NEW HORIZONS IN THE FIELD OF MEAT RESEARCH

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There has been a remarkable increase in knowledge derived from research during the last 25 years concerning the quality and nutritive value of meat produced and processed in the United States. Major contributors to this increase have been the State colleges and experiment stations and the United States Department of Agriculture. However, impressive though the record of accomplishment may be, it is fitting at any time in any field of research to raise the question, "What of the future?" or "Where do we go from here?" It seems especially appropriate at this time and in this group to discuss the question - "What are the new horizons in meat research?"

For a number of years, since animal husbandry workers and others became more "meat conscious," programs of meat research have rather frequently been a subject for consideration. One of the most active groups in this respect, for example, was the Conference on Cooperative Meat Investigations, with which many of you are familiar. You will remember that numerous suggestions for lines of research on meat came from the Conference during a long period of years and that in 1940, as a result of Conference work, there was issued a "Revised Program of Research," which was very comprehensive in scope. It was interpreted and amended in 1941 in the light of the national emergency. Early in 1944 a special committee of the Conference on Cooperative Meat Investigations prepared recommendations for research to meet further war-time needs, and, moreover, to meet those of the post-war period. In discussing "new horizons" today I make no claim with respect to completeness, nor do I wish to imply that they represent only my own thoughts and ideas. In fact, in large part they are derived from Meat Conference recommendations, discussions with coworkers, and other sources. Some of the suggestions do not relate to entirely new lines of work but point to problems of major importance where only a limited amount of research has been done.

I should like to call attention first to the need for more information on the significance of age in our meat animals. It is true that a number of experiments have been conducted to study relationships between age of the animal and certain characteristics of the carcass and meat. However, it is entirely possible that there are important basic facts that have not been uncovered, or at least not made clear, relating to changes in physical, chemical, and organoleptic characteristics associated with increasing age. For example, it could be extremely helpful to know what changes in factors such as diameter of muscle fiber, proportion of connective tissue, amino acid picture, growth-promoting value of the protein, tenderness and juiciness, accompany increasing age of the animal when (1) there is no change in weight, and (2) there is no change in condition -- that is, growth occurs with the least possible fattening.

Animal growth is a basic problem, closely associated with age, that has not been adequately studied in relation to quality and nutritive value of meat. All of us know the tremendous variations that occur in rate of growth
among different animals and, especially in the case of cattle, within the same animal at different times during its life. These variations in rate of growth are not caused entirely by nutritional factors but there can be no doubt that they make a large contribution. The need for more, well-controlled work, involving different planes and combinations of planes of nutrition, is suggested. Other factors influencing rate of growth also require more intensive study.

The great problem of fattiness or finish continues to be with us. Just how fat should our cattle and hogs and lambs be when slaughtered to have the beef, pork, and lamb meat most generally acceptable? Moreover, is it adequate to view the problem merely as it relates to gross fattiness? Is it not true that the distribution of the fat is a matter of major significance? Who of us does not believe that the fat of most of our hogs could be redistributed to great advantage? Are we not more concerned actually with intramuscular fat than with external, internal or intermuscular fat in dealing with the palatability of pork and other meats? These and other questions suggest the need for much further study of fattiness and fat distribution in relation to factors of livestock breeding and nutrition.

It seems logical next to consider the subject of muscle-bone ratio. Few would criticize the statement that most of us eat meat for the muscle or lean meat component. Therefore the general -- probably universal -- interest is for a muscle-bone ratio as wide as possible. This introduces the problem of skeletal and muscular growth and development and the question as to how much bone the meat animal should have. Probably the correct answer is that it should have no more bone than is necessary to enable it to move around and to carry out the body functions satisfactorily. There is a very limited amount of information in the literature on the subject of muscle-bone ratio and much further research on the effects of genetic, nutritional, and possibly other factors on this characteristic would seem to be appropriate.

There is considerable evidence that hormones and hormone-like substances affect the fat, protein, carbohydrate, and mineral metabolism of the animal body. Moreover, some of the substances have appeared to have one or more of the following effects: (a) increased rate of growth, (b) higher feeding efficiency, (c) more rapid fat deposition, (d) better fat distribution, (e) change in size and texture of bones, and (f) modified conformation of skeleton. Although the picture at present is complex, it is sufficiently clear to suggest that a more intensive program of research would be justified.

The need for a system of market grades in the livestock and meat industry of the United States has been well established. However, there is frequent criticism of the subjective methods of grading employed and an increasing belief that objective methods should be developed and made available for use, especially for dressed carcasses and cuts. Some efforts have been taken in that direction but much research remains to be done. When suitable objective grade standards have been worked out, there should be more assurance to producers that their superior animals receive the recognition to which they are entitled in commercial channels.

Methods for determining the carcass composition of cattle, hogs, and other kinds of meat animals are rather well established. When for any reason, however, it is necessary to retain the animal in the herd or flock, as in the case of breeding stock or of young stock that is to be subjected to test for feeding efficiency, and still have knowledge of the composition, a difficult and,
up to now, an unsolved problem is presented. Moreover, the relation between the composition of market grades of live meat animals and that of the corresponding grades of the dressed carcass is involved. Devising and developing satisfactory methods for estimating the composition of live meat animals will greatly accelerate research in animal husbandry, through facilitating the evaluation of breeding and feeding factors. It will also contribute to the characterization of market grades of livestock objectively.

Time permitting, much could be said about the future of research on freezing and curing. However, this discussion will be limited to a brief description of a new major project in the Bureau of Animal Industry. As the first step, a survey is being made to determine the typical methods of freezing and curing, and methods of storing meats so preserved, now in use throughout the country. Samples of meats representing those typical methods will be assembled for study of factors of quality and nutritive value. Next, meats will be processed by these typical methods, under controlled, experimental conditions, and further work done to evaluate them in terms of quality and nutritive value of the products. The major phase of the project will be concerned with efforts to devise and develop methods that will represent improvements over the typical methods now in use. Wide deviations from conditions employed in carrying out these methods will be studied and evaluated. For example, the Bureau will be prepared to freeze and store meat at a temperature as low as -100°F. and to cure meat at any temperature or temperatures desired between the freezing point and atmospheric temperature. The project provides an excellent opportunity not only to develop information of great practical value but to uncover facts of basic scientific significance.

Electronics is a subject concerning which the public has already heard a good deal. Although much of the publicity has not been very specific, many people have learned enough about the subject to know that electronic heating, perhaps more correctly identified as dielectric heating, possesses unusual characteristics. Involving the use of a high frequency current, this method effects a uniform increase in temperature throughout the material, especially when the material is homogeneous or reasonably so. Moreover, the desired temperature is quickly and accurately attained and accurately held. When the electric current is turned off there is no tendency for the temperature at the center of the mass of material to go higher before it starts down.

There appear various possibilities for the use of dielectric heating in the processing and preparation of meat and meat products. Among them, for example, are (a) inactivation of enzymes preparatory to the storage of frozen meat and cured meat, (b) thawing of frozen meat, (c) a source of heat in canning, (d) dehydration, and (e) cooking. This method of heating may have important advantages relating to the retention of high levels of eating quality and nutritive value and in other respects. There is a broad field for research here that has been opened up only in a small way.

Another new problem is concerned with ultrasonics. This involves the use of high frequency sound waves. The sound is so high pitched that it is not detectable by the human ear. As a general rule the sound waves result in high frequency mechanical vibration throughout the mass of the material exposed to them. This vibration leads to friction and the latter generates heat but the temperature can be controlled to a considerable extent by cooling while the vibration continues. The extreme vibration to which meat would be subjected by this method suggests the possibility that changes, - perhaps both physical and
chemical, would occur. It is conceivable that as a secondary effect, for example, tenderness would be increased. This "new horizon" is both interesting and promising.

Any discussion of this type would obviously be incomplete without some specific consideration of the problem of nutritive values. The opinion has been expressed to the speaker by one of the outstanding leaders in that branch of meat research that the determination of the non-essential amino acids may prove to be equally as important as the determination of some of the essential acids. Moreover, he points out that as new methods of processing and preparation come into use the retention of nutrients must be followed, and that the determination of total nutrients, at least as we know them today, may not reflect the true nutritional value of a ration or a diet. Additional studies with animals are needed in which meat makes up a part of the diet proportional to that consumed by average human beings.

In closing, may I call your attention to the need of additional and better methods in meat research? This is an old story to many of you but cannot be disregarded. Earlier I spoke of the need for a method for estimating the composition of live animals. Another requirement is an adequate chemical method for measuring flavor. Numerous other examples could be mentioned. Future progress in meat research will depend to a large extent on improved technics becoming available, as well as on the wisdom and ingenuity with which older methods are utilized.

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PROFESSOR PIERCE: I had a conversation with a man on the train. I think he was a physical scientist from Rochester and he said that somewhere in Germany they had experimented with high-voltage current. The application, I think, was 400,000 volts applied for 1/100,000ths of a second, to a piece of raw meat, and this particular piece of meat retained its original state, or I should say, quality for three months when it was kept at room temperature.

Now, he is sort of working with a pliofilm, which is a two-way stretch film, which when it is stretched, as it gradually returns to its original size, creates a radio-active energy, which they are experimenting with with vegetables and meats, and he says that this will keep. For example, an apple, if you would slice it in half and put a piece of this two-way stretch pliofilm over it, would keep the same color for a period up to three weeks.

I was just wondering if anyone else in the group had heard about anything similar to that?

PROFESSOR BRATZLER: We had a man bringing a two-way stretch film down in Michigan, and he gave Professor Brown a package, and he got aches in his legs. It was supposed to kill headaches.

PROFESSOR PIERCE: That's the same man, I think. He said it would cure headaches by placing a piece on your forehead.

PROFESSOR BRATZLER: I asked Professor Brown what results he had. He didn't know whether he did it right or didn't do it often enough, but it didn't work.
PROFESSOR COLE: I might make one statement here. We recently have had a project approved by the Atomic Energy Commission in Washington with the use of radiation and isotopes down at Oak Ridge, Tenn. Of course, it is with the Medical Division of the Atomic Energy Commission, because they are primarily interested in what effects these isotopes and different amounts of radiation will have upon the meat.

We, of course, are going to proceed, and if any of you people have any suggestions on how we might proceed, we'd appreciate them on how we might test it, - whether meat is fit to eat after it has been radiated and so forth. We would be very happy to receive any comment. I think it is going to be very interesting. They are building us a building, and we will have good equipment and plenty of land, and we will be working with cattle that were radiated at the Los Alamos area in New Mexico this fall, and then we will radiate some of our own cattle in varying amounts, and also check different isotopes.

This is not just on meat, but also on breeding, and of course, the use of isotopes in feeding and other things. If you have any helpful suggestions, we would appreciate them.

PROFESSOR BULL: We are going to do some work in the carbon radio active lab. next year, and it seems to me that it can be applied to meat research, if somebody will send me a man that is smart enough to do it. I think that this deposition of fat could be studied by hanging a radio active carbon on a starch, although they tell me it's pretty difficult to hang one on the starch unless you grow it under the proper conditions; build a plant under the proper conditions.

PROFESSOR LOEFFEL: It seems to me in meat research we have done all the easy things. The difficult ones are ahead.

PROFESSOR BULL: Which brings in the point which I attempted to emphasize, that we have got to go outside of the meats division; we have got to go outside of the animal husbandry department; we have got to go outside the college of agriculture to train the men who are competent to do this work. Perhaps some of us may tell them that "This is a porterhouse steak you are working with; that's a chuck rib." I think most of us can do that. But when it comes to these highly technical trained men, they are not going to get it in the meats division.

PROFESSOR LOEFFEL: I personally have been very much interested in muscle histology, and the muscle is one of the most difficult teachings there is to work with, and you practically destroy it in fixing it and staining it, so that you really don't know if the material that you are examining under the microscope is what really exists in the living animal or not.

I think we have got to do a lot of work with methods, and the more I see the more I am impressed with the immensity of the problem we are facing. Muscle is perhaps the most difficult of all tissues to work with -- dehydration that occurs when you take it through the alcohols, for example. In conventional staining and preparation techniques, artifacts appear in the muscle. You often wonder whether you have anything that is representative of the muscle in the living animal when you get through with it. We just simply have to develop new techniques to make progress in this field.
I still feel the microscope holds the answer to many of our problems, at least insofar as they relate to tenderness.

PROFESSOR PIERCE: Well, didn't Mr. Snyder down at Texas work with some ultra-microscope in studying formation of ice crystals?

PROFESSOR SNYDER: No.

PROFESSOR COLE: That was another man.

PROFESSOR SNYDER: That was probably over at the University, but I am not familiar with it.

PROFESSOR COLE: Yes, he's a chemist over there.

CHAIRMAN TOMHAVE: Thank you very much.

We will now stand adjourned until 1:30, and be back as promptly as you can, because I am sure we are going to have an interesting session this afternoon.

... The meeting adjourned at 12:05 p.m. ...