Grades for the Future: What, Why and How?

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If there were no grades at all for cattle or for beef, what would be gained by developing grading systems for feeder cattle, slaughter cattle, beef carcasses and/or retail cuts? A system for identifying differences in value and acceptability of beef might increase consumer confidence as purchases were made, might stimulate sales of beef of the preferred grades, and might encourage production of improved beef cattle. For precisely those reasons, some 250 beef cattle breeders and feeders formed the Better Beef Association in 1926 and decided to sponsor a grading service which would label beef so that consumers would have a reliable guide for identifying beef of the quality they desired. Then, as now, there was a need for providing a tool—a system of grades for cattle and beef—for reflecting consumer preferences back through the marketing system to the producer.

In addition to the central function of improving the precision with which preferences of consumers are transmitted through the marketing system to producers, widespread industry use of grade standards should: (a) provide for more equitable returns to producers, (b) provide a reliable basis for selling commodities by description, without necessitating visual determinations of quality, (c) allow for more precise, accurate and meaningful price quotations in market news reports, (d) help quantify goals and guidelines for product improvement, (e) enlarge the area of informed decision-making in the marketing process, (f) enable more systematic allocation of supplies of each kind and quality of product to the highest order of demand, (g) provide a framework by which consumers are assisted in selecting, from a wide variety of qualities, the specific product desired, and (h) increase competition by allowing small producers and packers to gain entry into the marketplace, by facilitating specialization in commodity production, and by substituting widely-known grade nomenclature for brand-names.

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Beneficiaries of the use of grades include purebred breeders, producers of feeder animals, feedlot operators, livestock and meat marketing personnel, packers, wholesalers, restaurateurs, retailers and consumers. A complete grading system would be comprehensive—satisfying needs of the entire livestock and meat industry by providing grades applicable to feeder animals, to slaughter animals, to carcasses and to retail cuts. For purposes of this report, discussion is confined to grades for cattle and beef; however, the principles involved would apply, at least to some extent, to other livestock and related meat products which are or which could be graded.

Feeder Cattle

If there were no grades for feeder cattle, what would we want a grading system to accomplish? The value of a feeder animal to a stocker operator or to a feedlot operator is determined by: (a) its ability to gain weight rapidly and efficiently, (b) its muscle to bone ratio, (c) the live weight at which it will reach a pre-determined level of fatness or grade, and/or (d) the length of feeding time required to achieve that predetermined level of fatness or grade. Ideally, a feeder cattle grading system would identify animals that would respond to feeding in a manner that would allow an entire group of the same grade to be marketed as slaughter cattle at the same time and with nearly identical carcass composition and grade.

When the U.S. beef cattle industry was dominated by Hereford, Angus and Shorthorn cattle, the response of feeder cattle to a given feeding regimen undoubtedly was more uniform—and likely somewhat more predictable—than it is at present. This was because selection within these three breeds had been for the same general body type. However, in the last two decades, more than 50 "new" breeds of cattle have contributed progeny to the U.S. beef cattle population and many of these new or so-called "exotic" breeds (Maine Anjou, Limousin, Chianini, etc.) do not "finish" in response to grain feeding in the same manner as did the Hereford, Angus and Shorthorn cattle of previous decades. Many of these "exotic" breeds of cattle are large framed, muscular and late-maturing cattle which respond to the usual feedlot finishing regimen with more growth of skeleton and muscle and less fattening than is typical of the British breeds of cattle. Because of these breed-related differences, some people contend that the development of feeder cattle grade standards is quite simple—that we could simply identify cattle by their breed with reasonable expectation that groups of feeder cattle of the same breed would respond to feeding in a uniform and

predictable manner. Such is not the case because: (a) not all "exotic" cattle are big or small, or thick or thin, or uniformly anything, (b) not all "Angus" cattle are big or small *(et cetera)*—there are big Angus cattle and little Angus cattle *(et cetera)*, and (c) widespread use of a variety of new breeds and of cross-breeding has resulted in a U.S. cattle population which contains numerous individuals for which precise breed identification is essentially impossible. Therefore, something other than breed must be used to grade feeder cattle.

Trading in feeder cattle is presently characterized by consideration of age, weight, sex and USDA grade where the grade is based on "frame size" (the live weight at which an animal will have 0.5 inches of subcutaneous fat opposite the 12-13th rib) and "thickness" (degree of muscling and/or muscle to bone ratio). Thus, a complete description of a certain bovine animal might consist of "450 lb, feeder steer calf, Medium-No. 1." The latter description provides, in a very concise form, information regarding *intended use* (feeder); *age* (calf); *weight* (450 lb); *sex* (steer); *skeletal size, fatness, healthfulness,* and *thriftiness* (Medium); and *muscling* (No. 1).

Research has determined that categorizing feeder cattle by "frame size" and "thickness" does an acceptable job of identifying differences among such animals for (1) their rate and efficiency of gain (except for compensatory growth), (2) their live weight at a pre-determined level of fatness or grade and (3) their muscling and muscle to bone ratio. Identification of feeder cattle for differences in frame size and thickness accounts for the two genetically determined traits which are most closely associated with value of feeder cattle. Although the variation in fatness of feeder cattle is an important factor affecting their value, if the marketing system can successfully reflect inherent differences in a feeder animal's growth potential, its weight at a defined stage of fatness or carcass quality grade and its relative amount of muscling, then feedlot operators can sort feeder cattle of a given grade into fatness and/or compensatory growth potential groups that are likely to achieve a pre-determined level of fatness or quality grade after a specified period of time on a given feeding regimen. Finish or relative fatness is not presently thought to be amenable to use in a grading system for feeder cattle because variations in fatness have differing effects on value of feeder cattle depending upon the cost of gain relative to the price of slaughter cattle and because fatness is environmentally, rather than genetically, determined. The validity of the latter rationale is likely to be subjected to considerable scientific scrutiny in the next decade.

For the first two decades of their existence, it was thought that USDA feeder cattle grades should reflect the animal's logical slaughter potential (the carcass quality grade at which the animal's conformation and quality were comparably developed) and also that the feeder cattle grade names should be the same as the carcass quality grades. The first departure from that premise occurred in the 1979 revision of feeder cattle grade standards. Present USDA grades for feeder cattle reflect the most current research available on this subject and address the present needs and requirements of the cattle feeding industry. It is doubtful that new factors will be identified in the 1980s that will improve substantially on the ability of the USDA feeder grades to identify feeder cattle for physical differences indicative of carcass composition at slaughter. However, strides will be made in the 1980's in improving the accuracy and precision of making the required subjective evaluations for determining grade and, hopefully, in the extent to which industry uses the frame size and thickness concept in trading of feeder cattle and in allocating cattle to a specific feeding regimen based on their grade and degree of fatness.

Research needed in the 1980s to increase the accuracy and precision with which feeder cattle can be graded should include: (1) basic research on factors related to muscle growth, in general, and to determination of the extent to which there is differential development of muscles; (2) basic research on factors related to fat deposition, in general, and to sequential deposition of fat in different body areas or depots; (3) studies of relationships between subjective evaluations of "frame size," "thickness," "muscling" and "fatness" to: (a) live weights at a pre-determined fatness level or slaughter grade, (b) quality-yield grades and carcass composition after a constant feeding time, and (c) length of feeding time required to achieve a pre-determined fatness level or slaughter grade; (4) studies of effects of pre-finishing plane of nutrition on feeder grade scores, feedlot performance and carcass composition; (5) studies of effects of finishing period regimen on feedlot performance and carcass composition; (6) evaluation of feeder cattle for the present and potential muscle to bone ratios of their carcasses; (7) studies to determine effect of age (e.g., calf, yearling, two-year-old) on relative muscle growth and fat deposition patterns and (8) studies of effects of an individual animal's appetite on feedlot performance and carcass composition.

Slaughter Cattle

If there were no grades for slaughter cattle, what would we want a grading system to accomplish? The value of a slaughter cattle to the packer is determined by: (a) its dressing percentage, (b) the value of its drop (hide and offal) and (c) the value of its carcass. Since neither dressing percentage nor drop credits are amenable to characterization in a grading system, slaughter cattle are presently characterized by referencing their weight, sex and USDA grade where the grade is based on that expected in the resultant carcass. A complete description of a slaughter cattle (950 lb, Choice-3, slaughter heifer) reflects its *intended use* (slaughter), *weight* (950 lb), *sex* (heifer), *quality grade* (based on the interaction of *age, sex, fatness*), and *yield grade* (based on the interaction of *weight, fatness, muscling*).

In 1927—the year that USDA beef quality grades were promulgated—"grade" standards attempted to codify beef industry practice in dealing with (a) biological variability among cattle and beef, and (b) divergence in feeding and management practices as they affected desirability—and thus, end-use—of beef carcasses. For a multiplicity of reasons, cattle are not fed and managed in 1980 in the way that they were in 1927; the intervening half-century has seen tremendous standardization of feeding and management practices with essentially all calves and cattle intended ultimately for the block beef trade being fed high energy rations for periods of 4 to 8 months immediately prior to slaughter. Standardization of

these practices has greatly decreased variability in the age and finish of slaughter cattle whose carcasses are used for block beef. This latter development has occurred despite the greatly increased emphasis on the selection of cattle for growth rate and mature size and the fact that this selection has resulted in a decrease in the average ability of our cattle to deposit fat as marbling (intramuscular fat) in response to normal finishing periods in the feedlot. The standardization of feeding and management practices has resulted in considerable standardization of cooked beef palatability—it is quite likely that our block beef is now less variable in flavor, juiciness, tenderness and overall palatability than it was in 1927.

Scientific evidence is accumulating which suggests that cooked beef from young cattle fed high energy rations for 4 to 8 months is highly satisfactory in flavor, juiciness and tenderness even if the carcasses have marbling levels less than that presently required for the U.S. Choice grade. Presence of marbling—once taken as an indication that cattle had been fed a high energy ration for a relatively long period of time—can no longer be relied upon to indicate either feeding and management history or expected palatability of cooked beef. To the extent that the carcasses of certain "exotic" cattle or large-framed cattle of the British breeds that have been fed a high concentrate ration for a long period of time have equivalent-to-Choice palatability but do not have the amount of marbling required for Choice, the requirements in the present USDA quality grades which prevent these carcasses from grading Choice are a deterrent to progress in the beef cattle industry.

Because of the significance (to the consumer) that has become attached to the word "Choice," some relaxation of the present marbling requirements for the U.S. Choice grade might be a progressive step for the industry to take—especially since most of the scientific research suggests that small differences in marbling are not closely associated with differences in cooked beef palatability. The adoption of such a philosophy in deciding on where to draw the line between Choice and Good might, through a series of steps each lowering the requirement for marbling, eventually lead to the inclusion of all young cattle now graded Good, and even Standard, in the Choice grade. There is research which questions that there is a meaningful difference in the palatability of beef presently graded "Choice" and, at least the major portion of that presently graded "Good." If the real effect of the present Choice/Good grade-line is to unnecessarily encourage overfattening of cattle and to discourage use of certain kinds or breeds of cattle, and not to assure maintenance of satisfactory eating quality, then continued efforts to defend the present minimum marbling requirement for the U.S. Choice grade would be unwarranted. If the Choice grade should eventually include beef from all young cattle, irrespective of their ability to deposit marbling, and if consumers were satisfied with the palatability-prediction performance of the grade, our emphasis in beef cattle production could focus on other important matters—like improving productivity and efficiency.

On the other hand, there are retailers who insist on handling only Choice beef, believing that their customers prefer it, and who are strongly opposed to any further reduction in marbling requirements for the Choice grade. If there is really nothing magic about the word "Choice," then what is needed is a consumer education effort to stimulate the use of "Good" grade beef by those who prefer it.

In 1927, it was generally thought that cooked beef palatability was determined by type (beef cattle vs. dairy cattle, for example), age at slaughter and finish. Subsequent research has dispelled the notion that beef from beef-type breeds of cattle is any more palatable than that from dairy cattle—such is not the case. Of dairy cattle breeds, only the Holstein-Friesian is fed in sufficient numbers to comprise a significant portion of U.S. block-beef production. Market news reports indicate that Holstein steers, fed to grade U.S. Choice, usually sell for less per hundredweight alive than comparably finished beef-type steers. This is because the Holstein steers will have lower dressing percentages than the beef-type steers and because their carcasses—at comparable yield and quality grades—are considered to be worth less per hundredweight. According to an industry source, the price differential between Holstein and beef-type carcasses exists because Holstein carcasses yield less valuable middle-meats (about 12 cents per pound less for top butt, loin strip, tenderloin and oven-ready rib roasts) than beef-type carcasses and lower percentages of middle-meats (about 1% less in top butt plus loin strip plus oven-ready rib roast). Research documenting this latter belief is lacking; in fact, one USDA study showed that the average cutability and palatability of Holstein and beef-type carcasses of the same yield and quality grade were almost identical.

Age at slaughter, across the complete range of ages at which cattle come to slaughter (1 to 15 or more years of age), is considered to be an important criterion in determining tenderness of beef. Prior to the latest (1976) change in beef carcass grade standards, relative maturity (A-minus, A-plus, etc.) within each USDA maturity group (A, B, C, etc.) was a grade-determining factor. However, a 1976 change in grade standards removed consideration of relative position within the "A" maturity group in determining quality grade. In the light of more recent research, it is possible that the research studies on which that change was based were reflecting the fact that the younger carcasses in the A maturity group were lighter in weight and/or less fat and thus more susceptible to cold-shortening than were older—and usually heavier and fatter—"A" maturity carcasses and that if these variations in fatness were removed, variations in maturity within the "A" maturity group would have been more closely associated with palatability. It is also possible that, while relative maturity within the "A" maturity group is not closely associated with tenderness of support muscles (e.g., *longissimus dorsi* and *psoas major*), relative maturity within this maturity group may be extremely important in determining tenderness of locomotive muscles (e.g., *biceps femoris* and *semimembranosus*) because of differences between such muscles in their amount of connective tissue and because of the well-known age-maturity effect on collagen solubility. Nevertheless, increases in age among cattle which produce "A" maturity carcasses (presumably about 9 to 30 months of age) are not presently considered in determining grade. For those who feed yearlings and older steers or heifers, there is a possibility that some of the resulting carcasses will exceed "maximum B" maturity at which they are still eligible for the Prime, Choice, Good or Standard grades. There is research evidence which

suggests that beef from carcasses presently classified as "C-minus" and from cattle "finished" in a feedlot is as palatable as that from "A" or "B" maturity carcasses. Research is needed to provide definitive information regarding effects of maturity on palatability of beef.

It was widely believed in 1927 that the palatability of beef was greatly enhanced by the long-time feeding of high energy rations to cattle prior to slaughter. It was known that such feeding increased the fatness of cattle and it was thought—perhaps erroneously—that the fat deposit which was responsible for the enhancement of tenderness in association with the fattening process was "marbling." Recent research suggests that "fat" carcasses may be more tender than "lean" carcasses because of the insulatory effects of the subcutaneous fat covering (a) in preventing cold-induced shortening—and consequent toughening—of muscle fibers in association with the death-stiffening *(rigor mortis)* process and (b) in slowing carcass temperature decline during chilling thus increasing the rate or extent of autolytic proteolysis of muscles in the same manner as is normally accomplished during "aging" of the carcass or its cuts. It could be that with the chilling practices normally used there is some quantity of subcutaneous fat that is sufficient to reduce the chilling rate of carcasses and thereby increase tenderness to a desired level and that fat thickness in excess of that quantity does little or nothing to further enhance tenderness of beef. Data in a number of research studies during the past three years suggest that .28 to .35 inches of subcutaneous fat over the outside of the ribeye muscle opposite the 12th rib is sufficient to make the cooked beef more tender and that thicknesses of this fat in excess of .35 inches are of little or no consequence in this connection. Since increases in subcutaneous fat are associated with decreases in cutability, it is essential that attempts be made to accomplish the desired end-result (improved palatability) with as little fat as possible so as to not compromise carcass cutability.

There also is some evidence which suggests that the length of time that cattle are fed on a high-energy diet may be useful for improving the accuracy of predicitng the ultimate palatability of beef. It is possible that time-on-feed and maturity might be a reasonable alternative to use of marbling and maturity for predicting the palatability of steaks and roasts from carcasses. In one research study, more than 90% of rib steaks from cattle fed a high-concentrate ("finishing") ration for 100, 130 or 160 days received "desirable" ratings for flavor, tenderness and overall palatability; increasing "time-on-feed" beyond 100 days did not result in additional assurance that rib steaks would be "desirable" in palatability. If the minimum marbling requirement for U.S. Choice was lowered, for example, to minimum-Slight, time-on-feed might be useful for assuring that beef in that grade was from grain-fed rather than forage-fed cattle and therefore would be satisfactory in flavor. Time-on-feed certification is one of the few viable options for quality grading of beef destined for hot boning.

Exact characterization of relationships between time-on-feed, subcutaneous fat thickness, maturity and marbling as they relate to the palatability of cooked beef—and the incorporation of that information in the grade standards—would allow for much more equitable pricing mechanisms to prevail in the cattle industry. Cattle feeders who presently have no defense against inequitable bids or offers for their product would be immeasurably benefitted by a system that assured them an appropriate return for their cattle if they agreed to feed their cattle for a prescribed period of time on a predetermined energy-level ration and to market only those cattle which had achieved some pre-designated level of subcutaneous fatness. Likewise, the packer could bargain more effectively, offering feeders who comply with such guidelines more for their product, with reasonable assurance that the value of the carcass would not ultimately be determined, from a quality grade standpoint, by marbling alone. Packers would have reasonable assurance, for example, that a carcass would qualify for the highest retail consumer-oriented grade: (a) if it came from an animal that had been fed a high-energy ration for a specified period of time, (b) if the carcass had some minimum amount or thickness of subcutaneous fat, and/or (c) if the carcass was of the appropriate maturity and had some prescribed amount of marbling. If such a system were used, slaughter cattle could be offered for sale with reasonable expectation that the value received from their carcasses would be commensurate with that paid for the slaughter cattle.

Research needed in the 1980s to increase the accuracy and precision with which slaughter cattle can be quality graded should include: (1) Studies of the relationship between subcutaneous fat thickness of slaughter cattle and the palatability of their cooked cuts to identify minimum and maximum fatness levels which are efficacious in assuring production of beef of "satisfactory" or higher eating satisfaction; (2) studies of the effects of time-on-feed and ration energy density on palatability of cooked beef and (3) studies of relationships and interactions of subcutaneous fat thickness, time-on-feed, ration energy density, age (relative maturity within a maturity class and the maximum age constraint for the Prime-Standard grades), weight, sex and breed in determining palatability of cooked beef.

The value of the carcass from a slaughter cattle is also determined by its cutability (carcass yield of retail cuts). Since cutability is primarily affected by degree of fatness, great progress in improving cutability in beef could be achieved (1) if cattle producers would select for and produce only cattle that combine thick muscling, high quality lean and a minimum of external fat, (2) if consumers were educated to buy beef of grades lower than Choice for certain purposes and if such beef was available at retail, and (3) if quality grading criteria were changed to reduce the need to over-feed cattle in the hope of increasing the probability that marbling, equivalent to that presently needed to qualify for the U.S. Choice grade, would be deposited. While options 1 and 2, above, may be valid as long-term objectives, each has little to offer in the short-term. Option 1 would proceed more rapidly if the required identity of "high quality lean" did not include the amount of marbling equal to that presently required for the U.S. Choice grade. If minimum time-on-feed and/or minimum fat thickness requirements were adopted for use in determining quality grades, these could have an immediate result of limiting fatness of the cattle to that considered minimally essential to the palatability of cooked product and, thus, in increasing the average cutability of our domestic beef supply.

Nevertheless, research needed in the 1980s to increase the

accuracy and precision with which slaughter cattle can be yield graded includes: (1) Studies to increase reliability of subjective evaluations of muscle to bone ratios in slaughter cattle and the effect of variations in these ratios on the cutability of their carcasses; (2) studies designed to increase the reliability of subjective evaluations of size, fatness and muscling in slaughter cattle for predicting cutability and (3) studies of the precision of cutability estimates made solely on the basis of predictions of trimmable external fat rather than by use of interactions of external fat thickness, body cavity fatness, muscling and weight. The latter is predicated on the fact that many retail cuts are still sold bone-in (rather than boneless as presumed by the present yield grade standards). As such, fatness should become even more important in determining cutability than it is in the present yield grades.

Beef Carcasses

If there were no grades for beef carcasses, what would we want a grading system to accomplish? The value of a beef carcass to the packer, wholesaler and retailer is determined by: (a) its physical appearance (firmness, color, quality), (b) its relative percentages of high-priced to low-priced cuts, (c) the expected palatability of its steaks and roasts, and (d) the proportion of the carcass that can be sold as closely trimmed bone-in or boneless retail cuts. Trading in beef carcasses is presently characterized by consideration of sex, weight and USDA grade. USDA grades assess and identify the relative merit of carcasses in terms of the "quality grade" (expected palatability of lean) and in terms of the "yield grade" (expected yield of boneless, closely trimmed, major retail cuts). A complete description of a certain bovine carcass might consist of "600 lb, Choice-3, heifer" where, in very concise form, information is provided regarding *weight* (600 lb); sex (heifer); *maturity, fatness, marbling* and *firmness* (Choice); and *weight, fatness* (external and body cavity) and *muscling* (3).

Based on the premise that quality grades should identify differences in the palatability of cooked beef product, two approaches could be used in the development of the standards on which beef would be quality graded. In one approach, it could be assumed that consumers are only interested in being able to differentiate between beef that is or is not "acceptable" in cooked palatability—that is, in having assurance at the time of purchase that the cooked beef will be either "acceptable" or "unacceptable" in flavor, juiciness, tenderness and overall eating satisfaction to a high proportion of potential consumers. If so, a *DICHOTOMOUS* grading system in which beef was segregated into only two categories—"Acceptable" or "Unacceptable"—would be adequate. In such a system, all beef having been judged to have at least the minimum requirements (or the equivalent thereto) for certain quality indicators (e.g., marbling, color, firmness, texture) would be assigned to the "Acceptable" grade while beef which failed to meet those minimum requirements would be assigned to the "Unacceptable" grade. Although the Dichotomous system appears simple, its supposed simplicity rests on being able to find an "acceptability" consensus among a high proportion of all potential consumers of beef. Given the American consumers' divergent preferences on virtually all issues, it seems very doubtful that such a consensus would be attainable.

The second approach to developing standards for grading beef to identify differences in palatability would be to assume that consumers are discriminating with respect to the beef they purchase and that consumers are willing and able to pay premiums for beef of "better than average" palatability. Using that premise, the *HIERARCHICAL* system of grading—a body of several entities (grades) arranged in a graded series—would be appropriate for use in sorting the available supplies of beef into categories that differed in relative desirability. If there were four such categories they could be identified, for example, as "Superior," "Very Good," "Average" and "Inferior"; as "Prime," "Choice," "Good" and "Standard"; as "A", "B," "C" and "D"; or as "1," "2," "3" and "4," *et cetera*. Segregation of beef into a given category could be based upon: (a) its average palatability score or its relative rank in all or some of the palatability (flavor, juiciness, tenderness) traits, or (b) the relative "risk" of obtaining a product that is "undesirable" or "unacceptable" (tough, dry, bland, intense) in all or some of the palatability traits during a sustained period of purchase of product in that "grade." In a Hierarchical system, we admit that consumers differ in what they perceive as "acceptable-unacceptable," "desirable-undesirable," "good-bad" and do not attempt a solution to the consensus problem since trial and error purchasing should lead to the consumer finding a grade of beef that best suits his needs. In an attempt to meet the desires of individual consumers relative to automobiles they purchase, this is the same rationale as that used by automobile manufacturers in producing a wide variety of styles and kinds of cars—all with numerous optional features—even though all the automobiles manufactured are "acceptable" as vehicles of transport.

In the grading of beef, it must be recognized that there is a continuum of quality indicators and a continuum of quality attributes. Therefore, in either the Dichotomous or Hierarchical approaches to grading, it must be accepted that the beef immediately adjacent to the opposite sides of a line between grades will have essentially the same degree of acceptability. However, the drawing of lines in a continuum to separate several groups—as in a Hierarchical system—has less severe economic effects than drawing a single line to separate the two groups in a Dichotomous system. Theoretically, a line in the beef quality continuum which separated "Acceptable" from "Unacceptable" beef would very materially limit the use—and value—of "Unacceptable" beef for sale as block beef and could have exceptional monetary significance. However, a line in the beef quality continuum which separated "Superior" from "Very Good" or "Average" from "Inferior"—though reflective of quality differences—would separate product into categories with only slightly different end-uses—and only slightly different monetary values. It would be ideal if lines in the continuum could be drawn at points where quality declines abruptly; however, in the case of beef, no such points have ever been identified. In lieu of such readily identifiable points, lines should be drawn at points which are defensible in some terms (research findings, trade practice, monetary significance) that are meaningful and economically important to buyers and sellers.

Further logic related to the use of a Hierarchical grading

system is that regarding probability-risk concepts. If grade factors can be identified which are related to cooked beef palatability, "grades" could be assigned based on the probability that an individual sample from a carcass would have of being either "very desirable" or "very undesirable" etc., in palatability. In such a system, there might be 90% vs. 80% vs. 70% probabilities that the cooked sample would be "very tender" if it came from Grade A vs. Grade B vs. Grade C carcasses, respectively, and the risk of obtaining a "very tough" sample from the respective grades might be 1 in 100, 1 in 40 and 1 in 10. This aspect of current USDA beef carcass grades is of apparent consequence to retailers; certain retailers probably sell beef of the Choice, rather than Good, grade because they believe that they receive fewer customer complaints regarding unsatisfactory flavor, tenderness and/or overall palatability of retail steaks and roasts.

Although there has been a great deal of research aimed at the identification of factors which affect beef palatability, this has proven to be a very complex problem. While the USDA quality grades do segregate beef into groups (grades) having differences in average palatability, there is considerable overlap in the palatability of beef between and among the grades, i.e., there is a significant percentage of beef in each of the grades whose palatability is more similar to the average palatability of beef in another grade than it is to the average palatability of the beef in the grade for which it qualifies. Presently available research indicates that the two most important carcass characteristics associated with differences in beef palatability are marbling and maturity. Those are the factors on which the present USDA beef carcass grade standards are based.

One approach to making improvements in the present USDA quality grade standards is that of further refining or "fine-tuning" them. In this regard, it must be noted that every change in grade lines in the USDA beef grade standards between 1927 and 1976 has had the effect of lowering the standards (minimum requirements) for the Prime and Choice grades. Obviously, this kind of "fine-tuning" cannot proceed indefinitely. It must also be noted that, as a country, we seem always to have changed our beef grading system to fit the cattle being produced rather than changing the cattle (through improved animal breeding practices) to fit the grading system. Thus, in the past, as economic pressures mounted, cattle producers, feeders and packers have sought relief by an easing of USDA grade requirements—usually by the lowering of the minimum marbling requirements or by changing the maturity × marbling interaction in determining grade. To the extent that these changes have been research supported, they have almost invariably been justified—by those who supported them—on the basis of limited research evidence that suggested low relationships between marbling and cooked beef palatability and by the failure of meat science to produce evidence to the contrary.

Quality grade identification, via roller-branding across strategic areas of the carcass, is presently effected in a manner which results in placement of the official USDA grade shield on essentially all of the retail cuts. It is possible, however, that quality grade is of consequence—is useful in predicting palatability—only for those retail cuts from the middle meats. Using the latter rationale, only the rib (9%) and loin (17%)—26% of the carcass, on a wholesale cut basis—benefit from quality grade identification while the remaining 74% of the carcass is made unnecessarily fat by feeding and management practices designed to cause deposition of sufficient intramuscular fat to qualify the middle meats for the Choice or Prime grades. In this rationale, additional fat (as subcutaneous, intermuscular and/or intramuscular deposits) is of little or no consequence in improving palatability of most of the chuck and round and all of the foreshank, brisket, short plate, flank and hindshank when these cuts are prepared as they normally are for retail sale and when they are cooked, as solid muscle cuts, with moist heat or when they are ground, chopped, cubed or diced prior to sale. Conversely, it has been the contention of the USDA that, as quality increases, the number of cuts that are amenable to dry heat cookery—and thus are benefitted by marbling and youthfulness—increases. In the latter rationale, the top round, rump, knuckle and clod from a U.S. Prime carcass will be of satisfactory palatability when roasted, pan-broiled or broiled while these same cuts, from a U.S. Good carcass, must be cooked with moist heat to be acceptable to most consumers.

Another criticism of the present USDA quality grading system is that regarding its subjectivity; it is widely believed that something like "minimum-Small" marbling is so imprecisely defined that it cannot be identified as such from one time to the next by the same grader—much less by different graders. Since USDA meat graders presently use memory standards for identifying the relative development of a grade factor like degree of marbling, it has been suggested that pictorial marbling standards would help graders to attain consistency and repeatability in assigning quality grades to carcasses. Photographic representations of the lower limits of each degree of marbling referenced in the standards have been used by meat grading service personnel since the mid-1950s. The pictures in present use are very small so their usefulness is somewhat limited; life-size, colored pictures of the ribeye muscle with intramuscular fat deposits representative of the minimum required for each marbling score would be of considerable assistance to meat graders. Development of such photographs might also make possible the development of instruments capable of quantifying marbling and of assigning quality grades by use of video imaging, optical sensing, acoustical holography or ultrasonic imaging technology. Instrument grading might, if it were also designed to stamp the grade on the carcass, lessen the possibility of graft, bribery or coercion affecting assignments of grade.

Numerous researchers have questioned the veracity of the marbling × palatability hypothesis, but few have offered alternatives to use of intramuscular fatness as the basis for the quality grading of young beef carcasses. One alternative which has been promoted in the beef packing industry involves use of the zinc to iron ratio of raw muscle to predict the tenderness and juiciness of the cooked product. The patent which describes this invention, (U.S. patent number 4,009,390) states "It is believed that the ratio of iron to zinc is particularly well correlated to tenderness because zinc increases the amount of marbling which inhibits calcification and the iron decreases marbling by promoting its oxidation thereby allowing calcification to increase." The preceding statement suggests that zinc to iron ratio is effective in predict-

ing tenderness because of its association with marbling; however, references to "calcification" make the statement difficult to interpret.

Numerous researchers have explored alternative solutions to the beef tenderness problem. In the last two decades, a number of "tenderization techniques" have been identified which markedly increase the tenderness of beef in some carcasses and/or which reduce the variability in tenderness among carcasses. Tenderization technology can be effected prior to or following occurrence of the death-stiffening process. Pre-rigor tenderization techniques with well-documented success include: (a) antemortem injection of tropical plant enzymes, (b) suspension of the carcass via the pelvis, (c) chilling of carcasses at 62°F for the first 16 hr postmortem, and (d) electrically induced muscle contraction-relaxation cycles. Post-rigor tenderization techniques with proven efficacy include: (a) repetitive introduction of blades or needles into meat cuts and (b) storage of carcasses or cuts at 32°F for prolonged periods of time. The present structure of USDA beef grading does not provide for use of science and technology to up-grade a carcass; if it did, methodology exists which could provide tenderness improvement sufficient to assure that most of today's carcasses from young, grain-fed cattle would produce steaks and roasts that would be acceptably tender for the block beef trade.

If the purpose of beef grades and of a beef quality grading system is to provide the American consumer with a means of purchasing the quality of beef desired, but if the present grades do not do this with a high degree of accuracy, then the salient question is "Why guess what the palatability might be, when we can better assure what it will be?". If we were to make effective use of the science and technology revelations of the last 20 years, we might change the requirements, for example, which qualify a carcass for the U.S. Choice grade. A "Choice" carcass under revised grading standards might be one which was qualified by virtue of its maturity and marbling, as at present, or on some combination of marbling and maturity plus (1) a "certification" that the animal from which it was produced had been fed for a specified period of time on a ration of a specified energy-density, (2) a specified subcutaneous fat thickness, (3) treatment with an appropriate pre-rigor tenderization technique or (4) treatment with an appropriate post-rigor tenderization technique. Compliance by the feeder and/or packer with such qualifying conditions would allow a carcass to be graded "U.S. Choice," for example, which otherwise would qualify for only U.S. Good.

Research needed in the 1980s to increase the accuracy and precision with which beef carcasses can be quality graded includes: (1) studies to determine the magnitude of palatability trait differences that are important to consumers; (2) studies to determine the relative advisability of using a Dichotomous *vs.* a Hierarchical system for segmenting beef into expected palatability groups; (3) studies which would determine the usefulness of attempts to refine or to "fine-tune" the maturity × marbling relationships and/or minimum marbling requirements in existing USDA beef carcass quality grades; (4) studies to determine the efficacy of instrument grading; (5) studies of the effectiveness of use of pre-rigor or post-rigor tenderization techniques for "up-grading" carcasses which would otherwise qualify for a lower quality grade; (6) studies of the possibilities of the use of young intact males (bullocks) and "hard-boned" females (heiferettes or cows), suitably fed and appropriately subjected to pre-rigor or post-rigor tenderization techniques for production of block beef; and (7) studies which would make possible the grading of carcasses that are to be hot-boned.

The value of a beef carcass also is determined by its cutability—the expected yield of boneless, closely trimmed major retail cuts. If there were no yield grades for beef carcasses and optimum cutability predictive accuracy was desired, it seems likely that we would use some of the same factors (ribeye area for muscling; fat thickness opposite the 12th rib for external fatness; the amount of kidney, pelvic and heart fat for body cavity fatness) that are now used in USDA yield grading standards. Those who are critical of present cutability grades criticize some or all of the following aspects of the yield grading system: (a) Inclusion of carcass weight and/or the size and direction (sign) of the beta coefficient assigned to carcass weight in the cutability prediction equation, (b) provision for subjectively determined adjustments of fat thickness, (c) continued inclusion of body cavity fat estimates in routine grading practice and use of a special identification (double-stamping) of carcasses if all or part of that fat is missing when it seems more sensible to require that such fat be removed during slaughter-dressing, and (d) use of a yield grade equation that is linear rather than curvilinear. The most recent research on beef carcass cutability and yield grading supports use of carcass weight, with a very small negative coefficient, and the provision for adjusting fat thickness to improve precision of cutability estimations. Adjustment of measured fat thickness is necessary (a) because the order and extent of fat deposition in different body locations on the carcass differs among carcasses, and (b) because the subcutaneous fat cover of so many carcasses is disturbed intentionally (to remove bruises or grubs or, possibly by some, to improve yield grade) or inadvertantly (by poor dressing techniques—especially as associated with the use of hide pullers). That same research suggests that progressive addition of ribeye area and carcass weight to equations that contain adjusted fat thickness and kidney, pelvic and heart fat percentage increases predictive accuracy in estimating cutability (depending upon the cutability end-point) by 1.0 to 6.8 percent and by 0.2 to 1.3 percent, respectively.

In actual grading practice, estimation of and adjustment for ribeye area in relation to carcass weight is by far the most difficult aspect of high-speed (300+ per hour) yield grading. It is possible that yield grading would serve part of the industry as well as, or better than, it presently does if cutability grades were based upon a trimmable fat concept; this is possible because: (a) so few carcasses used by the retail trade are completely boned (thus muscling and muscle to bone ratio are likely to be less important determinants of cutability to that trade), (b) the present yield grade equation may unnecessarily penalize some kinds of carcasses that are not boned during fabrication, and (c) it would simplify the yield grading process thereby decreasing judgmental error in high-speed grade application. This is not to say that muscling or muscle to bone ratio is not important in determining cutability when the cutability end-point is one of boneless cuts; it is. Rather, it is to suggest that research is needed to explore alternatives to

the existing yield grading system in the hope that its usefulness and value to industry can be improved.

Research needed in the 1980s to increase the accuracy and precision with which beef carcasses can be yield graded includes: (a) studies to evaluate the accuracy of the present yield grade equation for estimating yields of bone-in retail cuts—when both very light-weight and very heavy-weight carcasses are in the test population—and to provide information that would be useful in developing yield grade standards based on yields of bone-in cuts and (b) studies which would determine the usefulness of a yield grading system predicated upon a trimmable fat concept rather than upon a trimmable fat and bone concept. Such standards might be more directly applicable for use by the retail trade than are the present standards.

Beef Cuts

If there were no grades for consumer cuts, what would we want a grading system to accomplish? The value of a cut to the consumer is determined by: (a) its expected or actual (as-served) palatability and (b) its leanness. At present, wholesale cuts, subprimal cuts and retail cuts, if they are from carcasses that were federally graded and if the grade insignia has not been trimmed off, bear USDA stamps on their outer surfaces that allow grade identification. Such identification is useful at all stages of marketing if parties to the transaction use grade as a value-determining characteristic. Grades on beef cuts are those which relate to relative merit in terms of quality (expected palatability of lean) and in terms of yield (expected yield of boneless, closely trimmed, major retail cuts).

At question is the rationale of attempting to "guess" what the palatability of a piece of beef will be, even when that guess is an educated one, as opposed to using science and technology to more nearly assure that the beef will be of some desired degree of palatability. If research studies proved that time-on-feed, subcutaneous fat thickness and/or use of tenderization techniques—in lieu of or in combination with maturity and marbling—improved the accuracy and precision of palatability predictions but USDA did not feel that it was feasible to change the present carcass grades to recognize such research, the available science and technology could be used to create a new system of "consumer grades" for beef which would be applied by retailers under some "licensing" system by USDA. In such a system, retailers would need the full cooperation of feeders and packers to furnish the information needed to justify any change in quality grade from that of the carcass. However, based on such additional information, individual cuts from "U.S. Good" carcasses, for example, might be labeled "U.S. Choice." It is recognized that sanction of such a system by USDA would create tremendous enforcement problems.

Patrons of hotel, restaurant and institutional establishments seldom see the raw commodity and cooking-preparation further complicates receipt of grade information for these customers. Because some consumers use grade in their decision-making processes, many retail meat markets and most restaurants that use U.S. Choice or Prime beef generally mention grade in their advertising, promotion and point-of-purchase materials. However, grade information is seldom mentioned if the meat merchandiser and/or restaurateur opts for grades of beef that are lower than U.S. Choice. The necessity of providing grade information at the consumer level also can be questioned because of the apparent success of those operations which do not use USDA grade as a merchandising tool.

Either of the options offered above (adherence to some pre-described treatment or condition by the feeder or by the packer—separately or in conjunction with USDA quality grade) might provide a solution to the need to improve the palatability-prediction function of USDA beef grades. However, a complete modernization of the grading system would also provide for identification of differences in leanness among cuts offered to the retail customer. Recent surveys suggest that the American consumer is vitally concerned with the leanness of beef because of its real or supposed implications to diet-health problems (e.g., obesity, atherosclerosis, coronary heart disease, etc.). Complete "consumer grades" for beef would provide a means for extension of the cutability concept through the marketing system to the retail cut level. In this regard, it seems possible to establish a system for consumer grading of beef retail cuts using a word-number system wherein the word ("Prime," "Choice" or "Good") would describe the expected palatability level and the number ("1," "2," "3," etc.) would describe the leanness of the cut. As an example of the means by which a leannness categorization might be accomplished, we might: (a) define retail cuts of "1" leanness as those which come from carcasses of yield grade 1, while retail cuts of "2" or "3" leanness would be those which come from carcasses of yield grades 2 or 3, respectively, and (b) allow "up-grading" of retail cuts (for example, from "2" to "1") if they were trimmed to remove portions of the surface and/or seam fat. Admittedly, if leanness grades were not applied or enforced by USDA they would be only as useful as the retailer might wish to make them and his trimming procedures might negate differences suggested by a yield grade number. If leanness grades were applied or somehow enforced by USDA, such a program would be tremendously complicated and expensive. The crux of the matter is whether something should be attempted in this regard—at the least, use of the carcass yield grade would be better than nothing at all. In this connection, though, it should be noted that retailers are now free to use carcass yield grades on retail cuts but few have elected to do so.

Research needed in the 1980s to facilitate development of meaningful "consumer grades" for beef cuts includes: (1) studies designed to thoroughly investigate the efficacy of use of time-on-feed and of various tenderization techniques for "up-grading" cuts which would otherwise qualify for a lower quality grade; (2) studies which would determine the usefulness of a word-number (e.g., Choice-1) consumer grading system for merchandising beef at the retail level; (3) studies of the trimming of retail cuts to permit them to be labeled with a "higher" leanness grade than the carcass yield grade from which they were made and (4) cost/benefit studies designed to evaluate the worthiness of consumer grades.

Conclusion

Although our present system of USDA beef grades is not

perfect, beef presently enjoys excellent popularity among American consumers. Grade changes thus should not be made for the sake only of change; that approach would be comparable to "developing a cure for a disease that does not exist." Likewise, grade changes should not be made in response to changes in the profitability of one or more segments of the industry such as those which result from periodic imbalances between feedlot and/or packing plant capacities and the numbers of cattle available for feeding and slaughter. In this connection, though, it is unrealistic to believe that Federal grades are immune to political pressures which eminate from such changes in profitability. Historically, the USDA has opposed changes in grade standards when they thought that a successive series of such changes could so reduce the levels of quality in the grades that they would become totally ineffective for identifying differences in quality. On the other hand, USDA has acknowledged its obligation and willingness to make changes in the standards when the need to do so is indicated by established or highly likely changes in production practices or consumer preferences or in recognition of new research findings which make possible more accurate evaluations of grade. In all of this, U.S. meat scientists have an obligation and opportunity to use their knowledge and expertise to assist in "modernizing" the grade standards for cattle and beef so that they will continue to be useful tools in maintaining beef's very favorable consumer image.

Appendix

Several members of the Committee that developed the paper "Grades for the Future: What, Why and How?" were asked to briefly describe their personal ideas and/or an approach to development of a beef grading system for the United States. Because these thoughts may be of interest and use to scientists, teachers and extension personnel in the field, it was decided to include them as a part of these RMC Proceedings.

The Topel Approach

The current meat grading system for beef carcasses is in need of major evaluation as the system stimulates excessive fat deposition which is not necessary for desirable palatability traits of beef.

A. CUTABILITY GRADE

The current cutability system is not suited for rapid, objective techniques for predicting the percentage muscle, fat and bone in carcasses or live animals. A system is needed where live animal value can be determined based on the carcass value. This information should be determined by objective methods in both the live animal and the carcass and adapted to a computer program.

Our current technology indicates that fat thickness and weight should be used as the basis for estimating carcass composition and live or carcass value. Both methods are simple and are as accurate as any current methods. The fat thickness at the 12-13th rib would be measured, the carcass weight recorded and the carcass cutability established based on these two measures. Grades of 1 to 5 could still be used for cutability.

B. QUALITY GRADES

For the last 10 to 12 years, I have told our beef producers that the current quality standards for beef are costing the beef producers over a billion dollars a year. During my first presentation on this topic these comments were often questioned by producers, several meat scientists and people in the hotel or retail industries. Currently, however, many producers are concerned about the excessive costs for depositing fat in cattle just to obtain a small amount of marbling or the Choice grade. Most consumers object to fat in our fresh beef supply and it is therefore difficult to understand why we use our current standard for marbling in the quality grades. A grading system must be developed where less emphasis is placed on marbling. I would suggest two degrees of marbling and three grades for cattle less than 35 months of age. Marbling degree of practically devoid or less would grade Standard. The degree of marbling ranging from a trace to a small amount would grade Choice. More marbling than a small amount would grade Prime.

The standards for processing beef from older animals should have two maturity groups, 35 to 50 months for one group and over 50 months for another group. One degree of marbling is suggested for this group. A small or greater degree of marbling for one grade and less than a small degree for the other grade within each maturity group.

Carcasses with abnormal color or other low quality traits such as firmness problems, etc. would be graded in the older animal group.

The Kauffman Approach

I. The predictive end-product should be a boneless, fat-standardized, wholesome, nutritious and palatable food that can be produced economically to compete with other protein foods.

II. Qualitative Attributes

A. Biological Characteristics

1. *Maturity*—have an old and young classification; ossification to any extent on cartilaginous tips of chine bones would automatically qualify for old category.

2. *Muscle condition*—(12th rib since fore- and hindquarter separation is still most practical)

a) free of the soft, watery condition

b) presence of at least slight amounts of marbling

c) dark cutters would be acceptable

d) free from abnormalities such as blood-splashing

3. *Sex*—all sexes would be acceptable but would be identified for classification purposes (I'm a bit concerned about the identification part because I believe young bull beef should be included and yet if it is identified, the consumer may reject it for no good reason)

4. *Fat condition*—should not be soft and oily

(We should have a system that would encourage hot boning, but I'm at a loss to know how to handle items 2 and 4 above)

B. Up-Grading Beef Quality by Mechanical and Chemi-

cal Techniques that would include any one of the following:

1. Preventing cold shortening by postmortem, pre-rigor temperature control or by electrically stimulating in pre-rigor condition.

2. Perfusing a proteolytic enzyme (i.e., papain) just prior to or immediately after slaughter.

3. Needle penetration tenderization of cuts at later stage of processing (would only be applicable if carcass were processed in same plant as slaughter).

C. Nomenclature

There would be two quality classifications:

*Quality Beef (meets all standards above)

*Manufacturing Beef (does not meet all standards above)

The letter M would be included when marbling exceeds medium amounts (moderate).

III. Compositional Attributes

A. Nomenclature

There would be three categories based on yield

*lean (high yield)
*medium (medium yield) } determined subjectively for simplicity in application
*fat (low yield)

B. The above would be based on:

1. Fatness as viewed at the 12th rib and at other locations (brisket, rump, plate). Kidney, and pelvic fat would not be included because it would be removed during slaughter (required) except for a slight covering over the tenderloin.

Marbling would be used and would be scored as low, medium, or high (a formula would be used to know how to subjectively use marbling content to adjust the overall yield evaluation so that the prediction of a standardized fat content could be accurately assessed). I'd have to think about this more.

2. Muscle/Bone would be determined by general shape of carcass, excluding effects of fatness. Such items as loin eye area and thickness and plumpness of round and chuck would be considered.

3. Fatness and Muscle/Bone would be assessed simultaneously to establish the overall yield. It's possible that a very poorly muscled carcass that contains medium to low fatness would be classified as *medium yield,* whereas a heavy muscled carcass with excessive fat could also qualify for the *medium yield.* For purposes of occasional verification of the subjective evaluation assessments, or when there is disagreement between grader and packer, objective measures of loin eye area, fat depth, and a specific marbling score could be used in a regression equation to verify the classification.

4. Weight of carcass would be recorded (as was sex for quality) for purposes of classification.

IV. Final Combination of Grades That Would Identify All Beef Offered For Grading

The six possible grades would be:

*Quality-lean
*Quality-medium } All would include hot weight and sex identification (Steer, bull, heifer, cow)
*Quality-fat

Manufac-lean
Manufac-medium } sex identification (Steer, bull, heifer, cow)
Manufac-fat

*When marbling is greater than medium (moderate) the letter M would be attached to the word Quality (i.e. Quality-M)

V. Other Species

With some minor modifications, the same approach could be used for pork and lamb.

VI. Live and Cut Grades

With appropriate modifications, the above standards could be extrapolated to be applied to live feeder, live slaughter, wholesale cut and retail cut grades. For live grades, health condition would need adding.

The Murphey Approach

Some fundamental considerations applicable to the development of grades for beef:

1. Purpose of grades—to facilitate marketing by identifying carcasses for different degrees of development of the factors which affect their acceptability—differences in palatability and differences in cutability. (The present quality and yield grades are designed to identify these differences).

2. If at all possible, beef grades should reflect conclusive research results relative to acceptability or to conclusive evidence of established production practices and consumer preferences.

3. Changes in grades should *not* be made in response to industry pressures originating from short-term economic difficulties.

4. Grades cannot be too far "out-in-front" of industry practice. If they are, they will not be used. Factors used in the present USDA quality grades reflect the presently available research results for identifying differences in palatability. These would be used in any new system of grades developed "from scratch." Further, serious consideration would be given to use of a more "glamorous" name than "Good" or to combining the Good grade with the lower ⅓ of the Choice grade and labeling it as "Choice" then creating a new grade from the upper ⅔ of the Choice grade. The factors presently used in yield grading are those which research indicates are appropriate for use in a grading program to identify carcasses for differences in cutability. New yield grades "from scratch" would be based on total yield of boneless, closely trimmed retail cuts—rather than yields of these cuts from the round, loin, rib and chuck—and would eliminate weight as a factor to facilitate application of the standards without any appreciable sacrifice in accuracy. A concentrated effort also would be made to convince the industry to remove kidney, pelvic and heart fat at time of slaughter, so consideration of those fats could be eliminated.

The Schafer Approach

1. The present system is not bad. It is a product of an evolutionary process that seems to serve most elements of the industry wanting to see that it works.

2. Time and cost considerations for additional precision to be achieved must be made. The present system is based primarily on *indicators* of ultimate value; more direct measures should increase precision, but may take more time or increased cost. Present Good to Choice or Y.G. 3 to 4 spreads would seem to indicate that plenty of money is available to work on ways to up-grade, although grade-mix changes would change price relationships.

3. The *mandatory* nature of Quality-Yield grading should be reversed. It still is a service paid for by those expecting to benefit from it.

4. Quality grading is supposed to predict relative palatability. Tenderness is related to maturity, ossification, bone hardness and collagen cross-linking or solubility. Perhaps we should go to microwave cooking and shearing of a sample from each carcass. Destruction of a high-priced sample to cull out 1-3% of young cattle which have tough meat, but perhaps the opportunity to get most Good's into Choice on this basis, would more than pay for added testing. For flavor, gas-liquid chromatography or some other fat measure could be used as an indicator of strange off-flavors. For juiciness, "Slight" to "Small" marbling seems to be the minimum to avoid several palatability problems. A rapid test for ribeye fat content could be used and sorting could be at 5% chemical fat on wet tissue basis. We could use 1 cm of outside fat cover as another means of qualifying carcasses as having come from cattle that had been high-energy fed. If they can run the daily DHIA milk samples through as fast as they do, we should be able to speed such a system up. The latter approach would also be very adaptable to hot boning which seems to have been stymied on this and perhaps other bases.

5. Identification of all animals for ease in computerized tracing of disease, better production records, certification of feeding programs, carcass evaluation for breeding information, processing history and pedigree to allow packers to produce and then stand behind specification-meeting treatments such as electrical stimulation, high temperature or in-the-bag aging, blade tenderization or other well-defined "up-grading" procedures. Let purveyors with Quality Assurance programs and in-coming product testing monitor these product specifications (e.g., Hormel Cure 81 and other branded products with individual production numbers).

6. Grading should encourage competition among all segments of business and all sizes of business; it should not discourage or act against a segment of the business doing the best job it can under the circumstances.

7. For greatest efficiency and productivity of industry, grading should incorporate more "either/or" programs of either meeting the grade under present standards or demonstrating that an equal product is achieved by, and monitored by, other means to also "receive the stamp."

8. I believe strongly in the benefits of the proverbial "fatted calf." It's just a matter how we measure it and divide up the population.

9. Color prediction (dark cutters) in hot boned beef may be a problem. Either it will have to be overlooked which is not feasible or pH (time-constant) may work as a predictor. However, too many measurements of different types like fat sampling, maturity measuring and pH measuring may make the whole system unfeasible.