In this paper, I would like to:

1. Sketch the types of research with which we will be concerned.
2. Give a brief indication of the nature of the meat packing industry which has a direct bearing on the types and magnitude of research performed.
3. Outline the chief areas where research effort has been directed and the reasons for this, and show the relative importance of research effort in the industry.
4. Consider the strong and weak aspects of the research conducted, i.e., is it properly oriented and balanced.
5. Consider the general effects of research efforts on the demand for livestock and the prices of meat.
6. And finally, give some thoughts on what types of research can be best done by private interests and by public effort.

Obviously, to cover this broad area, my comments on each point may prove quite sketchy. But perhaps points of interest can be more fully developed in our later discussion.

Research covers a wide range of activities and, as generally used, the term "research" is broad enough that we could say that research goes on in almost any part of a company where there are conscious people. The accountant simplifying a form, the industrial engineer modifying a process, the traffic manager laying out new routes, the engineer developing a new machine or a chemist doing basic research on protein, are all researchers. The difficulty of defining and limiting the term "research" complicates the problem of evaluating research even within one's own company. For purposes of this paper, attention will be devoted primarily to research in products, packages and processes in the meat industry and to industry's appraisal of consumers' wants.

To a large extent, scientific investigation in the meat packing industry, as is true of industry generally, tends to be applied on developmental research rather than basic inquiry. Our scientists are more likely to devote their efforts to application of known principles to a specific situation rather than to the development of new basic knowledge. This is not to say that important basic research has not been conducted in the meat packers' laboratories;

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grants have also been made to research institutions which engage in basic investigations. But it is quite apparent that with limits on both budgets and qualified personnel, results which are apt to show up quickly on the profit side of the ledger are more likely to come from the applied than from the basic research type of activity.

The research which we do may be classed for convenience into that designed to affect demand and that which has as its object the reduction of costs. Quite obviously the results of much research is a combination of these two. Research which might result in increasing demand is probably best represented by that designed to improve a product, or create a new product or package. This research is aimed at increasing total dollar margins on a product or developing a new product which will increase the total dollar margins from the processing of a given quantity of raw materials. This might come from the development of a product which will be consumed in greater quantity at the old margin from movement of the same volume of raw materials at a wider margin or some combination of both.

The other general kind of research aimed at reducing costs is illustrated by automation, improved layouts and that multitude of things done to result in a greater output from a given input of labor and capital. Here, as in the case of demand influencing research, the company may elect to sell the same quantity of the lower costing product at a wider margin, or it may decide to lower prices in order to move a greater volume. Usually some combination will result, even though it is recognized that a lowering of the price of a branded item invites competitors of similar products to reduce prices also, and the first company finds that its volume may not increase significantly.

Nature of the Industry

Before proceeding further, it seems in order to very briefly review some of the characteristics of the meat industry which have an important bearing on research. Today the meat industry is a collection of a very large number of firms intensely competitive with one another, both in the purchase of livestock and in the sale of meat. Two of the firms are large, together handling about 28 percent of the livestock; another group of eight firms represents about 18 percent of the livestock capacity. Smaller than these in size is a group of several thousand companies which compete very effectively in regional and local areas.

Most of each year, and at all times in many years, the industry's capacity exceeds the livestock available. This results, in large part, from the seasonal and cyclical fluctuations in livestock production. When livestock is abundant, margins in slaughtering tend to widen, and new capacity is created which becomes a millstone around the neck of the industry when supplies tighten up.
Despite the industry's notable progress in the direction of more processed and branded items, about 70 to 80 percent of total meats are still sold without any type of packer identification which effectively carries over to the consumer. The absence of identification and effective advertising means that over time not even the oldest or the most successful operators have been able to develop consumer loyalty for their fresh meats. This factor restricts the incentive for demand inducing research. The lack of consumer loyalties on such a large proportion of the production, together with relatively low capital requirements, means extreme ease of entry into the industry. The availability of government grading of fresh meats and the acceptance of it by retailers has facilitated selling on the part of new firms and this has been an added factor making for ease of entrance into the meat packing industry and for excess capacity. Many of the smaller firms are non-unionized and have more favorable labor costs than the larger firms. In addition, about one-quarter of the meat output comes from plants not subject to federal inspection.

These characteristics have led to a low income industry. And low income has resulted in limited research budgets. It has resulted, perhaps, in some tardiness in mechanized methods of operations. But low income should not be associated with backwardness. In the handling of fresh meats, the packers' position is much like that of the farmer's. In spite of increased efficiencies in agriculture, low income is still a problem. The individual farmer can do little to differentiate the demand for his own product -- to make the demand more elastic by means of branding or advertising. This is essentially the case with the packers in the sale of fresh meats. The narrow margin on which they operate is the result of intense competition and excess capacity more than lack of progress.

Areas of Research

The packing industry made some noticeable advances in the handling of fresh meat during its early history. The introduction of artificial refrigeration in the late 1800's and improved railroad transportation made it economical to concentrate processing in large packing centers. The concentration facilitated the introduction of mass production techniques.

Early research in fresh meats which resulted in the moving production line, and the gravity system associated with it, were developments with tremendous effects on U. S. industry generally, and they reduced costs sharply in the packing companies. While progress has continued, the more recent efforts in fresh meat research have not been very productive of major results. Most of the changes that have occurred have resulted from: improvements in layouts and equipment which have brought economies but little change in the form of fresh meat passing through a packing plant. Recently, one company spent substantial effort in researching frozen
fresh meats, but high quality frozen meats have not caught on with consumers generally. Research in commercial tenderizers and irradiation have received considerable attention without noticeable results. Fresh meats continue to enter the consumer's homes primarily in unfrozen, non-tenderized and non-irradiated form, and any processing developments have generally made the product less desirable or too costly to the consumer. In this regard research in fresh meats is somewhat like research in fluid milk: it has not resulted in a more desired product than the old fresh form.

Another factor has served to hinder technological progress and automation in the handling of fresh meats. Packers purchase animals from several million producers without definite specification as to production. This results in a relatively high degree of non-uniformity of carcasses from which fresh meat is cut and impedes the use of high speed, automatic machinery. It appears that the relatively low degree of integration in livestock production and meat processing may have impeded more spectacular progress in the area of fresh meats.

In the area of processed meats, the packing industry shows a better record in research accomplishments. Here, at least on many of the processed items, the products can be differentiated and labeled with a brand which carries over to the ultimate consumer. Through advertising and a system of maintaining a consistent product, a degree of brand loyalty can be developed among consumers which gives the packer some bargaining power in his sales. The capital and management requirements are generally higher than in the fresh meat area, and consequently "ease of entry" is not as great as in fresh meat. The very nature of the operation offers more opportunities for effective research and for new techniques and operations which lead to increased efficiencies. Processed meats, particularly sausages, because they are mixed from meat cuts, have been more readily adapted to new methods of mass production all the way from the mixing of the meats to the final loading of the packaged products. It has been easier in this field than in the fresh meat area to cut labor costs by use of improved machinery and to obtain more consistent and higher quality processed meats. The ability to differentiate one company's products from another provides a strong incentive to conduct demand-inducing as well as cost-reducing types of research. And, because margins are higher on processed meats, companies who devote a significant part of their efforts to production of these products are better able to afford research.

**Appraising Research in the Meat Packing Industry**

In appraising the research of the industry it is useful to consider the resources devoted to this work. From figures collected by the Bureau of the Census for the National Science Foundation, the expenditures for research and development performance by all industries are placed at about $6 billion for 1956. Of this amount about $58 million or 1 percent was
expended by "food and kindred products." A separate set of data collected by the American Meat Institute Foundation for the same year (1956) and covering 87 meat companies places research expense in the meat packers' laboratories at $9.6 million. Although there are several hundred meat packers in the industry, the 87 in the survey, which presumably covers all the major size companies, probably expend a high proportion of all the funds which the industry puts into formal research. On the other hand, some of the large packers produce a large volume of products other than meat and it can be assumed that much of the research is devoted to these non-meat areas. But taking the figures as presented, it would seem that meat companies in 1956 spent about 16 percent of the research funds expended by "food and kindred products."

<table>
<thead>
<tr>
<th>Funds for Research &amp; Development</th>
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<td>1956 (Mil. Dollars)</td>
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<td>All Industries $^1/\text{a}$</td>
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<td>Food and kindred products $^1/\text{a}$</td>
<td>$58$</td>
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<td>Meat Industry $^2/\text{a}$</td>
<td>$9.6$</td>
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$^1/\text{a}$ Research and development funds from census data prepared for National Science Foundation. In addition, in 1957, all industries spent $241 million for basic research while "food and kindred products" spent $3 million.

$^2/\text{a}$ From survey by the American Meat Institute Foundation covering all types of research conducted in the laboratories of 87 meat companies. In addition, these companies spent about $1 million in support of fellowships, research institutions, etc.

It should be noted in passing that of the $7.2 billion of total research and development funds spent by all industries in 1957, more than one-half ($3.7 billion) was derived from the federal government. Very little, if any, of these federal funds went into the food industries.

Another method of looking at the magnitude of research in relative industries, particularly cost reducing research, is to review labor productivity figures, i.e., the physical output per man hour or per employee. This method has distinct limitations. A given industry might show a big increase in labor productivity because of the state of its automation in the selected base period. Also, the products put out by industries change over time. If they
become more complex, more labor might be required for a given physical output even though there has been a substantial amount of successful research. Realizing that these problems do exist, the comparisons still are of interest. Imogene Bright of the U. S. Department of Agriculture has brought together some figures on the output per man hour of product workers in a few agricultural industries.

Index of Output Per Production Worker Man-Hour,\(^1\)
Selected Processing Industries, 1947-57
(1947-49 = 100)

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\(^1\) Figures for "All Manufacturing" calculated from Federal Reserve Data; All other data from "Trends in Labor Input and Output in Selected Agricultural Processing Industries," Imogene Bright, Agricultural Economics Research, October, 1959.

Whether or not the product mix in the meat industry has shown a stronger trend toward more complex items than the other industries could be determined only by considerable study. As stated above, the meat industry has concentrated its research in the field of processed items, which products result in large amounts of additional labor compared with selling the same raw materials in fresh form.

Still another method of evaluating the extent of research in the meat industry is to look at the spreads in margins from farm to retail.
Marketing Margins - Farm to Retail

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<td>$2.52</td>
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<td>1958</td>
<td>2.29</td>
<td>5.68</td>
</tr>
<tr>
<td>1959</td>
<td>2.50 Est.</td>
<td>5.75 Est.</td>
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1/ From Marketing and Transportation Situation, U.S. D.A.

It is significant that for beef there has been no significant change in the margins for processing and wholesale marketing during the eleven year period (1949 through 1959), in spite of large increases in labor, supplies and freight costs. Although fresh meat research has not been especially noteworthy in the postwar period, it appears that sufficient efficiencies --- better layouts, better buildings, better working conditions, more attractive incentives, etc. --- to largely offset the increased costs. It cannot be overlooked, however, that some of the apparent progress in beef may be the result of smaller returns in the beef portion of the business.

In the case of pork there have been increases in the margins, even though this is the general area where much of the packing companies' research is concentrated. This, of course, is partially explained by the fact that in the processed meats a great amount of extra services has been provided.

From the above considerations, it seems safe to conclude that research effort in the meat industry has been substantial. While many areas of the operations have not been automated, cost reductions have been sizeable. Work designed to increase the demand for meat has also been important.

Appraisal of Research Efforts

For the most part, research in our industry tends to be the cost-reducing rather than the demand-inducing type. This may be due to the fact that the meat industry has not moved into automation as fast as most big industries and there are many opportunities to reduce costs through new layouts and
improved machinery. The rapid rate at which wage costs have advanced in the postwar period has been a strong incentive to substitute capital for labor. At the same time, the industry has made good progress in recent years in setting up work standards which have been productive of more output per employee or per employee hour. In addition, there can usually be more surety that cost-reducing research will produce the results intended than is the case with the demand-influencing work. In most cases of changes of machinery or layouts, physical models can be developed and tested before there have been large outlays of capital. Even the total costs of the research project can be estimated with some degree of reliability and compared with the hoped for savings.

In the case of research of a new product or package to create new demand, it is difficult to ascertain the public reaction without first developing the new product or package and making consumer investigations. Even after initial market research, we cannot be sure that the consumers generally will react the same as those in a tested area. Nor can we be sure how the public generally will react after the newness of a product or package has worn off. In many cases, a new item must be before the public for some time and the demand for it developed through a coordinated sales promotion and advertising campaign before the product catches on. Thus the risk involved in the demand-inducing type of research is usually greater than that experienced in cost-reducing research. Also, as pointed out earlier, with about 80 percent of the pork being produced without brand identification which carries over to the consumer, the incentive for demand inducing research is limited.

Some of the risk involved in either type of research is reduced in the meat industry by the practice of moving in rather small steps. There is a tendency to modify a machine more often than to bring out an entirely new piece of equipment. The industry is not likely to radically change a plant's layout or to move too far from the customary way of constructing its facilities. Usually new products are likely to be very similar to the ones formerly sold. It is easy to add a new item to a line without much increase in product cost and frequently it can be sold along with the general line without too much market research.

While one can speculate that progress would have come faster with more imaginative moves, the increased risks cannot be questioned.

Without attempting to be inclusive, I would like to point out some of the progress which the industry has made in specific areas. In our efforts to affect demand, substantial progress has been made in finding ways to make what were formerly low valued raw materials into highly desired consumer items. While the new products (largely sausage items) compete with other meat products, they also compete effectively with non-meat foods and help increase the total consumption of meat.
Improved packaging has stimulated demand. Perhaps, unfortunately, progress in this research as far as our industry is concerned has been confined to processed meats. Canning, freezing or irradiating fresh meats has not resulted in a more desirable product than meat in fresh form, and the packaging of fresh meats has been largely left to the retailers. Packaging of beef as now done by the retailer in conjunction with self-service has probably been a factor in the strong demand which beef enjoys. In the modern food retailing world, where impersonal self-service dominates, meat must be attractively displayed to compete with progress in this same field in other food items.

The constant additions of new products in the processed meat lines, and improved flavorings which have resulted in part from market research, should also be a stimulus to improved demand. Similarly, the better keeping qualities of meat which result from better sanitation and superior packaging have increased the value of these meats. Our research, which has resulted in more consistent products, has probably been demand-inducing.

In the cost-reducing areas, in addition to the improved layouts, working conditions and machinery mentioned earlier, there have been notable results from the application of mathematical programming to many parts of our business. Some of the larger firms now determine formulation of sausage products by use of electronic data processing equipment. This insures the most efficient use of raw materials, and tends to equate the marginal value of each type available. Some firms also use electronic data processing equipment to evaluate their purchases of livestock. This enables them to compare cut-out values with costs over broad areas and to adjust the buying pattern rather quickly. To the extent that this is done, it insures a rapid correction of high or low priced pockets in the broad areas of livestock markets and makes these markets more competitive in light of the value of the livestock handled in them. Such analysis brings to light more efficient procurement methods. More recently, the use of mathematical programming in the meat industry is being applied to the location of plants and warehouses. It is used in connection with the routing of transportation equipment and in the control of inventories.

There are also areas where research has tended to be weak. As indicated above, the industry has devoted most of its research attention to the 20-30 percent of the total which is in the processed meats. Packers have done little to increase the palatability and acceptability of fresh meats. The low margins existing in this area may be an important factor in the lack of emphasis.

Market research in the industry tends to be done after new products are far along in development because of the difficulty in obtaining much assistance from consumers in what they want in a new product. This is not to say that we are not guided by the results of consumer research. The reverse is
The move toward milder flavored products, greater keeping qualities, more visibility in packages, has been in part the result of consumer investigations. But to a large extent we have been fairly narrow in our research among consumers, investigating primarily reactions to processed items or packages in which the processed items are contained. The meat industry has done relatively little in the broad field of consumer research in fresh meats. Although we have been critical of much of the public research in consumer preferences, we have not attempted to go far in this field with our own research work.

Most of the new products developed have probably been competitive with old ones and have tended to have little effect on increasing the total consumption of meat. This is difficult to measure, but the fact that meat consumption per capita has been rising faster than most other foods for the last two decades can probably be attributed more to reasons such as the rise in real income per capita than to the development of really new meat products. Even the fact that the consumption of processed meats has risen faster than that of fresh meats can not necessarily be attributed entirely to new products or packages.

**Beneficiaries of Research**

As indicated earlier, industrial research is undertaken primarily to improve the relative position of a company. That is, each company tends to work principally on those projects which it believes will show improved financial results. If the results of research are improved layouts or company-developed machines, or patentable processes and equipment, the company can usually reap some benefits before others develop similar or closely substituteable products and processes. But even the patenting of processes or equipment has a drawback in that the mere act of filing for a patent requires sufficient detail of the operation to enable competitors frequently to devise an article similar enough to be competitive but different enough not to violate the patent. Thus, the rewards of research to the company doing the initial work may be short lived in many instances.

This is not to say that the results of a company's research efforts are always completely lost. A process might be closely duplicated by others without attaining all the cost advantages which accrue to the originator. In this case the latter might enjoy benefits from his research efforts over a long period of time. But in an industry as highly competitive as the meat industry, it seems safe to say that originating companies of new products, processes or machinery hold an advantage for a relatively short period.

To the extent that others are able to move in quickly to share the benefits of a given company's research, the more quickly the rewards of research are passed on to others outside the industry. The chief beneficiary is
usually the consumer. But for the livestock farmers as a group, packer research is vital. Consumers have many outlets for their disposable income. Historically, food expenditures account for about one-fourth of it. In the food line, there are thousands of products competing for this share. It is because of this kind of competition that packers, as processors and manufacturers of meat products, must constantly research new products and new means of packaging and labeling to attract a substantial part of consumers' expenditures.

Another important reason for keeping meat products competitive in the food market is the fact that more resources are required to feed the population at any caloric level with meat than with cereals or other foods. This means that if the consumption of meat is increased by packer research, more farm resources will be needed to produce the basic raw materials, livestock. To the extent that this is accomplished, the pain of adjustment in reducing the farm plant to meet the food and fiber needs of the country is lessened.

Areas for Public Research

Some people, starting from the premise that research in the meat industry has unduly lagged behind other industries and reasoning that stepped up activities in the packing of meat would be beneficial to livestock producers and consumers, have suggested that more public research efforts should be devoted to this industry. It is reasoned also that because the results of public research would be available to all processors, the benefits of the utilization of such research would be passed back to producers or on to consumers more rapidly than is the case where private research is involved.

Undoubtedly, with additional funds and personnel assigned to the task of reducing packinghouse costs and stimulating demand for meat, more progress would be made. But the areas of research work to be done are very broad and research funds and qualified personnel are not unlimited. Some choice has to be made of areas in which to work. There is no assurance that resources now available for public research would yield better returns if devoted in part to problems in the meat packing industry. But it has been quite effectively argued that agricultural producers would be benefited if some of the research resources now being utilized to increase the production of agricultural commodities were devoted to reducing the spread between farm and consumer prices, or to stimulating greater demand for farm products. Such a shift in research, it is pointed out, would result in less urgent adjustments in agriculture. That is, there would be less likelihood of making obsolete certain capital now in agriculture, and would tend to hold more farmers and capital in agriculture.
To the extent that public research in the cost-reducing area resulted in bigger gains than the cost involved, consumers would also be benefited. It is not so clear, however, the extent to which consumers might be benefited from research directed at increasing the demand for meat. With the human stomach quite inflexible, the research might merely shift purchasing power from one set of foods to another, and while one can assume that total satisfaction of consumers might have been increased, we cannot be sure that when all costs are considered, consumers as taxpayers would have gained in total satisfaction.

If there were to be a step-up in the expenditure of public funds in meat and livestock research, what are some logical areas for such work? It would seem that with the rapid progress which is currently being made by the meatpacking industry in cost-reducing techniques, there is probably little room for a public research program in this field. There are, however, some other fields which might prove profitable. Some of these are listed below:

**Economic Research:**
1. **Further development of methodology:**
   a. Techniques for effective consumer research.
   b. Procedures for measuring the effects of advertising.
   c. Improved techniques for mathematically programming location of facilities, control of inventories, evaluation of operations within the industry and formulation of processed products.

2. Improvement in supply price analysis.
3. Research into what happens in the hog and beef cycles --- who expands production; who cuts back; how can the cycles be smoothed; what are the economic losses from cycles, etc.
4. Overall appraisal of the position of pork. Can it successfully compete with beef and poultry over time?
5. What are the economic implications of the growth of private labeling on the part of retailers.
6. What would be the effects of sale of food on a credit basis.

**Other Research:**
1. Research into improving the nature of fat --- can pork and beef fat be changed so that it may have more of the better qualities associated with the unsaturated fats?
2. Research into color and watery condition of some lean pork.
3. Determination of the factors which make for quality in meat.
4. Production of lean meat which has the desirable qualities of tenderness, juiciness and flavor.
5. Narrowing the range of quality differences in animals.
6. Improvement in artificial insemination in swine.