American agricultural producers have traditionally marketed their livestock in distant places. Hogs and cattle were driven over the Cumberland road in colonial times in order to see them to population centers in the East. The Chisholm Trail drives of Texas cattle to the Kansas railheads are enshrined in American literature. The huge, midwestern meat packaging industries in Chicago and Kansas City depended on livestock that were transported substantial distances.

It is ironic that the Texas cattledrives, which included all the hazards to cattle glamorized by books and films, may actually have resulted in fewer marketing losses than our modern transportation and distribution system.

The U.S. livestock industries transport related marketing losses were recently estimated to be in excess of one billion dollars, while losses in transporting and distributing meat from the slaughterhouse to the consumer may be even greater. A worldwide livestock and meat distribution system requires a detailed analysis of our distribution processes. Both live animals and fresh meat are perishable products that require special handling in distribution. Thus, the U.S. must necessarily develop an efficient "special handling," system for its livestock and meat.

About 3 years ago, I made a speech in which I stated that the United States was facing three formidable problems in exporting agricultural products. These were:

1. Trade barriers and other restrictions to entry.
2. A price disadvantage caused by the effects of inflation.
3. An inefficient transport system that added to costs and delivered U.S. products in poor condition.

Since that time the situation has changed somewhat. Trade barriers and restrictions to entry still exist, but the problems of demand, the desire for high quality American products, and the shortage of certain types of foodstuffs in various parts of the world are having their

effects upon these barriers. The United States is the only nation with an appreciable surplus of protein. When the people of a country want a food product badly enough, artificial barriers just seem to melt away.

The price situation for American food products also has changed considerably, especially with the dollar devaluation. The problems of our transportation system, however, have not melted away. This is not to say that we are not making some significant improvements. Additional containership service and faster ships are improving, considerably, our ability to deliver food products abroad, and the extension of containership routes into new areas can be of great help. The entry of Lash and Sea-Bee also should have an effect upon our ability to deliver foodstuffs abroad, but we still have a host of transportation problems. The present plight of the Penn Central Railway is only one of them. Recently, we added up the transportation bill for agriculture and forest products; it came to nearly $20 billion per year.

In the United States, the total food bill is now about $134 billion per year. The farmer used to get about one-third of this amount; now he is getting 45 percent. The remaining 55 percent goes to marketing, and we expect these marketing costs to go up rapidly to try to catch up with farm prices. Of this 55 percent, about one-half is for the physical distribution, transportation, and handling of food as it moves from the farm to the consumer. In our export trade, however, the percentage of the food cost devoted to the cost of physical distribution goes up considerably.

Without question, the opportunity exists for many more products to move in the international trade if we can solve the problems of distribution. In general, U.S. farmers have been most successful in exporting the following:

(1) The less labor intensive crop—those for which production can be highly mechanized.
(2) Products of exceptional quality as compared with competing products in foreign markets.
(3) Products not produced by competitors or in which the world production is limited.

In some ways meat fits all three categories. Our feedlots and processing plants are second to none. We have the quality and other nations have a short supply. However, as American agricultural expertise becomes known through AID or Self-Help Programs, fewer and fewer crops remain exclusive to the United States. Also, U.S. mechanized production techniques are being adopted overseas and high quality plant varieties and breeding stock are being exported, which put foreign producers on a more equal footing with the United States. Our fancy foods can often command high prices if they are delivered in good condition and at
reasonable cost. This has not always happened because of failures in packaging and in product protection in transit. Those crops that can be produced domestically at relatively low cost still must face a formidable hurdle of high transportation costs to foreign markets.

The Livestock and Meat Industry

In order to examine the distribution prospects for livestock and meat, we need to establish some basic premises about the industry. Several years ago, the Agricultural Research Service (ARS) began a systems study of livestock and meat. The idea was to look at the total livestock and meat industry as a physical distribution system in order to determine the least costly and most efficient overall methods, regardless of who owned parts of the system. As a result of the systems study, it was discovered that not one but several interrelated industries were involved in the physical distribution, with each industry pursuing its own goals. In one study, done by the A. T. Kearney Company, the bottleneck of the whole system was described as the supply of feeder calves (1). Every other segment of the industry had excess capacity that could not be utilized unless their supply of "raw materials" (feeder animals) could be increased. Studies have indicated that substantial economics are possible by such innovations as converting meat to boxed beef and central retail cutting (2,3) a fact well noted by the Cost of Living Council and the Food Productivity Commission.

Market segmentation is well illustrated in the poultry industry with cutup birds. Chicken breasts and thighs are marketed in the U.S. Certain high priced poultry products and cuts, such as Cornish hens and premium boneless breasts, are marketed to the foreign hotel trade. Wings are sold at a premium to Hong Kong and Singapore where the Chinese demand seems to exceed supply. Chicken necks and backs and low-grade frozen poultry are marketed to less well-to-do markets. Small retail stores in the Caribbean sell large quantities of these products which are used in native cooked rice dishes. By use of this sound and basic merchandising technique, poultry processors are able to maximize their return. Something similar seems to be happening with beef.

A recent cooperative study of Caribbean perishable foods deliveries between the Foreign Agricultural Service (FAS) and ARS showed that U.S. red meat exports were largely high-priced hotel beef--85 percent of which was consumed by American tourists in resort hotels or on cruise ships. The other 15 percent of the red meat shipments were goat meat, cheap pork cuts, and offal. At the same time, we were importing from Central and South America a considerable amount of frozen boneless cow meat, probably destined for the classic American hamburger.

Our red meat exports to Europe and the Orient also seem to concentrate on hotel, restaurant, and institutional cuts of offal and byproducts. This situation seems subject to change with consumers ready to buy good beef in retail food stores.
Meat Transportation

The most successful of American meat exports have been offal, hides, and the products of rendering plants. Exports of American frozen and fresh poultry were so phenomenal in the 1960's that the importing countries began to develop their own poultry industries and some established artificial barriers to entry. However, poultry exports continue at a healthy level. More recently, hotel beef and pork have been growing export items especially to the Orient. This HRI trade is a rather heterogenous group (4). There also seems to be a growth in the exports of fresh meat products, especially vacuum-packed boxed beef.

The problem with offal export has been that packers do not pay much attention to the product. The methods of trimming and packing vary. The product is accumulated in freezers for some time and the exporters, "super brokers," gather it from various sources to accumulate an export load. Foreign buyers tell us that they are not really satisfied with the quality, trim, or pack of U.S. offal products as compared with those they get from other countries. Some similar problems exist with green hides because some ocean carriers refuse to handle them. Some improvements are developing with palletized handling and special ventilated van containers to handle hides.

During the 1950's, considerable effort was made to develop a market for U.S. beef in Europe. At the time the price differential was significant, and the development of supermarkets in Europe provided the opportunity to promote this American product. The European supermarkets had developed modern central retail cutting plants which eliminated many problems of retail delivery. We had cooperated in doing some research with the Department of Defense on exporting beef to U.S. troops abroad. However, when we began experimental commercial test shipments of beef, we encountered a number of problems. In the 1950's, the Irish were shipping beef to New York for one-half what it cost us to export beef to Europe. Shipping schedules were "spotty," and it was often difficult to deliver the product on schedule. We had a number of problems with refrigeration units breaking down or not delivering the proper temperature to maintain the product. European buyers requested special methods of cutting meat often unfamiliar to the American packers. Handling by longshoremen in domestic and foreign ports became a problem when containers were "stuffed" at dockside or had to be inspected there. Also, there were a number of problems with the importing country's inspectors.

About the time we learned how to ship beef overseas, the price relationship between Europe and the United States changed and the potential exporters backed off. So far, we have few firms willing to supply the market on a regular basis when the foreign price drops below the U.S. market plus export charges.
Research Needs

In looking back over the last several proceedings of the Reciprocal Meat Conference, I think I see a favorable trend in your attention to marketing and distribution. Certainly the work of Texas A&M, the University of Georgia, and others in transportation, packaging, and determination of microbial conditions in packinghouses and distribution is encouraging.

The U.S. livestock and meat industry is in the midst of a major "revolution" and most of these changes are occurring due to demands of the market. Whether we like it or not, consumerism is bringing about changes from "wholesome" meat to microbial-free meat, from historical labeling methods to more descriptive terms with nutritional information, from marketing grades to grades more meaningful to the consumer, from less visible to more visible packaging, from traditional trimming to a lean meat trim, and to a meat that is free of all residues or toxins, natural or unnatural.

The meat industry needs all the research help it can get in order to meet these demands, requirements, regulations, or laws and still be able to deliver good meats at reasonable costs. Also the meat industry needs research that documents conditions in the "real world" of distribution and seeks to solve some of the operational problems within the constraints of daily commercial pressures and available facilities and equipment. In particular, I believe we have to pay more attention to the total system of distribution and to understand the impact of the different physical stages of distribution on the product.

Sometimes the real problems may require research solutions that seem a bit mundane to some scientists. For example, recently chlorine in various forms added to a water wash has been receiving increased attention for use on meat surfaces to reduce microbial counts. When we began inquiries to our meat researchers, it appeared that they were aware of chlorine as a potential germicide and that some work had been done a number of years ago, but recent research had been concentrated on newer or more sophisticated approaches. We got the impression chlorine was just a little "old fashioned" or perhaps too ordinary.

As another example, the research approaches used to seek solutions to livestock losses related to transportation have been largely under the title "shipping fever." The Agricultural Research Service is now gearing up for some serious studies of live animal transport, and we will be looking at a wide range of animal management practices, not just seeking a "vaccine" to cure shipping fever. We will be trying to solve such problems as failure to supply adequate protection from the weather, feed, water, or even oxygen for the animals to breathe and looking at the practices and procedures typically used in assembly of young calves.
Since 1967, the scientific effort in support of meat animal production and marketing has been declining; yet today our research needs are greater than they have ever been, and the visible problems seem to have multiplied.

A major export need is increased production capability. We need research which allows us to increase the supply of beef, especially reproduction research to increase the number of available young animals. Another way to increase capability is to optimize slaughter weights.

We need production efficiency research to increase yield of meat per animal fed and increase feed efficiency. We need research to reduce loss to the available cattle either through death or morbidity. This may involve substantial animal disease or animal management research. We need research to increase our animal capacity through improved pasture, range, and forage. We need research to increase protein supply for animal feed. This may involve increased feed grain yields, byproduct utilization, or feed mixing.

Effective animal waste management is going to be essential if we are to continue to produce beef in quantity and at a competitive price.

Most of these problems deal with supply.

Marketing and physical distribution are going to need even greater attention if we hope to increase exports.

Slaughter operations must become even more efficient. Meat physical distribution is characterized by high packaging, and transport and handling costs; and large losses occur in the system from physical damage and spoilage. Refrigeration costs are high and refrigeration is a heavy user of energy. Typically we have been trading off higher energy costs for less expensive facilities and equipment and limited maintenance.

Transportation of meats has been a major neglected area of research attention, and is critical for overseas shipments. High packaging and shipping container costs are a major deterrent to modernization of the distribution system, and typical shipping containers provide poor product protection and materials handling.

Meat retailing offers a significant potential for savings due to high costs and relatively small size operating units.

The Hotel, Restaurant, and Institutional trade also has major distribution problems and is receiving very little research attention.

In particular, sanitation and product protection throughout the marketing system need research. Also, let's not forget consumer acceptability and the consumer's needs and desires. This will be especially important in foreign markets.
Above all else, however, we need to better understand the total marketing system, how it operates, the effects of changes at one stage on the other elements of the system, and on ways to reduce the overall costs of the system and streamline its operations. This requires an interdisciplinary research team approach to problems of the industry and may require some reorganization of our traditional research programs.

Kind of a System Needed to Export Livestock
and Beef on a Major Scale

First, the United States must be able to produce substantially more livestock and meat. We need livestock marketing firms and meat packers who are export minded, willing to dedicate a substantial portion of their output to foreign markets and maintain those markets through price fluctuation periods, not just when prices are favorable for exporting.

We need marketing firms willing to service those markets with promotional material and with staffs permanently located in the market to expedite shipments, solve problems, and promote the U.S. products. We need marketing firms that are willing to give both livestock and meat the extra attention needed for lengthy export shipments. We need the proper preconditioning of livestock for transport. We need meat slaughter and distribution that will provide and deliver microbiably cleaner meat which will not discolor or sour. This is not only a health problem but an economic one. If the microbial load can be reduced to a minimum at the slaughter plant, the chances of delivering a good product are greatly increased.

We need to take a serious look at high packaging costs for boxed meats.

We need a transport system that can supply adequate quantities of specialized equipment for either livestock or meat to the heartland of the United States and deliver the goods on schedule to ports. This means improvements in livestock transport equipment and facilities and adequately cleaned and maintained refrigerated containers for meat.

Foreign supermarket chains are as modern as their U.S. counterparts and merchandise the same way. Shipments must be delivered on time to meet the promotional or advertising programs, which means that suppliers must deliver what they promise on time. Both overland and ocean carriers must meet delivery schedules.

I would say our prospects for developing such a delivery system look good.

First, for livestock, a number of airport and ocean port facilities have been established. Containers for ocean carriage and air carriage of smaller lots of livestock are being made available and research on transporting live animals is being undertaken.
Second, for fresh meat, we are developing some export minded slaughter operators such as Colorado's Ken Montfort. Boxed, vacuum-packed wholesale beef cuts can be shipped considerable distances. Some slaughter plant operators are reducing microbial counts on the surface of beef carcasses and cuts which extends their shelf life.

Some plants have established refrigerated vehicle, pre-trip inspections to insure that the vehicle is clean and the refrigeration unit is working properly.

Air carriers are developing insulated and refrigerated air cargo containers so that small-lot perishable shipments can be protected on the ground as well as in the air.

Consumers in the developed countries now have the income to purchase U.S. meat products and are developing a taste for good meat products--products which only the United States is prepared to supply in any quantity at this time. Foreign hotels and supermarket chains have the facilities to distribute and market the product efficiently, and the price relationship between these potential markets and the U.S. market appears favorable. Furthermore, most of the more difficult barriers to foreign entry have been overcome. The potential to export appears greater than at any time in the past, if only we had the product.

Unit trains for perishables are being established from the West to the East coast which we hope will provide more reliable fast schedules. Meat shippers may be able to utilize them also. Ocean shipping lines are also establishing unit trains in other areas and they are moving their van containers inland more than ever before. Refrigerated van containers have been improved over the years and ARS research is developing even better refrigerated equipment which should be made available shortly to shipping firms. Trans-Atlantic container service was cut to 4 1/2 days from New York to Rotterdam and about 6 days to cross the Pacific although present schedules are slower, due to shortages of bunker fuel.

Some problem areas still of concern include our traditional methods of assembling calves and feeders, the demise of the railroads as live animals and meat carriers, temporary shortages of air carrier equipment, and similar problems. The Northeast railroads are still considered a bottleneck in perishable operations. We have not overcome all of the import barriers and restrictions placed on beef.

Some of our meat packers will have to become more marketing oriented, especially to the export market. Significant changes in slaughter and processing operations and procedures and in packaging may be necessary.

Also, our own consumers may look with disfavor on any substantial beef export program.

But in spite of this, the prospects for increased livestock and beef exports look good and the delivery system appears adequate to handle them.


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O. E. Kolari: Thank you, Mr. Anderson, for your inimitable, interesting discussion of "Problems in Transportation." It is high noon and time for lunch. Thank you.
M. D. Judge, Purdue University: The committee on research methods has been a very energetic and cooperative one. Rather than take time to read their names I would like to just refer to the back of the program in which their names are listed. Fred Parrish has been our coordinator for this area and he too has been very helpful.

Meat scientists have been very resourceful in developing and adopting new methods to answer many research needs. We may recall the recent past to find examples. In the histological area the use of the cryostat has aided in developing a new view of muscle tissue with very minimal kinds of disruption. Out of this has come such valuable contributions as the characterization of fibers by metabolic capability and their ability to differentiate. The gas chromatograph is another example of an item that has been used in a major way. Lipid research and flavor research has been implemented by utilization of this instrument. Automated analysis is another example of a technique which has enabled us to multiply output many times, particularly of those people working with enzymes and amino acids. We shouldn't forget the electron microscope and the contributions it has made in solving practical problems in meat science. The identification of the Z line structure as a site of degradation during aging is a good example; the involvement of the myofibrillar proteins in the development of the pale, soft, exudative muscle condition is another.

We could mention many additional areas that scientists have adopted new methods and new equipment as they have become available to make significant achievement in meat technology. In some instances the individuals have shown ingenuity and developed their own equipment. Examples here go back some years to the Warner-Bratzler shear, then, more recently, the tenderometer, the rigorometer and the myotron.

The point in these comments is that the research methods we will be hearing about today may be the ones that investigators in the future will look back upon and cite as real innovations. I'm confident that the speakers we have with us today have the insight and experience to do just that and show the manner in which some of the future work is going to be carried out.