I am sure all of you attending this conference are indeed grateful to the members of the Review Committees in Cooperative Meat Investigations for the time spent in assembling, abstracting and summarizing all the experimental information on meat over a period of years. The National Live Stock and Meat Board and its manager, Mr. R. C. Pollock, also are due a "thank you" from all of us because they have made possible the distribution of these five volumes of the Review Committee to experiment stations and others interested in livestock and meats. We are also indebted to the National Live Stock and Meat Board for including the progress reports of Cooperative Meat studies in their annual reports. These reviews and progress reports have proven to be invaluable in teaching and research in meats.

In the beef sections of these reviews of meat studies, the summaries and reports have been classified under the following subdivisions: age; sex; degree of finish; breeding; type; influence of grass; effect of various feeds; limited feeding; management; color; and processing.

In general most of the experiments dealing with differences in age or sex have been concerned with economy of gain, dressing percentage, percentage yields of various cuts, market grades and palatability factors. In general, economy of gain decreased, dressing percentages increased, and color of lean became darker with age. Most palatability factors except tenderness increased at least up to two years of age. There seems to be very little difference in slaughter cattle grade and in carcass grade related to age. Percentage yields of various cuts were little influenced by age except that yearlings had more cutting fat than calves whereas steer calves yielded a higher percentage of hindquarter than steers of other ages. Although fatness varied with age, most experiments have indicated slightly more ether extract in the "eye muscle."

Steers in general gained more rapidly and had greater final weights than open heifers fed the same length of time. They also gained more economically than open heifers. Heifers gave slightly higher dressing percentages although at lighter weights. Open heifers had a greater amount of cutting fat and the rib cuts contained more fat with less lean and bone. Several experiments have shown steer carcasses to have more round and chuck than open heifer carcasses but there was no appreciable difference in loin and rib. The color of lean of heifer carcasses was slightly darker than that of the steers. Pregnancy of heifers had no significant effect on the total gain or dressing percentage but bred heifers were fatter and their carcasses graded higher than open heifers.

In experiments dealing with degrees of finish, the carcass grade and dressing percentage increased but economy of feed utilization decreased with finish. The color of lean in general became slightly lighter although the color of fat was affected only slightly with increasing finish. The brisket, navel and flank were the fattest cuts and all became fat early while the loin, rib, and chuck fattened more slowly. Forequarters increased and hindquarters decreased in percentage with finish. Palatability factors all scored higher with a greater degree of finish.
There have already been a good many experiments in all parts of the United States dealing with type and breeding in beef cattle but with increased numbers of regional projects in the Western and North Central regions and perhaps added numbers in the Southern region we should have a great deal more information on this subject in a few years more.

I will not attempt to summarize all the carcass results of these type and breeding experiments except to say that the comparisons are under the following subheads:

- Purebred and Grade Cattle in Comparison with Native and Scrub Cattle.
- Comparisons Involving High-Grade Hereford, 1/2 Brahman- 1/2 Hereford and 1/4 Brahman- 3/4 Hereford Cattle.
- Crossing Brahman with Hereford and Shorthorn Cattle.
- Crossing Africander with Angus and Hereford Cattle.
- Crossbred Versus Purebred Cattle.
- Comparison of Types and Breeds.
- Comparison of Calves Sired by Closely Related Sires.

"In general, in the studies on the influence of breeding in cattle on carcass and meat characteristics the most distinct differences have been found in such factors as appearance, grade, yield of carcass in relation to live weight, physical and chemical composition and color of lean meat. Also, interesting differences with reference to fat distribution, particularly intramuscular fat, and tenderness have been observed in a number of instances. Other differences in palatability were indicated but such other differences as may have existed were not clearly shown with methods available."

Experiments dealing with the effects of feeds have always been of major importance in beef cattle studies. Unfortunately the carcass data on many of these experiments have been confined to carcass grades and weights and dressing percentages.

At the 1937 conference on Cooperative Meat Investigations a subcommittee of the committee on Beef Projects prepared the following summary on "The Influence of Grass:"

"Feeding grain on grass increased the gains on cattle. Alfalfa, brome, alfalfa-bluegrass, and bluegrass produced carcasses ranging from creamy to yellow even when steers were fed corn and cottonseed meal on pasture. The alfalfa-brome combination produced the greatest number of yellow carcasses. Subsequent dry lot feeding for 100 to 112 days failed to eliminate the creamy to slightly yellow color of external fat. Pasture was not a factor affecting dark cutting beef. Cattle fed in dry lot 64 days following the grazing season raised the grade of their carcasses two-thirds of a grade. There was no significant difference in dressing percentage between cattle fed grain on grass and in dry lot."

More recent work on the influence of grass has tended to substantiate

the facts in this summary. While the grade of carcasses from cattle fed grain on pasture has suffered because of the pronounced yellow-colored fat, very little difference has been found between the palatability of beef from steers fed in dry lot and those fed grain on pasture when finished to the same degree. The deeper yellow colored fat of the grass-fattened cattle contains more carotene as well as more Vitamin A.

Beef cattle experiments dealing with limited feeding and methods of management might well be grouped together since most of the experiments under these two headings include limited grain feeding. In general, limited-fed cattle as compared with full-fed cattle carried to the same degree of finish were heavier at slaughter time, contained a larger percentage of fat in the "eye" muscle, carried slightly more edible meat.

Color studies have been confined largely to the problems of dark cutting beef and yellow-colored fat. Since yellow-colored fat has been discussed in connection with the influence of grass as it affects the color of fat, I shall confine my remarks on color to dark cutting beef. Dark cutting beef has been a perplexing problem and economic loss to the livestock and meat industry for many years but due to the combined efforts of the National Live Stock and Meat Board, the American Meat Institute and member meat packers, a number of experiment stations and cooperating agencies, a great deal of fundamental information has been secured on this subject in recent years.

Some of the early work failed to show a relationship between production factors and the appearance of dark colored meat but did show that this meat was nearly equal in palatability to meat from brighter colored carcasses. Age was thought to be a possible factor since mature cattle were found to have a higher muscle hemoglobin content than younger cattle. While the amount of muscle hemoglobin present appeared to have an influence on color, it was not the controlling factor. It was thought that dark cutters were the result of some condition of the hemoglobin in the tissue rather than due to the amount of hemoglobin present. Delayed bleeding and extreme excitement at the time of slaughter had sometimes produced dark-cutters but these conditions had not always given these results.

Fortunately, a study on 4-H Club calves shown at the International Livestock Exposition and slaughtered by meat packers at Chicago gave some good "leads" which were tested out in controlled experiments. Briefly, abnormal feeding, exposure and improper handling tends to produce dark cutting beef. Dark cutting beef had a low reducing sugar content, a high pH, and a low phosphorus content. These factors influenced the oxygenation cycle of hemoglobin which in turn was reflected in the visible color. If the content of the sugar in the muscle was reduced by the administration of insulin or by the withholding of feed plus a loss by greater energy requirements during chilling, exposure, or exhaustion, this cycle was disturbed and dark colored beef resulted.

I would like to mention very briefly current beef carcass projects being conducted at present in connection with Cooperative Meat Investigations.

The Bureau of Animal Industry at the Agricultural Research Center has the following projects on beef carcasses:

Evaluation of beef sires and lines of breeding in terms of significant carcass characteristics of their steer progeny.
Relative juiciness and composition of the juice of meat from beef type and dual-purpose type Shorthorn steers.

A study of the variation in physical and chemical composition of 500-pound beef type and dual-purpose type Shorthorn steer calves representative of animals used in RP progeny testing work.

Further studies of the evaluation of beef carcasses grades by objective methods.

The relative growth-promoting values of the protein in the several primary cuts of beef.

The Florida Station is securing carcass data from steers being fed sweet Blue Lupine seed as a protein supplement in a fattening ration.

The Illinois Station under their project "Feed Requirements for Producing Beef" have made an "Economy Study of the Retail Cuts of Different Grades of Beef" by breaking down into retail cuts and separating into lean, fat, and bone, fifteen Prime, twelve Choice, sixteen Good, fifteen Commercial, and eight Utility grade carcasses and determining the cost per pound of lean meat for each retail cut in each grade. The percentage of ether extract in lean and in lean and fat of retail cuts of the different grades of beef have been determined.

Dressing percentages, carcass grades, percentages of fat and color grades have been secured on steers fed on brome and bluegrass pastures.

The Kansas Station is collecting data relating to fat deposition and grade of carcass.

The Michigan Station is securing carcass data in their project "Maximum Utilization of Roughage and Pasture by Steers," and as a part of a project titled "Changes Occurring in Beef During Cold Storage Between Slaughter and Consumption." They are studying the following factors in addition to others that apply more specifically to freezing:

- Length of hanging before use fresh as deep fat fried steaks.
- Grade of animal.
- Differences between cuts from right and left sides.
- Differences within some of the large muscles.
- Effect of shearing values using 1/4 inch rather than 1 inch borers.

The Minnesota Station's project "Variations in Fattening Performance of Typical Beef, Dairy and Dual-Purpose Steers" is in progress.

The New York Station has just completed a series of experiments on "A Comparison of the Quality and Palatability of Beef from Steers Fattened by Various Means." Color, tenderness, press juice fluid, and other palatability factors have been studied. A project on "Length of Aging Beef" that has been a part of a freezing and tenderness study has recently been completed.

The North Carolina Station is securing carcass grade, dressing percentage and percentage of hindquarter results in their project "A Comparison
of the Effects of Certain Management and Breeding Methods on Beef Cattle Production."

The Ohio Station is making a carcass yield comparison of purebred and crossbred steers and heifers of known ancestry. They are also using a planimeter on the 12th rib to analyze the comparative fat and longissimus muscle areas.

The Oklahoma Station has two projects with beef carcasses in progress.

"The Color of Beef Fat as Influenced by Pasture and Feeding." Carotene and Vitamin A determinations are being made on the blood plasma and liver. Color of lean, color of fat and Tendometer readings are also included."

"The Influence of Arsenic in Rations on the Color of Lean in Beef Steer Carcasses."

Work to date indicates that feeding arsenic in the form of Fowler's Solution (\(\text{As}_2\text{O}_3\) in the proportion of 1 gram per 100 ml.) at the rate of 5.375 grains for 108 days of feeding had no detrimental effect on the color or quality of carcass produced.

The Wisconsin Station is doing some work at the present time on connective tissue involving veal calves, U. S. Good beef and Utility cows.

The Wyoming Station is securing carcass scores, dressing percentages and the percentage of rib, loin, and round in connection with their project "Progeny Testing of Beef Sires."

I have purposely omitted reference to beef carcass studies dealing with processing and freezing as L. J. Bratzler who appears later on the program has been assigned this subject. I believe that the scope of material on beef carcasses will be greatly enlarged by the regional research projects "The Improvement of Beef Cattle Through Breeding Methods," and "Marketing Slaughter Livestock by Carcass Weight and Grade." It is my hope that this brief review of beef carcass research will stimulate some discussion to follow on planning future investigational programs.

PROFESSOR BULL: I have a comment which I have made at a good many of these meetings of the meat co-operators on this matter of the review of the experimental work. Hankins, Loeffel and Warner have burned a lot of midnight oil doing that particular chore, and frankly, all of them are getting too old to do that sort of thing. I cannot see why, with this group of experiment stations and Department of Agriculture, they can't hire some good girl or some good man to do that chore.

Dr. Carroll spent a lot of time working on that, and it would have been better spent doing something else. He asked me to help him, but I wouldn't do it, because I was busy, but I can't see why some means of financing an office to do that can't be arranged. I am sure I could persuade our administrators to kick in some money to hire somebody to do that job.

We have a girl in animal nutrition who spends full time going through the literature of the nutrition work; she has a very valuable file. I can't
see why all of us together couldn't kick in a few dollars apiece and get that job done without imposing upon the good nature of some of you people who could spend your time to better advantage.

PROFESSOR LOEFFEL: I subscribe to that 100 per cent. I think Hankins would, too.

MR. HANKINS: Amen.

PROFESSOR LOEFFEL: I have something along that line I would like to bring up.

We have been thinking of turning this job over to Biological Abstracts and getting them either to fatten up one of their present volumes, or they have offered to get out a new one on meat technology. It is going to take some money and that has been the crux of the matter, finding the money to finance the thing. The plan was that each one of you fellows would take one or two journals to abstract. Of course, it wouldn't mean that every month you'd have something to abstract; it might be that for six months you wouldn't have anything to do. Send in these abstracts and combine them with abstracts which they are already getting, and either fatten up Animal Science - or they have one on Food Technology -- or make a new one on Meat Technology.

To make a new one would cost about $5,000.00 a year, and to fatten up one of the present sections would take $1500.00 a year. We have had trouble finding the money. I'd like to discuss it with you later.

PROFESSOR BRATZLER: Professor Comfort mentioned in regard to this grass work the yellowness of the fat reflecting grade. As I understand it now, the Government graders aren't paying any attention to fat, are they?

PROFESSOR COMFORT: Not as much as they did at one time. Of course, part of that dry lot after pasture was due to the difference in conditions, too. Two-thirds of the grade, as was mentioned there, was due to the conditions, the slight difference in color of fat.

PROFESSOR MACKINTOSH: I was rather surprised, since our spring meeting, to learn there were several of our own group who were unaware of the volumes of the material collected by the Review Committee that now exists. Maybe it might be well if you just took a few minutes to tell the entire group, because I take it there are some here who do not know of the existence of those volumes such as they are.

PROFESSOR LOEFFEL: In 1935, the Cooperative Meats Investigations Conference, an abstracting committee, was set up. The function of this committee was to review all of the existing meat work and to abstract it and publish abstracts, and also to summarize this work. Hankins was first Chairman of the Committee. Ken Warner was a member. Hankins took beef projects. Warner had lamb projects and grades and measurements, and Miss Boller of the Meat Board had nutrition. Miss Cline had meat cookery - Dr. Hall of Kansas State, on methods. I had pork projects and Miss Lowe had lard projects.

We reviewed all the literature and published our first volume in 1937.
There were a hundred sets published, and those were available at $10.00 per set of two volumes. They were published by the Meat Board and are no longer available, but they are available in most of the agricultural college libraries, or can be borrowed from the Meat Board.

In 1942 the next two volumes were issued. The personnel of the committee had changed a little — and then in 1946 another volume was issued, so there are now five volumes of this Meat Review available.

PROFESSOR MILLER: This is not exactly a question. What I had in mind was in trying to develop objectives or other measures of quality of meat. Sooner or later some hardheaded person says: "The proof of the pudding is in the eating." That brings up these palatability committees, and frankly, we haven't been too satisfied with what we have been able to do on palatability committees, and I would like to ask some of you who have had a lot of experience, what can be done to improve the efficiency or accuracy of the palatability committee?

PROFESSOR LOEFFEL: Hankins, you have done a lot of work on palatability. What is your reaction?

MR. HANKINS: It is such a big story, really, that I hesitate to dip into it at this time. A great deal can be said. Some of it is more favorable than it was a little while back. I think perhaps the most helpful suggestion I might offer to you folks is this:

The Quartermaster's Laboratories here in Chicago have taken this thing very seriously in the last few years, and they have set up special facilities for doing the job. They have made special studies of the job, and I would urgently suggest that if you really want details, that you get in touch with them. They have some published material I think they can give you, and go see their facilities also at your first opportunity.

So far as I know, there isn't a better job on palatability being done in the country than right out there.

PROFESSOR LOEFFEL: That's right here in Chicago out on Pershing Road?

MR. HANKINS: That's right, and it is not just with meats, of course. It is with all kinds of food. They have a broad concept of the job, and they really have gone into it very thoroughly. We can get many helpful suggestions from them for our future meat work, I am sure. We are expecting to put some of them into effect.

PROFESSOR LOEFFEL: As a matter of fact, there are only four fundamental tastes that you can distinguish by your taste buds anyway. There is sweet, sour, salt, and bitter.

Some years ago we took our folks whom we were using on our tasting committees and brought them into the laboratory in the middle of the afternoon; that is, we didn't want them to be hungry and we didn't want them to come in too soon after a meal. We brought them in without telling them what we were going to do with them.

We had a number of threshold tests. We have very dilute solutions of — I think it was sucrose or dextrose that we used — and we'd give them a
test tube, and we'd say: "Do you taste anything?" "No." We'd give them a little more concentrated solution. "Do you taste anything? Do you taste anything?" Finally they'd say, "Yes, I taste something, but I can't make it out." We'd give them another one until they'd say, "Yes, that's sweet." We'd make threshold tests that way.

In the same way we'd take salt, and for bitter - we used caffeine. We had four tests at any rate. We let them rinse their mouths with distilled water in the meantime, and we found that some folks just couldn't perceive acid, and some were very, very acute for acid, and some of them were very acute for one thing and weren't much for others.

Well, we tried to weed out our judges that way, but most of the flavor of meat is the aroma which comes up and strikes the olfactory lobes, rather than the taste buds in the mouth, so it is rather a complicated situation, and I don't know that we have helped ourselves any by weeding out our judges, but some of these chronic cigarette smokers aren't worth much as meat judges.

MR. HANKINS: There has been some rather nice work done on that matter of thresholds and published. At the moment I can't think of the name of the author, but doubtless some of the rest of you know, and as Bill indicates here, there is quite a variation in the threshold of each one of these primary taste factors among any group of individuals, within any group of individuals, and our Mr. Barbella came to the conclusion that perhaps the best judges were those who had what you might regard as about average threshold to taste.

Now, this little scheme also provides the opportunity to check on the individual's ability to reproduce his judgment; that is, he may show one day or one time that his threshold is here, and you may test him again and you will find the floor higher. Well, that sort of individual, obviously, ought to be thrown out and not used. But the practical problem that we all run into is this, of course: That we have a limited number of people to draw on, and in many cases I suspect if we'd throw out all who should be thrown out, we wouldn't have enough left.

PROFESSOR SNYDER: Bill, I'd like to have a show of hands of those who have been sitting on these palatability committees right here.

... A number of hands were raised. ...

Well, now, what does that show? There are more that are not, than are, I would say. Is that right?

MR. HANKINS: Maybe they are not doing any cooking tests.

PROFESSOR LOEFFEL: Well, folks, this is all very interesting, but I presume we must be moving along with the program. Here (indicating) is a copy of Volume 5. This is just one volume, because it is mimeographed on both sides, and the material has been condensed somewhat. If some of you haven't seen it, it will be available here for you to look at.

CHAIRMAN TOMBAVE: I am sorry to break off the discussion, but I hope that someone will bring up this subject again for further discussion, because I am sure that as meat investigators it is a very important problem to us in connection with palatability of meat.
A great deal of research work has been done in recent years on the lard and pork studies. If I am correctly informed, this has been done both by the agricultural colleges and experiment stations and by commercial concerns which are interested in anything pertaining to pork and lard. We will now have Professor E. J. Wilford, University of Kentucky, discuss the subject "Review of Current Pork Carcass and Lard Research."

Professor Wilford.

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