Flavor is generally thought of as that quality of anything that affects the taste; flavor may be gratifying or it may be objectionable. It is generally accepted that there are only four primary taste qualities; sweet, acid, salty, and bitter. It is also usually considered that there are specific taste buds in the tongue and throat for each of these taste qualities, though there is no supporting histological evidence for this theory. Volumes have been written on taste but probably the most recent and most comprehensive presentation of the subject is contained in the monogram entitled "The Taste Sense and the Relative Sweetness of Sugars and Other Sweet Substances", by the late Dr. A. T. Cameron of the University of Manitoba. In this monogram flavor is described as a mixture of various tastes and odors.

Taste varies between races and between individuals and this variation in some cases is inherited. There also appears to be a wide variation in the taste sense of the individual from time to time depending upon numerous factors. In the study of taste, liminal or threshold methods have been used largely, though supraliminal methods using concentrations well above the threshold level have also been used. In the discussion that follows it must be accepted that the flavors in question are well above the threshold level and are common to most individuals in this country.

Beef:

There is a mass of information pertaining to the flavor of beef as a result of breeding, sex, and feeding but much of it is conflicting and of doubtful significance. There seems to be a trend towards improvement of flavor with improvement of breeding when pure bred bulls are crossed with Brahama cattle and scrub cattle, but the improvement is not marked. Where normal feeding practices were conducted there was no significant differences as a result of feeds or methods of feeding, though increased fat seemed to produce some improvement in flavor. There seems to be no significant difference in flavor of beef resulting from feeding on grass or strictly grass fat cattle. One exception to the latter was the very intense and undesirable flavor noted at North Dakota in cattle grazed on very sparse pasture in 1934. This was attributed to the consumption of certain weeds or grasses not normally consumed. The undesirable flavor disappeared after feeding in dry lot. From time to time certain weeds have been accused of producing off flavor of beef but the only factual information related to any one weed comes from Georgia where wild onion was shown to produce a strong flavor in the rounds, loins and shoulders of beef fed wild onion. No form of cooking appeared to remove the flavor, neither did various types of treatment of the carcass. This flavor does disappear, however, if no wild onion has been consumed within several days before slaughter.

Work at Nebraska and Missouri Stations indicate that flavor increases with age from calf-hood to maturity. An extensive statistical study by Barbella and others of the U.S.D.A. also bears out this observation. The same study confirms the observations of numerous others regarding the increased flavor with increased degree of finish.
Lamb:

Retarding the growth of lambs, either by feeding ample amounts of roughage only, or by feeding insufficient amounts of a ration consisting of grain with roughage, measurably reduced the desirability of flavor and also reduced the tenderness of the meat. Submaintenance rations have been sighted by several experiment stations as influencing the palatability adversely, but the Nebraska Station seems to be the only one that specifically mentions the lowering of the flavor value. The influence of breed has also been studied by a number of stations but intensity or desirability of the flavor has not been included among the observations. Contrary to common opinion, failure to castrate ram lambs until they are one year of age has no measurable influence upon the palatability factors either before or after castration according to observations at Cornell, Maryland, Tennessee, Vermont, and the U.S.D.A.. In general all work done with lamb indicates an increased desirability in aroma and flavor with an increase in the degree of finish.

Pork:

Palatability of fresh pork, particularly flavor seems to have been overlooked in the majority of pork studies. The following summarizes most of the observations. Breed has no influence upon flavor. Plane of nutrition seems to have no significant bearing upon palatability, though the North Carolina Station observed that limited feeding of hogs from weaning to slaughter produced a more pronounced flavor and aroma than those full fed. However, those hogs receiving a limited ration throughout the feeding period produced pork grading lower in palatability than the full fed pigs, but was not objectionable. There appears to be some improvement in flavor with increased weight of hogs, from 145 pounds to 300 pounds, but this may be due to the increased deposits of fat.

Although the work on soft pork is voluminous there are very few observations on flavor. The primary difference between soft pork and firm pork seems to be in appearance only. The Georgia Station suggests that the flavor of soft pork is preferable to that of firm pork. The kind or amount of protein supplement including fish meal seems to have no influence upon the flavor, though it may influence the firmness of the pork.

The type of feed including pasture has no influence upon the flavor though there are a few notable exceptions. Rye grain has been observed to produce pork that is objectionable in both aroma and flavor, though the causative factor has not been isolated. The Nebraska Station found that grain treated with paradichlorobenzene as an insecticide when fed to hogs even in a very limited amount produced fresh pork so objectionable that it was inedible. The cured products were likewise inedible and caustic refining failed to remove the odor and flavor from the lard.

All in all the references to flavor are rather limited, probably due to the lack of specific methods of measurement. Undoubtable there are many other chemicals that might have an influence upon the flavor of the meat similar to that of paradichlorobenzene, but it is fortunate that they are not listed among the items commonly fed to livestock.
Dressed and Frozen Meat:

There seems to be very little factual information on this phase of the subject, but there are many observations that seem to be generally accepted though not backed with experimental evidence. Odors and flavors of frozen foods have been described as nutty, metallic, brassy, bitter, turpentine and sour. The storage of fresh fruits and vegetables in the same cooler with meat, particularly warm beef should be avoided as the fresh meat will absorb the aromatic gases given off by the fruits and vegetables. The presence of decayed potatoes, cabbage, and lettuce have been known to cause such off flavors that large quantities of meat have been replaced. This situation has been by no means uncommon during the period of expansion of the locker industry.

It is recognized that aging meat has a desirable influence upon the flavor, but aging for too long may produce a flavor that is too "gamey" to suit many palates, therefore aging should be limited, particularly if the meat is to be preserved for a period of time by freezing. Off flavors also frequently develop during aging as a result of bacterial growth on the outside of the carcass. When fresh meat is held in an aging room for short periods, a slimy growth of putrefactive organisms can frequently be observed. Henrickson (unpublished data) observed that growth of this organism was slow at 34°F but abundant growth was noted at 40°F. When the organism was isolated and plated bacteriologically, it was found to be a gram negative, small rod shaped, psychrophilic organism. This organism is aerobic and grows best at 23°C. When grown on Difco's North Nutrient agar a very putrid odor was evident. Henrickson has classified this organism as Alcaligenes Metalcaligenes, and it is felt that it is the cause of numerous complaints of off flavored meat when the meat is removed from the locker only a short time after freezing. Unless the surface of a contaminated carcass is carefully wiped before cutting, the power saw will smear the slimy growth over the surface of the cut meat and an obnoxious odor and flavor in the meat results. This is a condition that can and should be avoided but is happening far too frequently. Other bacteria may also be involved in a similar manner with off flavors in meat.

Spices have been observed to give off flavor to ground meat and sausage. Only recently pepper was noted to have a strong ucalyptas aroma which flavor it imparted to the meat. There are some cases on record where wax papers have imparted a petroleum flavor to the meat after a period of storage. Such papers should be avoided. Oat flour has been added to sausage and dusted over pork roasts as an antioxidant. Under such conditions a slight charring of the surface during the cooking process has been noted. This charred condition of the surface has given the product an added flavor which in no case was recorded as objectionable. It has also been reported verbally that some antioxidants when added to meat have produced an off flavor. These materials were tried only experimentally and are not available on the market as antioxidants.

A few years ago many locker rooms had an odor that was frequently described as that "Locker Room Odor". With the installation, of sharp freezing facilities, lower temperatures in the storage room, better chilling facilities and a general improvement in the sanitary condition of the locker plant this odor has practically disappeared. It was believed, and the disappearance of the odor in part substantiates the belief, that the odor was associated with bacterial growth due to lack of sharp freezing facilities and in some cases to actual decay of the foods stored in the lockers due to inadequate freezing. There is no question about the occurrence of the odor, and that the packaging material absorbed the odor which in turn influenced the flavor of the food.
contained in the package. Lower temperatures, improved wrapping material, better sanitation and better management seem to have practically eliminated this type of contamination. In the earlier days of locker plants when wood was used extensively in the construction of the lockers there were numerous cases where the wood sealer and paint flavored the products placed in the locker. Turpentine has been known to impart a bitter taste to food products. It should be mentioned, however, that during the period these things happened the wrapper paper was poor and sharp freezing facilities frequently lacking.

Dehydration is still with us and with dehydrated meat there is a flavor that though probably not obnoxious, is certainly not desirable. The flavor is difficult to describe but is one that all member of a palatability panel recognize immediately. Again improved wrapping materials, improved wrapping, and more constant storage temperatures are aiding in the elimination of this condition. Rancidity, though not necessarily so, is usually associated with dehydration. The most common cause of off flavors in frozen meat today is rancidity. Since some degree of oxidation takes place even in a frozen state, rancidity will develop if the fats are stored too long. Palatability of the meat, particularly flavor drops rapidly with the onset of rancidity. Sharp freezing and lower storage temperatures aid in delaying the onset of rancidity, some antioxidants have been used with a fair degree of success, but when products containing unsaturated fats are to be stored by freezing, they should be consumed within a reasonable period of time or some degree of rancidity will be noted.

Summarizing These Observations or Factors Related to Flavor:

Age and degree of finish have a desirable influence upon the flavor of all meat, feeds in general have little influence, though some specific items may prove detrimental. After slaughter, aging alone improves the flavor. In no instance has freezing been suggested as improving the flavor of meat, but rather to the contrary, there is a slow and gradual deterioration or lowering of the flavor from a desirability viewpoint. The matter of off flavors would seem to be more a problem, of sanitation, temperature control in both the chill room and the storage room, proper packaging, sharp freezing, and do not store too long. It would also seem as if there is a fertile field for research open to the food chemist in determining some of the compounds related to off flavors. There appears to be great need for further research on the subject of flavor in general.

CHAIRMAN BRATZLEB: We have time for about two questions. The open discussion will be led by E. J. Wilford of Kentucky.

PROF. WILFORD: The paper by the speaker who just left the floor needs no apology. I think the paper has been well written and the ground efficiently covered.

Before I open the floor to discussion or questions, I think that he cleared up one point for me. I noticed when we were slaughtering some lambs that one group of lambs seemed to have a very strong flavor and other lambs of similar type and breeding did not have that same taste. The first lambs that I am talking about that had the strong flavor were very slowly grown and produced their gain very slowly. Others of the same kind of breeding
and feeding, were better fed, grew much more rapidly and did not have that strong taste. In other words, slow growth seems to develop that so-called mutton taste.

Now we are open for discussion or questions on this paper.

PROF. BULL: I would like to ask the Professor how he likes these ozone generators to purify the air in locker plants.

PROF. MACKINTOSH: That was another note I scratched off with intent, first, because I could not find authentic material on the subject, because personally I do not consider advertising material by the manufacturer as authentic, and like Pete over there, I am very scrupulous about what I believe any more.

Personally, I am very much opposed to it. I cannot help but feel that the presence of ozones in the cooler very definitely accelerates oxidation. If all our packages were put up absolutely in an impermeable form, as Pete said, if the wrapping material was impervious to gas - and we must pay more attention to that - we would have little worry about it. But most of them are not, and it is purely my opinion that the presence of those things in the cooler and in the storage room accelerates oxidation.

I am a firm believer in the fact that it does not remove the cause. If someone has an odor in their freezer, it is time they determined the cause and removed it, rather than try to camouflage it.

PROF. BULL: Do you think Air-wick would do? (Laughter)

MISS LOWE: I think Davey's paper was fine, but I think there are a lot of intangibles, and I am sure he will agree with me. As long as Fred and Davey and I have scored meat, we have not discovered the cause for the difference in the flavor of animals. I am making this comment because it is up to the younger people to go ahead on that problem.

The University of California is working on the flavor of chicken, and one of the distinctive flavors in it is caused by a weak acid. At the Western Regional Laboratory, they are collecting the distillates and determining the chemical agents that are linked with the flavor of meat and also chicken.

Returning to the subject of milk, since milk is a fluid that is produced in the body of a dairy animal, we can all tell when the cows are turned out on spring pasture. We can detect the flavor of wild honey, skunkweed, and many other plants. If you have watched a good milk man work, he can tell you whether the milk came from cows that were on silage, or whether it was dry feed, and so on.

I think in killing the animals, when you take out the fluids, where those water-soluble constituents are, and the blood is out, you leave such a small amount of the flavors that it is rather intangible, but if you will observe a great many things as you are working with the meat, you may gradually work back. I wonder if feed may not cause more difference in flavor of meat than we think. Crocker, in using his pork, said he used an Eastern pork - he is in Boston - and an Iowa group. He said there is a difference that is either inherent, due to the breed, or due to the feed, because it was different from the regular pork flavor that he mentioned.
All of you who have scored meat a long time remember certain animals that have tasted terrible and others that were very good. I just mentioned to Fred a minute ago -- was it you who was at the Station at Iowa when we had those animals that were fed on cocoanut feed? It was the best tasting fat, outside of two other animals, that I have ever eaten, and the meat came from one of the animals fed cocoanut feed. Whether it was the feed or it just happened to be the individual animal with a great many other characteristics, it is certainly something that needs a lot more investigation. It is a wide-open field for all the youngsters to begin on.

PROF. WILFORD: I think you have something there.

PROF. MACKINTOSH: I think the statement of Miss Lowe regarding the probable influence of feeds is quite correct. However, as indicated, they are below the average threshold. I think evidence of that lies in the case of rye. Rye pasture is one of the things you can tell the day the cow went on to pasture by the taste of the milk, and it is apparently strong enough to influence the carcass. Most other feeds, to my mind, may do such, but it is below the threshold level.

DR. NELSON: Mr. Chairman, I would like to ask, do you consider this rancidity is induced by the ultra violet light due to the radiation energy itself, or to the ozone generation by the ultra violet?

PROF. MACKINTOSH: You have me out in too deep water.

DR. NELSON: You put yourself there.

PROF. MACKINTOSH: My opinion is that it is the ozone.

DR. NELSON: I wonder.

PROF. MACKINTOSH: We cannot get away from the fact that we do know that that accelerates oxidation. Why shouldn't it, in the case of meat, when you bring them in contact?

DR. NELSON: The reason I asked that question, we had run into the difficulty quite a few times when these wonderful lamps that did everything were first developed. We found a lot of them did produce a considerable amount of ozone.

The question is: Why are you using an ultra violet anyway?

PROF. MACKINTOSH: Opinion again.

PROF. BULL: I might add in that connection that when Prof. Nelson was with Wilson & Company he did more work with ultra violet lights than all the rest of us here put together. I just mention that because judging from his remarks, he does not have much use for them. At least, Wilson does not have them.

DR. NELSON: We were never successful with them. It is a very fine scientific tool in curiosity. You can have a lot of fun with them, but the application from the laboratory into a plant is entirely different.
CHAIRMAN BRATZLER: Thank you, Mr. Wilford.

I know the next gentleman can not say that he does not know anything about the subject, because he was picked particularly, I remember, as he had done some work with home freezers, and he will present the next paper on "Factors Affecting the Efficient Use of Home Freezer Units in Urban and Rural Homes," by E. A. Pierce of South Dakota.