The plan to use time and provide experience in organolyptic tenderness testing has finally come to pass. Our purpose is to share in a demonstration where a macrobiological assay uses the human subject and his organs or systems of prehension, mastication, deglutition and finally thought processes to formulate a judgment of tenderness for a particular sample of beef. Two or more samples may be tested by individuals and the virtues of comparison may be counted. Experience taught Miss Cover, Dr. Deatherage and Walter Reiman that 6 persons on a taste panel who would partake in duplicate samples could provide very useful results for recording the factor of tenderness of roast beef or broiled steak from the carcasses of experimental animals. Pearson has reported the use of 2 six-member panels where the sex and personal interests were in contrast but correlations by the two groups were identical.

This game that we propose to play right now has some rules. Its purpose is to determine tenderness of two meat samples. All are to participate but the 6 men seated here together are intended to simulate what each of us may consider as a taste panel ready for action. The product has been sliced 1 inch thick from two closed sides of 500 lb. carcass beef. It has been broiled with the attached metal tags in order to maintain identity. Each steak makes 3 servings. They are placed upon the plate in pairs with appropriate code numbers.

Now we are ready to cut, chew and think. By way of suggestion, my habit is to cut 2 bites from the end nearest the lateral processes and perhaps divide the remainder in vertical position with the fat and aponurosis intact. As you chew, look at the plate or the ceiling but please think about past meat eating experience and choose the number that best describes your impression, then record it on the name card opposite the identification number on your plate. The one item of advice is to eat with thought but not necessarily as the expert card player to remember which ones have already been played. In duplicate, subjection tasting when three or more carcasses are involved, we should not resort to sight judgments for scores that might seem to make us consistent panelists.

The 12 cards from our panel of experts may now be recorded on the board:

<table>
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<tr>
<th>Panelist</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Total</th>
<th>Average Score</th>
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<tbody>
<tr>
<td>Hereford Bull</td>
<td>9</td>
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<td>8</td>
<td>7</td>
<td>9</td>
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<td>49</td>
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<td>Hereford Steer</td>
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<td>7</td>
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<td>9</td>
<td>46</td>
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<td>6</td>
<td>9</td>
<td>41</td>
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How do your single scores compare?
What questions this demonstration provokes will be answered eventually if not now. We have achieved a promise that I wished might happen as recorded in the proceedings of our 1952 conference. Dr. Kastelic encouraged the threat and our 1954 Beef Committee Chairman, Prof. Adams, chose to complete the 2-year old obligation. Those of us who have done the work are grateful to all of you for participating in this organolytic tenderness panel. You have helped appraise good steer and good bull club steaks. I thank you.

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MR. ADAMS: Thank you, Larry. I think this has been very interesting. We are going to go right into the discussion part of this paper and to ask Bob Bray of the University of Wisconsin to lead the discussion. Bob, will you take over down there? You had better keep Larry with you. You may have some questions you want to refer to him.

MR. BRAY: Anything that I would add to the discussion that Larry has given along with the panel testing would certainly be anti-climax. For me this has been a very worthwhile demonstration, especially since I picked them correctly.

I think we will let the report stand, but don't use me on any more of them, Larry.

MR. KUNKLE: A champion always a champion.

MR. BRAY: This is one type of palatability testing, and there are several variations that have been used.

Our time is slipping away and our Chairman has warned us that we want to keep to a time schedule this morning. I think we might make better use of our time if we directed questions that we might have to Larry or to Fred Deatherage.

MR. WANDERSTOCK: Just a comment. I think the difference in the thickness and the degree of doneness of the two samples that we had, at least at this end of the table might well have accounted for that difference in the score. Of course, that was not Larry's fault because, as he told you, they cut them here at a different thickness, but one of my samples was quite well done and the other was rare. The well done one was much thinner than the rare one. I am sure that threw us off.

MR. SNYDER: I should like to ask, Larry, does your tasting panel at home check on the same cattle and if so, how does it come out?

MR. KUNKLE: I think we reversed this grading. The numbers are essentially the same with the six folks at home.

In answer to Jerry's question, I don't mean to rush this but when we use these sirloins, Jerry, we use the power saw and we try to be very cautious about how much pressure we put against the tender and we come back with a steel rule and measure them to make sure they are an inch thick.
MR. KEMP: Do you use all men tasters or do you use a combination of men and women?

MR. KUNKLE: I reported here two years ago that one good lady lost her seat on the panel because she tried to play a bridge game and to remember everything she had done before. In the past year it has been more convenient to use men than it has been to grab folks from the Home Economics Department. I do not mean to say that they are not eligible or invited to participate but it is just more convenient. Our two buildings are located within a couple of yards of each other, so it is just easy for us to get together and do it.

MR. BUTLER: Larry, do you draw conclusions on tenderness from this one muscle and one cut and one method of cooking or do you use other muscles and other methods of cooking of the same carcasses?

MR. KUNKLE: We do not have time or the ability to go into as complicated a matter as Ramsbottom and those folks who did that switch and tried to compare other muscles. We have not been able to get into all these muscles. Last year we were working with 36 cattle. This time we will have probably 40 or more. Until we get this boning work done we just know better than to try to raid the kitty for more samples to use. Time is a very limiting factor, I think.

We assume that the rib-eye is the cross-section of the carcass and then we use the steaks that are adjacent to it for such taste panels.

I believe we ought to give Deatherage a chance to say that he has compared ribs and short loins. Do you want to say a word about that?

MR. DEATHERAGE: This one is approximately what we got in Columbus. The other one was 1/8th of a point different actually, 7.08 and the other one was 6.92.

Concerning questions on this sampling procedure, there is a tenderizing effect on roasting. That puts a very great burden on the geometry of the roast. In broiling, you are broiling from a parallel heat source, which does not place any great burden on the geometry of the meat from the standpoint that you are broiling through a certain thickness. Since there is a roast, say a rib or a roast of loin taken adjacent to the steak, it will always be more tender, and in order to get the biggest break we want to use a procedure that will not introduce another factor such as roasting. So that is the reason we have settled on the loin. Furthermore, the entire loin is used. We have a comparable sample if we want to make more than one test, which you cannot do if you are using almost any other cut.

MR. BRATZLER: Fred, in comparing roasting with broiling at what temperature are you broiling? What temperature is your meat surface?

MR. DEATHERAGE: We broil to internal color.

MR. BRATZLER: No, you are comparing now roasting a roast with broiling a steak.
MR. DEATHERAGE: Your broiling is cooking by radiant heat. Roasting is not cooking by radiant heat.

MR. BRATZLER: My question is what is the temperature of your radiant heat at the surface of the steak?

MR. DEATHERAGE: Oh, I could not say. I can give you the distance that we used on this particular broiler, but we generally put the steaks on the bottom of the broilers.

MR. KEMP: Are these figures subject to analysis?

MR. DEATHERAGE: Oh, yes, indeed. We will not be satisfied if a taster cannot reproduce himself over the long haul at any one point. Usually the individual scores over the long haul will be within one point of the mean 50.

This is the first time that we have done this with this group, although I know they are all expert meat tasters. I think maybe some of these things would have changed, however, a little through the long haul, but this, on the basis of expert testers, is about 0.3. Plus or minus 0.3. Of course, as your reputation increases your error decreases. We have no more reprints of one article, but this has been worked out on a participation basis, and I think it is sound on that basis alone.

MR. DOANE: May we have the carcass grade again?

MR. KUNKLE: The two that we are talking about here?

MR. DOANE: Yes, the bull and the steer.

MR. KUNKLE: The bull was called average good, and the steer was first called high good, and on second thought he was willing to see it go to low choice.

MR. BUTLER: How do you get a good grader to put comparable grades on a bull and a steer carcass? They are a different set of specifications for grade.

MR. KUNKLE: The questions are getting a little tough. (Laughter) We let him grade the wholesale cuts, O.D., and we told him that the No. 1 rib and short loin had come from a heifer and that the No. 2 had come from a steer that had been treated with stilbestrol on two implantations. No. 3 was a straight bull. No. 4 was a straight steer. No. 5 was a bull that had been implanted with stilbestrol. We explained that to him. He understood it. He stood back and saw these wholesale cuts in terms of what he saw there.

MR. MACKINTOSH: Would he have graded the carcasses in the same manner?

MR. KUNKLE: Of course, one of the rudiments is to reach up and pull down that blood vessel and if there is any blood hanging on it, then he says, "This is a bull or at least it is a stag," and you lower the grade one notch.
I have to brag a little and say that these five animals were completely covered on the outside. The conformation of the heifer was N.G. The other four were quite comparable in shape. For all practical purposes they ribbed very close together except that this No. 4 that we are talking about had more marbling than the second, third and fifth samples.

There are 36 more of these to go. I hope we can have photographs, and if any of you are interested in seeing that part of it we will try to share them with you.

MR. BRAY: Anything further?

I think this is a good time to call a halt to the questioning because we have two more papers in this next hour of the program that we certainly want to discuss.

Again, Larry and Fred, we certainly want to thank you for an excellent demonstration this morning. (Applause)

MR. ADAMS: I, too, want to add to that statement, Bob, because I think that Larry and his crew have done an excellent job. Also I want to thank you for leading the discussion on this taste panel demonstration.

Now, to follow right along with this panel that tested for tenderness, we have a demonstration that we want to put on up here, on "Using the Warner-Bratzler Shear." So I will turn it right over to Lyman now and he can get started on this demonstration.

MR. BRATZLER: Thank you, Charlie.

You will notice that I did not call for any point of order, personal privilege or otherwise. I think perhaps most of you know that the inventor of this machine, the Warner-Bratzler Shear, received his Doctor of Agriculture degree from the University of Nebraska a week ago this last Sunday. Inasmuch as we are classified now, particularly myself, as not of the younger group any more, I hope it will be DBM in agriculture.

I am not here selling the Warner-Bratzler shear. It is not patented. However, if you will pardon my saying so, I used to sell meat and it is kind of hard to get selling out of your blood once it is in it.

I am going to give a demonstration of it, but I first of all want to thank George Wilson for making the machine available. We do finally have one at Michigan State College. (Laughter) Thanks a lot, George, for bringing it here. I really appreciate it.

We are at a slight disadvantage this morning because we do not have the samplers, but I think we can give a demonstration on the machine without the necessary samplers.

Jim Kemp wrote and asked what I was going to talk about and I told him if he would look up, I think it was the 1949 report of the reciprocal meat conference, the correlation coefficients, etc. were given in
that report, and I believe two years ago, in 1952, Ken Warner wrote the history of the development of the machine. I recommend particularly Ken's article on how this machine was developed.

The only part I had in the machine itself, of course, was the specifications of the blade and the shape of the hole in the blade.

The machine is very simple. All we are doing is the measurement of the force it takes to shear a core of meat as this moves down. You take your readings on the force of the shearing. The original work was done for the most part on roasts -- beef roasts and pork roasts. Since going to Michigan we have worked more with steaks, and of the two types of meat, kind of cookery or kind of meat I prefer steaks.

If we were going to do any roasting work now in sampling roasts I would slice, oh maybe an inch slice off of every roast and sample it that way.

I also want to thank Larry, Verne, and Fred for furnishing the steaks. I have had a gravy train as far as this demonstration goes.

I have a steak from each one, and in sampling a steak we think, for example, in this eye muscle the fibers or the grain runs exactly perpendicular but it does not. If you will notice I slice off the end of this steak and I find that the fibers run at an angle. That is one reason I like to slice our steaks in sampling because then I can be sure to get it parallel with the fiber. Another reason for using steaks is you all know what happens if you use too much pressure with a cork bore type of sampler with a solid piece. Too much pressure is going to get you an hourglass figure shape of the core. Buck, Bob and I will take steak in our hands and this has a cork bore and we can gage the pressure and come out with a sample that is uniform in diameter from end to end.

The fibers in this steak run this way and we would run our cork bore sample in at this angle whether we use an inch or a half inch sample. This isn't an inch cube by any manner of means, but you can see that cutting at a diagonal you are not going to get as many samples from your steak. However, I feel that the result will be more uniform if they are sheared perpendicular or directly across the grain.

This steak is about three-quarters of an inch. We could get one reading. It would work better with a round one, but we will just give you an idea of how it works.

By the way, if you buy one of these machines there should be a safety switch on it. This one has two knobs back here on the worm.

This particular steak was off the one that was labeled No. 14, I think, or could it be the one under 30. The reading is 15.

Taking a smaller sample or a half-inch core, I figured one out while I was sitting here. If we had a reading of about 18 on the inch core the reading on the half-inch core would be in the neighborhood of 7 or 7½.
On these correlation coefficients these are all minus because the higher the reading here the least tender or tough or very tough the meat is. Since 1933 up until about 1950 the range -- I see one low here of .6 with a high of .96. That is comparing the tenderness readings of the committee with the machine or vice versa.

On the other steak I have already sliced off the end to be sure that I could tell which way the grain was running. In using the knife instead of the cork bore we have to cut at an angle. I remember that when we first started in sampling these roasts we would go directly into the rib-eye or be perpendicular this way, and, of course, in most of the cases with the rib-eye you are not getting it directly across the grain. Such things as doneness enters into the reading quite a bit. That was brought out here even in the panel testing. Raw meat, of course, will give you a much higher reading than cooked meat. Well done meat will also give you a higher reading than medium well or rare. At Michigan we generally cook them to a medium well doneness, and steaks we cook in deep fat. Then we know the temperature at which the steaks are being cooked.

It is our feeling that regardless of type of cookery if the temperature and time are the same the action as far as tenderness goes will be approximately the same. We may be wrong, but that is our feeling on the matter of method of cookery.

I am not used to the calibration here. This other one that was above 40 read 32. Whether that agrees or disagrees with the panel, I have forgotten now which is which, but those are the two samples. They were not cut uniformly. To give a demonstration of the operation of the machine, if you are using the machine you have to be careful that the tissue or the fibers do not wedge in. This blade should run free. It should have the clearance to which it was adjusted when it was purchased.

The last price I had was around $285 including the motor. For those of you who may be interested, it can be purchased from the G. R. Manufacturing Company at Manhattan, Kansas. Professor Carlson, who designed the worm arrangement and as far as the automatic part goes, has a company that is in the manufacturing business and they could manufacture them. I think the last one we got we ordered in March and I believe we got delivery about the middle of May. It took about eight weeks. It was $285, but it may be a little higher now.

MR. MACKINTOSH: I got the same price last month.

MR. BRATZLIER: In the '49 article the things that will affect readings or the degree of doneness are covered: Uniformity of samples and the direction of the muscle fibers, whether you are shearing across or with the grain. At a meeting last week the Rutgers people reported that the shear values are less when the shearing is done with the grain than across the grain. I have never checked that but that is the way I would imagine it would be, because in shearing with the grain you may go between the muscle bundles or the muscle fibers and get less coarse.

We discard samples that have an excess amount of connective tissue or fat deposits in them. One would make higher readings and the other would make lower readings.
As for the temperature of the sample or the speed of shearing, as far as I know from the result of the work I did at Kansas speed of shearing had no effect, and as nearly as I could determine, temperature does not either. So the machine lends itself to mass scoring. How many stacks did we cook one day over at the Home Economics, Buck? We started in about nine o'clock. When Dr. Pauline Paul starts doing something she wants to get it done. I think we cooked steaks one day from around nine until about four in the afternoon. I don't know how many samples you gentlemen at Ohio can sample at one time. You know how students are. They always want to eat, but once they objected very strenuously to the testing of a different kind of pork sausage. By the way, we tested the Wisconsin seasoning method and as a control we used Michigan State. For the benefit of all concerned, there was no definite trend, even though we thought and they thought there was quite a bit of difference in the amount of pepper in relation to sage, etc.

That is getting off the subject, and unless there are further questions, Charlie, that will complete the demonstration.

MR. ADAMS: Thank you, Lyman.

We will turn it now right over to Jim Kemp who will lead the discussion.

MR. KEMP: Since this is one of Lyman's babies and I am not too familiar with the machine, I guess we will direct most of the questions to him. But I would like to do a little thinking on possible future uses of it. It was brought to my attention just a few days ago by a packer friend who said that we are doing all this beef breeding and bull testing as far as rate of gain is concerned and possible management, but has anybody done any work on the inheritability of tenderness? I don't know whether they have or not. I don't know of any work and I was just thinking that possibly this might work in on a project of that type.

Are there any questions or discussions at this time?

MR. BRADY: Lyman, do I understand right that it would not make any difference if you cut these cores out and put them in foil and, say, put them in coolers and did not run them until the next day? That would be a difference in time and temperature. Is that too extreme?

MR. BRATZLER: What I had reference to as to a difference of temperature was whether it was real hot or just like these steaks are now, say lukewarm or almost room temperature. I would not want to say about putting them in a refrigerator.

I think I forgot to mention on a rib-eye steak if you are going to use the inch sampler you can get at best about three good samples whereas if you use these half inch you may get seven or nine, and we have the feeling that the more readings we can get on a steak the truer the picture will be.

Also I forgot to mention that I understand that Dick Hiner summarized some data that is being published, although with this information
I hope I am not speaking out of turn. When they summarized their data, they could not get any correlation between grade and tenderness. Maybe the machine is not sensitive enough.

I think one other question that was raised here could be a good problem for some of you younger men who are working toward a Ph.D. degree. That is a comparison of different muscles. I personally believe that the longissimus dorsi is too tender. There is not enough variation between. If we want to think of a piece being tough and one being tender when we take the longissimus dorsi muscle there is not enough difference there, whereas in some other muscle, whether from the round or the chuck, we could pick up larger differences particularly on this machine.

MR. KLINE: I should like to ask one question. That is in regard to using the shear on raw meat, Lyman, where maybe facilities are not available to cook the meat. What about using the shear on raw samples?

MR. BRATZLER: If I could not cook the meat I do not believe I would even run shear values on raw meat. We get a correlation there, but it only explains maybe 25 or 30 per cent of the variation.

MR. WELLINGTON: I have a question on the care of the machine. Someone was questioning the way one of the operators was using the machine that we have. He took the thumb nuts out and removed those two plates and cleaned them and returned them, and the blade was not running quite as freely as it should. One of the engineers who is a specialist on stress forces came over and checked it all through for us, and he demonstrated to me that it not only made a difference whether the plate returned to the same position, but even the washers in there that separate the two plates have to return to the same position relative to rotation, and if you rotated one of these washers halfway around and returned it to position the knife didn't follow through there with the same freedom as it did otherwise.

I just wonder how you recommend caring for the machine of cleaning those plates.

MR. BRATZLER: On the washers first of all, on this new one I got I was rather disappointed, after paying $285 to find that it looked as though they had just used ordinary washers that were not necessarily machined down. They were not what I think of as polished steel washers and, of course, they would have a bearing on the results.

The other day I was putting ours away. The students after they had reassembled it had put the washers against the bar here. I was trying to raise it and, of course, I could not raise it because it was binding on the blade.

As to care of the machine we clean ours, and if it is going to be stored for a long period of time, particularly during the summer, we may put a little oil or grease on it to keep it from rusting.

I think all of us realize and no one any more than I that the machine could be refined considerably. The main thing is clearance.
The specifications for dullness, the treatment of the blades, and the thickness of the blades, of course, are there, and the manufacturers should be certain that no matter which way you put those washers in the clearance will be the same. Something must be out of line. Either the washers are thicker on one side than on the other or they might be slightly off plumb and not squared with the machine.

MR. PEARSON: I would like to ask one question. In using this machine, particularly on longissimus dorsi muscle you frequently in taking your sample see connective tissue. Do you attempt to avoid that? What is your work in connection with that?

MR. BRATZLER: If it is a large deposit that is rather out of the ordinary of connective tissue we avoid it. You would avoid it in sample with the committee. At least we do. We avoid it.

DR. HINNER: I want to qualify Bratzler's statement about the tenderness of grade. The animals that we used for study were all purebred, beef type shorthorns, and dual purpose shorthorns. They were fairly well imbred so that there was not too much difference as far as breed.

Referring to your statement with respect to tenderness, we did find that was one of the factors that had to do with tenderness.

MR. BRATZLER: What was the difference in range? What range did you have, Dick, in that study?

DR. HINNER: This was on the old grading system. They ran from utility to choice. The largest number were in the commercial grade and the choice grade. Of course, that applies to your milking shorthorns from the feed type shorthorns. At least I say they were all purebred animals out of the same herd. And we did find, for instance, differences between certain groups in respect to tenderness. I mean differences that were significant.

MR. DOTY: There is one comment I might make about this question of temperature of shear. We found that we had the most uniform results if steaks were allowed to remain in the cooler at about 40 degrees for several hours immediately preceding shearing. That is, they were cooked one day and actually they stood overnight in the cooler and were sheared the next day after the temperature had come down. That gave very uniform results, because the steaks all came at the same temperature.

One other question has been raised and that is the question of the relationship between tenderness of different muscles within the same carcass. I might say that our studies would show a fairly high degree of correlation between the longissimus dorsi and the semitendinosus of the round from the same carcass. In other words, I don't mean they were the same tenderness but we got good correlation between those two muscles with both shear and panel testing.

MR. KEMP: Are there any other questions or discussion?

MR. COLE: We have had a little trouble with the scale on there. I believe it is a Chatallion type scale. We have had a little trouble
with the needle, not the depth of the arm. The other one, zero to even. Sometimes it is set on the positive side or on the negative side of zero, and we can adjust all we want to and we have a heck of a time trying to get it to stay at zero. I just wonder how serious that is.

MR. BRATZLER: If your blade runs free, showing no pressure or pull on just dry run, I would not be too concerned. Of course, if your scale starts at minus 2, which I suppose it does some time, and then a plus 1 or a plus 2, it might be in the adjustment of your dynamometer cylinder. I was never too concerned if it didn't exactly zero even.

MR. WELLINGTON: I just want to discuss that particular point. Our engineer told us that it is best to put a load or weight on there. You don't really care whether it starts at zero providing your shear portion is greater where it starts. If you put five pounds on there and your dynamometer reads five pounds you know that is accurate and you are okay, or 10 pounds or 15 pounds. The question is whether the needle goes over to the proper figure when you shear.

Al and I were wondering what you do when you have a series of observations. For instance, we'll say like 8, 5, 10, 9, 10, 11, 8, 20. What do you do with the 20?

MR. BRATZLER: If we are taking seven readings we average them. At least I like to follow the idea that figures don't lie and neither do the men who handle the figures. We examine the core before we read it, and if we think there is a big hunk of connective tissue in there we discard it before we put it into the machine. If you are satisfied that the core is uniform, is representative of the steak, and it just happens that way, you do as you like. But as I say, we generally take them. Not generally. We take them.

MR. DEATHERAGE: I should like to say, concerning the panel here, we did not throw anything out. We ate all the meat.

The question came up as to how many samples can we do in this length of time. I have had considerable experience trying to figure that out. I think that experience would bear me out that eight samples are sufficient for one sitting, that is, eight samples in duplicate. It is usually within the noon hour. Classes conflict. We want to have the same people all the time, and so we have it during the noon hour. So six samples tested in duplicate can be easily handled within forty-five minutes.

MR. KEMP: Any other questions, comments or discussion? If not, we will turn it back to the chairman.

MR. ADAMS: Thank you a lot, Jim. We are getting through right on schedule.

They wish to take a picture of the group. Then we are going to go right ahead with our next demonstration of the use of the Carver press by George Wilson.

He is going to discuss that and tell us a little about it. George. (Applause)
Juiciness is an important part of the over-all palatability of meat. The Carver Press was adapted to the field of meat research in order that juiciness could be determined without relying on a taste panel, which is always subject to certain well-known limitations.

Several mechanical methods of determining the juiciness of meat have been proposed. All involve the principle of pressure but differ considerably in their design and effectiveness. Many of the earlier methods involved the use of ground raw samples rather than cooked intact muscle tissue. These first pieces of apparatus were limited in their application largely because extraction procedures were not standardized.

The pressometer was the first machine to be used extensively in the determination of meat juiciness. This was developed at the Minnesota Experiment Station and resembled in part the Carver Press which is used today. Two to three grams of cooked meat were wrapped in filter cloth and subjected to a pressure of 250 pounds. The loss in weight of the samples was considered the quantity of press fluid and the juices absorbed by the cloth were used for chemical analysis. The Minnesota group conducted studies on the effect of freezing, temperature of cooking, sampling, and amount of pressure on the quality and quantity of press fluid. No doubt the results of these first studies were of considerable help in adapting the Carver Press for press fluid determinations.

At about the same time as the pressometer was being developed, some experiments were being conducted using the hydraulic press. There are reports of this work from the Kansas Experiment Station, The Bureau of Animal Industry, and other groups. From these studies it was apparent that some standardization of procedure was necessary if comparisons were to be made between experiments or between cooperating organizations. This was done by Tannor, Clark, and Hankins of the Bureau of Animal Industry and the procedure may be found in the Journal of Agricultural Research, Volume 66, Number 11, 1943.

The method proposed by this group involves some alteration of the Carver Press. The standard press is equipped with electrically heated plates and is capable of producing up to 20,000 pounds of pressure. The cylinder holding the sample is 2 1/4 inches in diameter and 3 inches in depth and will hold up to 40 grams of meat. To collect the juices quantitatively, the test cylinder was modified so as to drain the expressed juice directly into a collecting vessel.

After the roast is removed from the oven it is allowed to remain at room temperature for about 15 minutes before sampling. In the larger cuts of beef and pork, selected muscles are dissected, cut perpendicular to the fibers midway between the ends, and a cylinder of meat removed from each half parallel to the fibers. The size of this cylinder varies according to the muscle size but is usually from 1 to 2 inches in diameter. If a committee of judges are to evaluate the meat, adjacent samples are used. In some cases, such as the rib or loin of lamb, the entire cross section of the muscle is used.
The samples are maintained between 45 and 50°C. until ready for the press and the hot plates and test cylinder apparatus are maintained at 50°C. during the operation. Suction is applied to the collecting vessel to prevent leakage around the base of the cylinder. Because of the limited drainage, pressure must be applied slowly, especially at the first part of the procedure. A pressure of 9800 pounds (about 2500 pounds per square inch) is maintained for 5 minutes. Because drainage from the press into the receiving vessel may not be complete and because of evaporation losses, the press fluid is determined by weighing the extracted cake.

Following this procedure, the U.S.D.A. workers compared adjacent samples of the same muscle and like samples from left and right pork loins and found duplicate determinations to check within 2.4 to 2.9 per cent on the average. The correlation between committee scores for juiciness and press fluid was about 0.60 when samples of average juiciness were used. When samples having larger differences in juiciness were used, the committee scores covered a wider range and were more highly correlated (0.90) with press fluid than when samples were selected at random. Other determinations of juiciness by mechanical means were found to be poorly correlated with palatability scores.

Using the pressometer described above, a number of workers have found correlations of 0.10 to 0.51 between press fluid and juiciness. Other groups have used the hydraulic press and found very low and insignificant correlations. In more recent work by Gaddis, Hankins, and Hiner, the correlation between juiciness and press fluid for beef and lamb were -0.01 and 0.31. From these and other studies the authors concluded, "in view of the universal belief and much evidence that meat from a fattened animal is more juicy and palatable than meat from one not fattened, there seems to be no strong foundation for the opinion that the amount of press fluid should represent scores for quantity of juice."

It is evident from this statement that a reliable objective measurement of juiciness is still needed in meat research.

Some rather interesting relationships have been found in regard to meat quality from the studies of press fluid. It was observed that with a given amount of expressible fluid, beef was rated by the judges as being the most juicy and pork the least, showing that the kind of meat influences the human judgment of juiciness. The score for juiciness is related to the fat content of the muscle. Results indicate an increase in score for quantity of juice up to about two per cent fat, after which there is little change with increase in fat concentration. A number of workers have found a close direct relationship between the quantity and quality of juice. From this is might be concluded that human perception of juiciness is influenced as much by the composition of the fluid as by the amount. Several workers have shown that cooked meat has a higher percentage of press fluid than raw, indicating that the Carver Press might be used in studying the water binding capacity of meat.

In summary, it may be said that under well controlled conditions the press fluid of meat gives some indication of juiciness but a trained panel will, in most cases, give more reliable results. Press fluid data may be of greater value in their relationship to other quality factors.
MR. ADAMS: Thank you very much, George, for that splendid discussion on the use of the Carver press. We are going to cut our discussion short on the paper prepared by George Wilson. I'll turn it right over to E. A. Kline. Ed, you go ahead and start the discussion of the paper on the Carver press.

MR. KLINE: I am sure that there are quite a few in this room who have had experience with the Carver press in some form or other. I think it is a machine that lends itself to more uses perhaps than just to press fluid or as a measure of juiciness. Certainly it is another tool that we can use in measuring the quality of meat if we accept juiciness as an indication of quality. For example, we have used the Carver press in our place for testing break strength of the femur bone of pigs that we have slaughtered on various experiments. We have also used the Carver press for rendering out small samples of meat to get the total quantity of lard out of a particular cut of pork. I cite those two examples as something that you may use the Carver press for other than for a measure of juiciness. We feel that it has served the purpose very well at our place for those two functions.

Now I am wondering if any of you who have had experience with the Carver press would like to voice opinions, suggestions or comments with regard to the use or the limitations other than what have been stated by Dr. Wilson?

DR. HINER: We were using 53 fat grade on our samples. The way we did that was we got a small aluminum dish with a slip cover on it. We put the sample in the aluminum dish and immediately transferred it to an oven that was maintaining 50 degrees Centigrade until we were ready to press the sample. When you take it out a certain amount of moisture or fluid seeps out. We were using the 50 degrees Centigrade because we were interested in knowing how much fat could be pressed out of this lean sample and to relate it to quality for organoleptic testing. That was the reason for our using 50 degrees Centigrade. I imagine that at 40 degrees Fahrenheit you would get nothing but the juice itself. We would extract the fat from the juice after we obtained it.

MR. KLINE: Are there any other comments?

MR. DOTY: I think there is no question that, as Dr. Hiner pointed out, two different temperatures will give you two different things. The reason we selected the low temperature, of course, was for means of control. It is very difficult to control the sample all during the pressing at 50 degrees Centigrade.

DR. HINER: With your plates you don't have too much trouble with that.

MR. DOTY: So actually you are measuring two different things.

MR. KEMP: I should like to know what the cost of this is. Does anybody have an answer?

MR. KLINE: Well, we got ours about two years ago somewhere around $360 or $380. As I recall, something like that. That didn't include the heater plates. It did include the gage, of course.
MR. WILSON: I think one of the purposes of bringing this equipment to this reciprocal meat conference was to show those who do not have the equipment what there is available in the field of meat research. In connection with what we said about quality yesterday and trying to find out what quality is -- and it has been brought up a good many times -- Jim Kemp just asked how much it costs, but if we want to determine the juiciness of meat should we go out and spend $385 to buy one of these machines when apparently it isn't what it might be? Is he justified in going out and investing that money? I think that is the point that should be brought out here at the conference -- whether those who have used the press and are familiar with it are satisfied it is doing the job. If so, then somebody else is justified in obtaining one; otherwise, I think we ought to forget about it.

MR. KLINE: Well, we'll turn it back to Chairman Adams.

MR. ADAMS: Thank you, Ed.

It is now time for a break, and I will turn it over to our General Chairman and he can tell us what to do.

CHAIRMAN WALTERS: I think just a five-minute recess.

(Recess.)

CHAIRMAN WALTERS: At this time I should like to present to this group Mr. N. R. Ellis, who has recently been appointed head of the Meat Production and Quality Research Section of Animal and Poultry Husbandry Research in the United States Department of Agriculture. Mr. Ellis, won't you stand up, and our congratulations to you. (Applause)

MR. ELLIS: Thank you.

I might say that this is a sort of job with a combination of duties. It is not quite what it used to be, and in my case it is a matter of carrying along the various duties that I have had heretofore with this job. I think this meat job is about No. 1 now.

CHAIRMAN WALTERS: We are glad to have you attend this Seventh Annual Reciprocal Meat program.

Now we will continue with the program.

MR. ADAMS: We have already dropped fifteen minutes behind schedule this morning. However, there is one person I believe who wants to comment on the Carver press. Dr. Hall, is there something that you want to say about the Carver press?

DR. HALL: No, Charlie, I don't really want to say it, but they sort of egged me on here. I have said things so many times before this group about the Carver press that it is really hardly necessary for me to stick my neck out again. But there are one or two things which we have found by the cut and try method regarding the use of the Carver press.
which I think should be remembered. One is the relation to palatability-
juiciness, which has been mentioned before, that whereas it may not cor-
relate with palatability-juiciness that does not altogether mean that
palatability-juiciness is a single factor, because it may be influenced
not only by the amount of free fluid in the meat but also by the flavor
and excitation of the saliva secretion in the mouth due to the flavor of
the meat which may influence the amount of juiciness which the one who is
chewing the meat thinks he is getting.

The Carver press isn't bothered by things of that sort. It
simply gives you a measurement of the amount of expressible fluid which
it can get out according to the pressure you apply to it, so that it is
more of a single factor that a palatability-juiciness factor for anybody.

Another thing which the Carver press can be used for is simply
expressing fluid for analysis. We have been doing a lot of work on
determining total protein and non-protein nitrogen in the press fluid of
meat which has been stored under frozen storage for various periods of
time as a measure of the breakdown of the proteins during storage. It is
excellent for that purpose. However, one cannot apply as high a pressure
for procuring samples for analysis as he would for measuring total juici-
ness of a piece of meat. The meat seems to pack down some times in the
press and it behaves as an ultra filter so that the protein molecule just
does not get through. It packs and jams in there and the fluid that comes
through is almost nothing but pure water. The soluble proteins that you
ordinarily would get are held back. We have found that if you want to
determine protein and non-protein nitrogen in your press fluid it is best
to press it at low pressure. We do not exceed 1,000 pounds pressure on
the ramp, total force on the ramp. In that way the samples can easily
duplicate the amount of nitrogen that they can take.

Those are the two points.

Another thing is the convenience of collecting your samples.
I just take an ordinary old tin cup if I can find one any more. They
are so scarce that you have to hunt around in little country stores to
find tin cups. But I take a tin cup and solder a copper tube spout on
the lower edge of it, and then I prop the whole thing up on a steel block
so that that spout hangs down and collects the press fluid in a graduated
centrifuge tube and centrifuge it. I measure the total volume on the
scale of the tube and the volume of the fat layer that is in there. That
can all be done in one operation.

MR. ADAMS: Thank you very much, Dr. Hall. I know that you have
used the Carver press a lot and I think it was well worth having your
comments on it.

We notice that one of the Directors of the National Live Stock
and Meat Board is with us. Mr. Pickett from Kansas. Will you stand up,
please? (Applause)

The next papers come under a second topic here, "The Relation of
Nutrition to the Beef Carcass."

I am going to call on Dr. Pearson, of the University of Florida,
to present a paper on "Fats and Proteins." Al.

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