The title for this discussion is Research and Development, which we at General Foods think of as technical research. However, the outline given to me indicates that the interest is in research in a broader sense -- including technical, engineering, market and economic. My personal experience and present responsibility is in technical research. I have, however, borrowed from my colleagues and am prepared to discuss R&D in the broad sense.

The other qualification that I must make is that I represent a company within an industry -- an industry that is highly competitive and in which there is little exchange of information. I have been assured by the president of the Cereal Institute that my presentation will be representative of the industry. I expect this is true with the possible exception of some details of organizational structure that are unimportant for this discussion.

In a presentation concerning the cereal industry, an historical background is important to the understanding of the industry as it exists; i.e., Battle Creek, Michigan, is the "Cereal Capital" of the world -- there is no economic justification for this situation.

The process cereal industry had its origin with the food faddists and certain religious groups. A series of inventions by individuals in this group provided the products that for the most part still exist today. These include:

<table>
<thead>
<tr>
<th>Year</th>
<th>Inventor</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1829</td>
<td>Sylvester Graham</td>
<td>Graham Cracker</td>
</tr>
<tr>
<td>1863</td>
<td>Dr. James C. Jackson</td>
<td>Granula - forerunner of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grape-Nuts</td>
</tr>
<tr>
<td>1893</td>
<td>Henry D. Perky</td>
<td>Shredded Wheat</td>
</tr>
<tr>
<td>1895</td>
<td>Dr. John Harvey Kellogg</td>
<td>Granose and others</td>
</tr>
<tr>
<td>1902</td>
<td>Alexander Anderson</td>
<td>Puffed Wheat</td>
</tr>
</tbody>
</table>

Varnum D. Ludington is research manager, Post Cereals Division, General Foods Corporation.
The Seventh Day Adventists, having food as a part of their religious teaching, established the Western Health Reform Institute in Battle Creek in 1866. Under the dynamic leadership of Dr. John Harvey Kellogg in 1876, this became a health center of the world. Dr. Kellogg exposed his cereal-based products to the sanitarium patients and established a mail-order business to supply them on their return home. The popularity for the sanitarium "treatment" was a result of the widespread dyspepsia caused by poor eating habits.

A former patient, C. W. Post, visualized the commercial possibility of these products and started the commercial production of them by the Postum Cereal Company in 1897. His immediate success (net of $1,000,000 in 1903) attracted others. W. K. Kellogg founded the Battle Creek Toasted Corn Flakes Company -- forerunner of the W. K. Kellogg Company -- in 1906. By 1913, there were 33 cereal companies in Battle Creek, by now a veritable boom-town. Thus, Battle Creek became the "Cereal Capital of the World."

Cereals were thought of as health foods -- not too good -- but good for you. They somehow became associated with breakfast. They were later thought of as energy foods. Then with vitamin fortification, they became one of the basic seven foods and a substantial contributor to the daily diet. They are also the first of the prepackaged convenience foods.

The success of C. W. Post was as much from his creative and imaginative advertising as from his products. He is often called the "father of modern advertising." From their origin, and today, breakfast cereals have been heavily advertised and promoted. This seems to be essential to the maintenance of a present day 7 to 8 lbs. per capita consumption.

Thus, not only was a cereal industry developed, but also an advertising industry and a packaging industry; and not from any economic justification but from the foresight, enthusiasms and energies of some rugged individualists.

Today R&D is in sharp contrast to those early days -- at least it doesn't seem as romantic.

Technical research is organized on a functional basis with groups devoted to product development, process development, package development, technical service and informational or basic research. It carries the development from an idea through a process and package. There is close co-operation with market research, particularly in the initial development stages, and with engineering research in the stages of pilot plant design and construction.
The personnel in technical research are all trained in the physical science disciplines, primarily chemists and chemical engineers, with an occasional refugee from the dairy industry, like myself. The people are also selected for their interest in foods and their ability to take basic information and translate it into products. To be successful, they must become enthusiastic generalists in applied science.

The personnel in market research are trained in social science disciplines. The engineering research people are either mechanical engineers or draftsmen.

In the Post organization, market research is a marketing function, and the engineering group is a function of the manufacturing department.

Technical research takes ideas from wherever they come, and this is primarily from idea generation projects, and produces prototypes -- bench-top samples. These samples are screened by a New Products Committee. Successful samples are then exposed, with or without description statements, to concept studies among consumers by market research. From this work, a product description or specification is evolved in preparation for product development. Last year Post cataloged several hundred "good" ideas, concept-tested 40 ideas, and defined 10 products for development. These were reduced to a priority list and four were selected for active development work. This is where R&D gets its definition sharpened up so as to minimize false starts, misunderstanding and failures.

A product must be marketable, technically possible, reducible to mass production and economically feasible to pass the test. The specifications should include grain type, physical attributes (form, shape, bulk density), nutritional value and any special properties (sugar coating, flavor, additives). The sharper this definition, the simpler the job for R&D, and the quicker the job can be done.

The development of a product and a process usually takes one to two years. It can be very interesting work, and it can be very, very discouraging. As much as a year can pass without making any demonstrable progress. The work can lead one from one field of chemistry to another, or to physics, or nutrition or enzymology. This is what makes the work fascinating to those who work at it, but bewildering to the true basic scientist.

When the product development is nearing completion, consumer tests of the product are run to establish consumer preference in relation to existing products. A product must compare favorably with existing products or return for further development.
Process conditions are partially established during the development stages. However, as soon as a product meets consumer requirements, process work proceeds in earnest. The process specifications are given to the engineering research for design and construction of a pilot plant. It may be a plant to test out the process, if the process is entirely new, or it may be a market test pilot plant for commercial production and market testing.

A completed pilot plant is turned over to R&D for them to operate and determine if it will produce the intended product. They work with engineering on modifications until it will produce, continuously and uniformly, the desired product. When this has been thoroughly demonstrated, it is handed over to manufacturing for operation. Research must also provide manufacturing with complete specifications for raw material, finished goods and packing; procedures for operation of the plant, and complete quality control information and test procedures.

During this period, marketing has been developing a plan for a market test. Markets have to be selected, advertising developed, sales coverage defined, package design and size developed and pricing volumes projected. The controller begins to formulate cost projections and gross profit figures. As a test market gets under way, R&D slowly withdraws from the scene. Market research, through field surveys, is following the progress of the product's movement. They follow advertising, distribution, consumer reaction and repeat purchase rates. Such an operation will run for at least six months and as long as two years before a decision is made concerning the fate of the product. If a positive decision is obtained from management, then engineering is called on to design and construct a national plant. R&D is generally called on to assist in this program and is always involved in the start-up of a national plant.

R&D's activities from this point on are in the areas of product improvement, cost reduction, shrinkage studies and general service to manufacturing. Such activities continue for three or four years on an active basis, with service work continuing forever.

From the activity described, it is planned to have at least one new product in national distribution each year that will attain a volume of 3 percent of the cereal market.

The span of time from idea to national expansion is at least 4 years and may be 6 or 7. To maintain such an activity, there are 65 people in technical research, 4 in market research (with most of the work being contracted with testing agencies) and 12 in engineering with support from the craft shops.
The process cereal business is a strongly consumer-oriented business. Through the years a consumer market has been created out of a changing need, from dyspepsia to prepackaged, convenient, economical breakfast food. This market is maintained with unusually heavy advertising and promotion programs -- by far the heaviest in the food industry.

There is no pressure from suppliers that has an influence on developments in the cereal industry. This is probably because the industry consumes such a small part of grain production. Although the cereal industry has sales in excess of 958,500,000 lbs. annually, it consumes only a fraction of 1 percent of the country's annual grain production. Among the major grain categories, the figures are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Processed Cereal Consumption 1959</th>
<th>1959 Total Production</th>
<th>% Total Production to Processed Cereal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>5,130,000 bu. (as hominy grits)**</td>
<td>4,361,170,000 bu. (56 lbs.)</td>
<td>0.12%</td>
</tr>
<tr>
<td>Wheat</td>
<td>5,880,900 bu. grain</td>
<td>1,128,151,000 bu. (60 lbs.)</td>
<td>0.52%</td>
</tr>
<tr>
<td>Oats</td>
<td>4,673,000 bu. grain</td>
<td>1,073,980,000 bu. (32 lbs.)</td>
<td>0.44%</td>
</tr>
<tr>
<td>Rice</td>
<td>951,250 cwt.</td>
<td>53,122,000 cwt.</td>
<td>1.79%</td>
</tr>
</tbody>
</table>

*Back calculated from Nielsen Food Summary Data
**Hominy grits are obtained from dry corn milling at a yield of approximately 20 lbs./bu. of grain. They are pieces representing approximately 1/3 of the endosperm of a kernel.
***U.S. D. A. Summary & Statistics - December 18, 1959

Wheat and rice are used largely as whole grain ("a whole kernel of wheat in every flake"), oats are used as flour and calculated back to whole grain assuming a 70 percent yield of flour.

With this data it is evident that the grain producers are unaware of the presence of the process cereal industry and would be unaffected by 100 percent variations in breakfast cereal consumption.

There is some pressure in the packaging area imposed by suppliers and their developments. However, this pressure is primarily in the opposite direction. The cereal industry applies considerable influence on paper
manufacturers and paper converters to produce better packing materials. This is for more product protection, more attractive, more economical, easy opener-reclosure features. This pressure is exerted to the tune of $35,000,000 of business concentrated in six customers.

There is a pressure not identified in the outline that is ever-present from governmental agencies. This can come from any level of government, but is felt in the cereal industry primarily from federal agencies--particularly the FDA and FTC. A current example of this is the 1958 Food Additives Amendment to the Food, Drug and Cosmetic Act of 1938. This law says in essence that no chemical substance can be added or used in such a manner, including packaging materials, as to become a part of the food, unless it is generally regarded to be safe.

A problem to the cereal industry may be the commonly used chipboard cartons. It is reasoned that since the board is made from waste no one knows what it contains, and there may be a deleterious substance. This could cost the industry somewhere between one and six million dollars and could have a serious economic effect on some board manufacturers. This governmental influence is very involved and could be the subject of an entire discussion.

The major pressure is form the consumer, so let us return to that one. The industry is influenced by strong competitive activity among a few large companies with immense resources, but the consumer is the object and, therefore, the primary source of the pressure. The consumer attitude toward cereal is a pallid one. The consumer psychologist says there is no "emotional involvement" on the part of consumers with their cereal purchases. They talk about their homes, cars, TV and steaks with enthusiasm, but it is difficult to get one to talk or brag about the cereal eaten for breakfast. People are concerned about the foods they feed their babies, children and dogs, but not about their own consumption.

In spite of this, the consumers do have some impressions. They rank cereals nutritionally: oats, wheat, corn, rice. They rank cereals in terms of preference: corn, wheat, oats, rice. The price rank is: rice, oats, wheat, corn.

Oats (some say for horses and Scotchmen) are considered good for growing boys. Corn is for adults; it is zesty, light, crispy and urbane. Whole wheat is for men and boys and is bland, fairly nutritious, sticks to the ribs and rural. Rice is for women, children and invalids; it is crispy, bland and light. The consumer does feel that breakfast cereals satisfy a need. This need is described as a compromise between a good breakfast and no breakfast. By feeding the family breakfast cereals, the housewife has somehow discharged her responsibility in feeding her family breakfast.
From this background, advertising as a communication must convey some message to the consumer that is exciting and impressionable. It must be impressionable enough to cause the customer to purchase the product. Then this impression must be repeated many times because of the consumer indifference. This indifference is measured by the fact that there is very little brand loyalty -- as measured by repeat purchase patterns. Only 35 percent of the people who buy in a given bimonthly period will buy again in the next bimonthly period.

The message that is used in advertising often seems indirect. It is as it is because it's the message the consumer understands. For example, a product having a completely balanced nutrition with 25 percent of the daily requirements across the board, is promoted as having "the nourishment of oat meal." That statement means more and is, therefore, much more impressive to consumers than "balanced nutrition." The problem is not what is the outstanding attribute of a product, but which attribute can be told to the consumer in the most impressionable manner.

Let's review this consumer situation briefly. This consumer pressure is one resulting from a desire created out of advertising. Advertising must overcome the indifference of the consumer about breakfast cereals, causing her to purchase a brand in the market place. This message, in order to be effective, must take into account the consumer attitude toward breakfast cereals, her feeling about various grains and her state of knowledge (in nutrition).

This situation accounts, in a large part, for the heavy advertising and promotion of the industry. The 7 lbs. per capita consumption must be earned every day in the market place, hence the consumer is the primary influence determining product and process innovations in the processed cereal industry.

It has been mentioned previously that the industry was concentrated among a few large suppliers. It is centered essentially in six companies with three of these representing 75 percent of the total volume. This makes for an intensive competitive situation. It also makes it possible to spend large sums of money on product and process innovations, and the overall consumer attitudes make innovations necessary for existence.

The final subject in the outline asked for an evaluation of procedures and criteria used in the selection of innovations. This part of the discussion is divided into three subjects: consumer, economic and manufacturing feasibility as the main areas involved.
The consumer testing involves the product acceptance as evaluated under various sets of conditions. Techniques have been devised for use at various stages in the product development, essentially based on reducing time and cost of the tests. Although consumer testing is an incompletely developed science, the various techniques do provide useful information when the technique used "fits" the information that is desired.

Concept testing -- is the testing among a small group of consumers (25 - 100) of a product description or positioning statement, with or without a product prototype. This work is done by consumer psychologists using depth interviewing techniques. It gives a measurement of the consumer's interest and involvement with a product idea. The results are purely qualitative but serve a useful purpose in the construction of a product specification in the early stages.

Triangular tests -- use independent evaluations by experts to determine if two samples are similar or different. They answer only the question of difference as determined by experts. This type of testing is used primarily by R&D in the laboratory.

Profile panels -- panels of experts selected for having an acute sense of taste, who can identify and describe product differences in meaningful terms. Profile panels are used primarily by R&D to determine direction in research. They do not contain any factor of consumer preference.

Consumer tests -- can be run as store tests or home use tests that are either mailed or placed. They can be local, regional or national panels. The test can be blind product, identified product, or product with positioning statement. They can be constructed as paired comparisons, multiple-paired comparisons or single evaluations. They can be single exposure or consumption studies. The consumption test may be preceded with diary information and can include "buying situations".

The size, scope and composition of these tests must be very carefully constructed, based on the information that is desired. These tests can be very helpful or extremely misleading.

The test that hasn't been conceived is one that will identify a product that is not generally accepted, but strongly liked by a minority group sufficient to represent a business opportunity. Also, the test that identifies the product that will gain acceptance only after extended use would be helpful.

The market test is the final acid test to determine the product's potential under the normal selling situation. This is expensive in terms of capital and expense monies, time and efforts. It involves the design and construction of pilot plant facilities, the development of complete market plans
with built-in measurement techniques of product progress, and the selection of the sections of the country for the test that will be representative of the country.

The market test determines the consumer response to the product as purchased in the market place. It measures product acceptance, advertising effectiveness, trade and consumer promotion efficiency, the manufacturing plant and design and the packaging adequacy. It gives the entire management a look at product potential and the first real figures on costs and profit potential.

During a market test, measurements are made of the share of market -- at an advertising level and at a price -- the repeat purchase pattern and overall consumer attitude about a product. These tests are continued for 6 months to 2 years, culminating in a management decision that there is or is not a business opportunity.

Thus far there has been little reference to economic considerations. There is a continual economic evaluation going on throughout the development process. The figures are of the "ball park" or "box car" variety, however, until the market test is conducted. During this test, costs for raw materials processing and packaging are accumulated. The production yields are determined. The consumer price--involving package size, net weight and apparent value--is determined. The advertising and promotional expense is measured in terms of the volume they generate. These figures produce the out-of-pocket cost of the product and thence the Variable Gross Profit which is the first economic index used.

The second economic criteria used is ROFE or return on funds employed. Here an accumulation of capital, inventory dollars, advertising funds, R&D costs and working capital is made. This accumulation for a 10-year period over the profit generated during a like period gives an average percent of return for the period. This is the second economic index.

A third calculation that is made involves the return of funds employed. In other words, how long does it take to get the investment back?

These criteria are used in all industries. The targets that are established, however, differ for different industries and are even different for different segments of the food industry. They do, however, come in for major consideration in the management decision regarding a new product-business opportunity.
Previous reference has been made to market test as an evaluation of plant and plant design. Since the value of a market test pilot plant as a means of measuring manufacturing feasibility is often overlooked, it bears repeating. The pilot plant answers the questions: Can the product be produced on the plant as designed, on any plant, of a given quality, uniformly and at what cost? The packaging feasibility and adequacy are also determined. These answers to manufacturing feasibility are often of sufficient significance to alone justify the cost of pilot planting.

These are the criteria used in the evaluation of a new product as a business opportunity in the cereal industry. They are not absolutely a guarantee of success. However, new product failures have generally been the result of short-cutting the described procedures in an attempt to gain time over the competition.

In summary, let me say that the processed cereal industry has a romantic past. It is a well established consumer business characterized by its heavy concentration and large advertising and promotional requirement. It has pointed the way for the consumer acceptance of prepackaged convenience foods that have grown so rapidly since World War II.