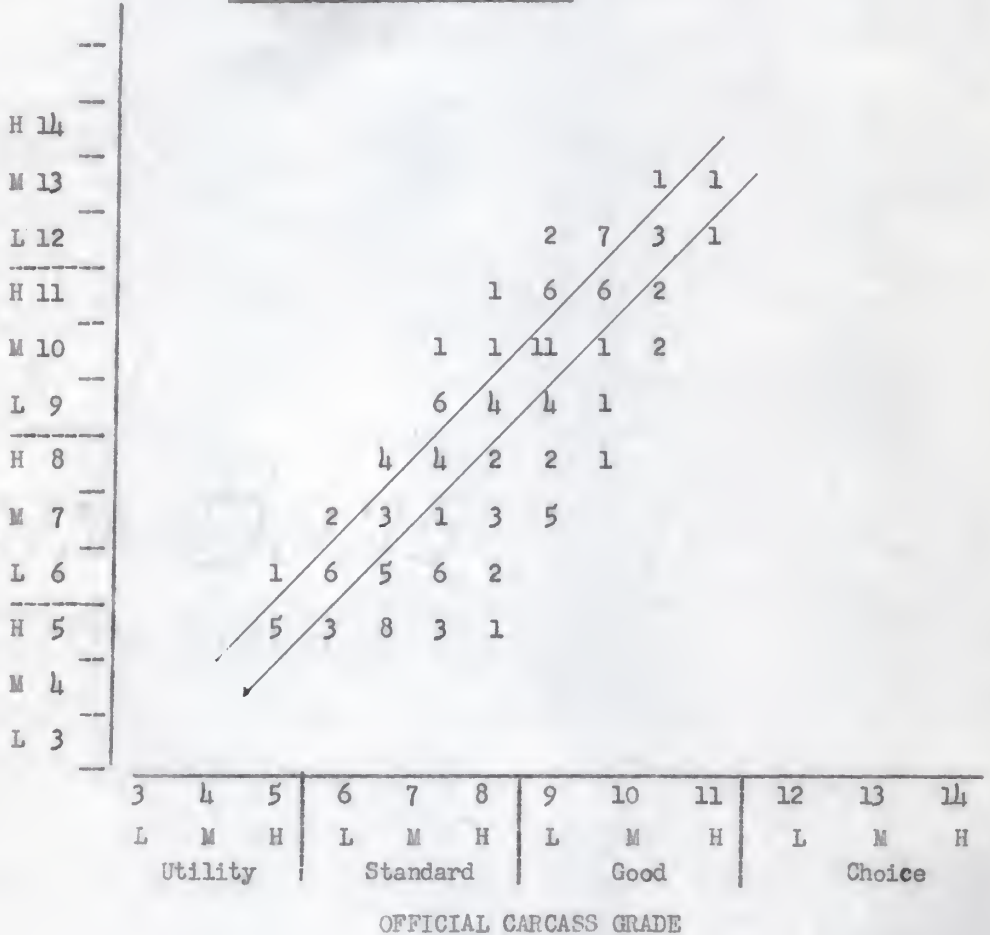
APPENDIX

APPENDIX I

Example on the determination of four measures of grading performance

The grading performance of the grader 5A (grader No. 5, lot A) will be used as example in the determination of the four measures of grading performance reviewed in this report.

Scatter frequency diagram of live animal estimates and corresponding official U. S. carcass grades for 128 steers, by live grader 5A\*



The data of the above scatter frequency diagram will be the only data utilized for determining the measures of grading performance.

<u>Magnitude of errors in live grade estimates by thirds of grade</u> $Y_{5A,j} - X_j$	<u>Frequency or Number of errors</u>	$(Y_{5A,j} - X_j)^2$	<u>(1)X(2)*</u>	<u>(2)X(3)</u>
(1)	(2)	(3)	(4)	(5)
-4	1	16	4	16
-3	11	9	33	99
-2	22	4	44	88
-1	19	1	19	19
0	43	0	0	0
1	28	1	28	28
2	<u>4</u>	4	<u>8</u>	<u>16</u>
	128		136	266

\*Absolute values

A. Percentage of correct estimates:

$$\frac{\text{Number of correct estimates}}{\text{Total number of estimates}} \times 100 = \frac{43}{128} \times 100 = 34\%$$

B. Percentage of estimates falling within a range of one-third of a grade below to one-third of a grade above the official carcass grade:

$$\frac{\text{Number of estimates within one-third grade above and below the official carcass grade}}{\text{Total number of estimates}} \times 100 = \frac{90}{128} \times 100 = 70\%$$

C. Mean absolute error:

$$\frac{d}{5A} = \frac{\sum_{j=1}^{128} (Y_{5A,j} - X_j)}{128} = \frac{136}{128} = 1.06$$

D. Index of precision:

$$I_p = \sqrt{\frac{\sum_{j=1}^{128} (Y_{5A,j} - X_j)^2}{128}} = \sqrt{\frac{266}{128}} = 1.44$$



## APPENDIX II

Example on the determination of the components of the index of precision

With the data of the scatter frequency diagram drawn in Appendix I, the components of the index of precision will be determined.

A. Mean error of estimate:

<u>Magnitude of errors in live grade estimate by thirds of grade</u>	<u>Frequency or number of errors</u>	(1) X (2)
(1)	(2)	(3)
-4	1	-4
-3	11	-33
-2	22	-44
-1	19	-19
0	43	0
1	28	28
2	<u>4</u>	<u>8</u>
	128	-64

$$\text{Mean error of estimate} = \bar{d}_{5A} = \frac{-64}{128} = -.50$$

B. Standard deviation of errors of estimate:

<u>Magnitude of errors in live grade estimate by thirds of grade</u>	<u>Frequency or number of errors</u>	<u><math>d_{5A,j} - \bar{d}_{5A}</math></u>	<u><math>(d_{5A,j} - \bar{d}_{5A})^2</math></u>	<u>(2)X(4)</u>
<u><math>d_{5A,j}</math></u>				
(1)	(2)	(3)	(4)	(5)
-4	1	-3.50	12.25	12.25
-3	11	-2.50	6.25	68.75
-2	22	-1.50	2.25	49.50
-1	19	- .50	.25	4.75
0	43	.50	.25	10.75
1	28	1.50	2.25	63
2	<u>4</u>	2.50	6.25	<u>25</u>
	128			234

Standard deviation of errors of estimate =  $\sqrt{\frac{1}{128} \sum_{j=1}^{128} (d_{5A,j} - \bar{d}_{5A})^2}$  =

$$\sqrt{\frac{234}{128}} = \sqrt{1.8281} = 1.35$$

AN EVALUATION OF CATTLE AND MEAT GRADES AND GRADING

by

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B. S., University of Buenos Aires, 1960

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AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Economics and Sociology

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1963

No topic is more controversial among people concerned with livestock and meat marketing than grade standards and grading. In such controversy sight of long term considerations and of economic goals often is lost.

A review of the factors behind the first marking of federal grades of beef dispels any notion about a neutral role of grades. To show the non-neutrality of grades is not synonymous with criticizing grades. Neutral grades would be useless.

There are two systems available to the industry on the same voluntary basis. The traditional single beef grading is a reliable measure of quality. Its major shortcoming in today's market is that it gives no consideration to the amount of excess fat that must be trimmed from retail cuts to meet consumer demands.

One of the most important objections to the Federal grade standards is that they are not oriented to consumer preferences. Since quality in beef is a complex structure of many variables, the industry must be prepared to accept some overlapping among the grades.

The grading system has played an important role, assisting consumers to choose the quality they want, guiding producers, helping smaller meat packers to compete with large-scale operators, aiding retailers and wholesalers in purchasing and selling.

The personnel of the grading service must be schooled in the interpretation of the specifications and proposed techniques should be tried in the training and selection of graders.

The present single grade standards for beef are better than none whatever, because (1) variation in quality within each of the grades is less than variation in the entire population, (2) the grades seem to differ

significantly in basic physical attributes, and (3) reductions in marketing costs and revenue increases that can be attributed to grading, it appears, exceed any associated cost increases. The implications of optimum criteria suggest that if the present grade standards satisfy the minimum requirements, the emphasis should be on ways of improving their usefulness.

The dual grading system represents an improvement provided that carcasses can be classified as to cutability accurately and inexpensively. For cattlemen, the new grading system could be significant. It could mean more money for "meat-type" cattle and, as a long range prospect, a means of holding and increasing the leading position that beef occupies, because: (1) dual grading offers a way to identify quality of meat and yield of trimmed retail cuts, thus a way to pay the producer a price which more nearly reflects the true market value of his cattle, (2) it should encourage the production of meatier cattle, thus reducing some of the marketing cost of trimming and transportation of waste fat, a saving that should reflect back to the producer, and (3) it offers a means to help fulfill consumer desires for high quality beef with a minimum of trimmable fat, thus a way to retain and even increase the popularity that beef enjoys.