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Symposium Papers

on

Food And Health

Together with Addresses Made at the

Dedication Ceremony

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Food Research Building

At the New York State Agricultural Experiment Station,
Geneva, N. Y., May 5 and 6, 1960

Published by the
New York State Agricultural Experiment Station,
A Division of the New York State College of Agriculture,
A Unit of the State University of New York
At Cornell University

Bulletin No. 790 **July, 1960**

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The new food research building has a frontage of 240 feet. Two stories in front, it has a basement floor and a sub-basement and pent house which accommodate machinery for operating various facilities in the building. A two-story pilot plant is in the rear.

PART I. DEDICATION SYMPOSIUM ON "FOOD AND HEALTH"

Presiding: DAVID B. HAND, *Head of Department of Food Science and Technology, New York State Agricultural Experiment Station*

Introductory Remarks by David B. Hand

THE theme of "Food and Health" that has been chosen for this symposium is one that is closely related to the work to be done in the building now being dedicated. No one will dispute the importance of foods to health. The healthful foods that will be the subject of scientific study will be based on the wholesome agricultural products long known to support man's nutritional needs. As the science of foods develops, the faddism so prevalent today will tend to disappear. We are not looking for super foods with mystic powers but rather for the sound scientific improvement of existing foods. The best diets will be based on a wide choice of wholesome foods.

The selection of foods that will contribute most to the maintenance of health will require extensive public education. Much of the information that the public now receives is biased. It should be kept in mind that the primary justification for a food industry is to feed people and not to provide employment for workers or even disposal of farm surpluses.

Some of the difficulty in education of the public is due to the limitations of scientific knowledge. More research is needed. Better foods will be made available to the public through improvements in nutritive value and in qualities that make for acceptability. These principal problems are covered by the papers presented to this symposium. The field of nutrition and its application by the public are advancing through the efforts of workers in education, biochemistry, bacteriology,

food technology, and the science of nutrition itself. The final goal of food research is to provide a better diet.

It is particularly fortunate that the Department of Food Science and Technology is located in an Experiment Station among a group of departments investigating cultural practices and the control of plant diseases and insect pests. Supplies of raw materials of known history and controlled quality are available. Most of the projects of the food technologists are in cooperation with the biological scientists in an effort to improve foods at all stages between the farm and the grocery shelf.

Determination of protein content of foods in the Kjeldahl laboratory.

What Is an Adequate Diet for Young and Old?

William J. Darby

Professor of Biochemistry and Director, Division of Nutrition, Vanderbilt University School of Medicine

THE title of this paper implies that there is a simple reply to the query, "What is an Adequate Diet for Young and Old?" Before attempting to answer this, one must pose other questions: Does one mean in fact a *single* diet? What does "adequate" signify? How young? How old? "Young and old" in what state of health? How should one describe the diet(s)—in terms of foods or as nutrients? Where are the "young and old" and what is their traditional food? What determines or limits their choice or use of foods? These and many more points need clarification to answer this simple question.

It is evident that we are not ordinarily concerned with designing a single diet or formulation which alone is "adequate for young and old". However, there are situations where knowledge of such formulations is important and where an adequate diet suitable for all age groups may be essential. Medical scientists have been much concerned for years with the development of a formulation of nutrients which can be administered by vein to patients whose illness makes impossible the ordinary route of feeding. This effort has met with considerable success and practical formulas are in limited use. However, there remain difficulties of several kinds which must be overcome before one can safely nourish patients over prolonged periods by intravenous alimentation.

We are today increasingly conscious of the need for feeding individuals adequately for long periods in crowded, confined spaces. For example, submarine crews must be fed for weeks during long undersea voyages, civilian shelters should be stocked with ready-to-eat food which can nourish young and old for varying periods of time, and increasingly

we realize that man will travel in space and that provision must be made for feeding him during these voyages. I am not presumptious enough to try to give you a formula for a diet to meet these situations —the research which is centered in this Food Research Building will deal with many facets of these and similar needs.

We can, however, identify examples of widely employed single formula feeding: mother's milk, the many proprietary infant foods. the all-purpose feeds and mixes so successful in animal husbandry. In recent years there has been much attention to and sometimes over-enthusiastic support for, the formulation and distribution of one or another single "multi-purpose" food. Some of these foodstuffs have been advocated as *the* solution of the problem of feeding the world's hungry and destitute. Some of the schemes for use of such products have been and are impractical, unsound, and possibly in a few instances motivated by potential profits to the promoters or by political considerations. The missionary zeal and "cultism" and exaggerated claims of advocates of some of these products have tended to make scientists skeptical of the soundness of the products, of the evaluation of their nutritional importance and usefulness, and, indeed, of the programs for their distribution. Despite the understandable emotional reactions which color opinions and judgments which should be based on objective scientific evidence, there is much of importance to be learned from study of experiences with such products. To be informative the appraisals must be objective and unbiased, however. We do have special situations in which nutritionally complete, acceptable, ready-to-eat, cheap foods of long shelf-life would be invaluable. Collaboration of food and nutrition research laboratories, such as this one, with responsible agencies and with other research institutions, will contribute to the solution of some of the considerations essential to the development of these dietaries.

These considerations, however, are not the direction of our main interest. Instead we are concerned with the adequacy of varied, generally used diets composed of wholesome foods. To discuss this let us first consider the concept of "adequacy". What level of nutrients will we accept as "adequate"? Certainly adequate should be sufficient to prevent clinically observable disease and to permit the accumulation of stored reserves of essential nutrients where this is possible. These stores or reserves should be sufficient to meet the demands of the organism for a reasonable period of deprivation. A "reasonable period" may vary in length, depending upon the biological properties of the nutrient. For example, there is little, if any, true storage of protein, and amino acids are more efficiently utilized if simultaneously available

for metabolism. On the other hand, the reserves of vitamin A, vitamin B_{12}, or iron may be so great as to maintain the subject in a state of health throughout years of deprivation. Accordingly, the margin of adequacy between minimum and abundance varies from one nutrient to another. There is no simple formula applicable to the many nutrients which permits one to derive a standard allowance from some base of reference. Hence, in setting up such dietary standards as the Recommended Dietary Allowances of the Food and Nutrition Board or the Standards of Dietary Adequacy of the Interdepartmental Committee on Nutrition there is a wide variation in the "margin of adequacy" from one nutrient to another. This margin has been arrived at by the process of scientific judgment and is subject to revision as new evidence accumulates. These simple points are not always understood, even by some nutrition scientists, and one occasionally hears complaints that tables of standard allowances are not consistent from one cell to another in the base upon which they are founded. One also hears that committees which formulate allowances may do so through a process of compromise. This is also a misstatement of fact—standards are arrived at by committees through obtaining a combined scientific judgment.

We have indicated that our concept of adequate is a scientific judgment based on available evidences of an amount which will prevent a clinically detectable manifestation of deficiency plus allowance for the accumulation of a desirable reserve sufficient to meet the demands of the organism during a reasonable period of deprivation. During growth of the young or during the growth process of pregnancy or lactation, sufficient must be included to permit unhampered growth and development of the organism, according to this concept of adequacy.

Is more-than-adequate of the nutrient beneficial? Despite frequent implications and statements that it is, I have not seen evidence that will withstand critical examination which supports such a conclusion.

Somewhat more of a nutrient than adequate amount may not be harmful—indeed a considerable excess of some nutrients, such as vitamin C and thiamine, is not harmful (neither is it beneficial). But this toxicological margin of safety (above adequacy) does have a determinable limit. Ingestion of excessive amounts of the fat-soluble vitamins A or D can lead to serious toxicity and even death. Excessive cobalt intake can lead to polycythemia, excessive selenium to symptoms of toxicity, etc.

Adequate, then, must be below the maximum possible intake—again by a factor varying for the particular nutrient. A consistent small excess of calories in any form leads to obesity with its associated health impairments, 10 times the adequate intake of vitamins A or D may

give rise to symptoms in infants, but the body can excrete very large quantities of ascorbic acid without harm.

May we examine the intakes between adequate and harmful. These are within the toxicologic margin of safety and, I believe, without benefit to the individual beyond the adequate level. Adequate intakes are for most Americans readily supplied in our daily diet through the variety of nutritious foods available to us. Intakes above this may result from feasting on a particular food or item especially rich in a given nutrient—thus, a teenager might consume 3 quarts of milk a day and thereby get more than adequate calcium and riboflavin. Or someone might drink a quart of orange juice and thereby take in 10 or so times an adequate quantity of vitamin C. Other individuals might ingest, in addition to an adequate diet, one or more multiple vitamin tablets daily and thereby have intakes above adequate in several of the vitamins. Even though, as indicated above, there is a wide range of the margin of safety for such excesses of intakes, it is evident that physiologically and economically such intakes are wasteful.

Whether, then, one chooses to enjoy indulgence in more than adequate of a foodstuff or a daily dose of vitamins depends upon the pleasure derived therefrom—and the ability to afford the waste—so long as the intake is within the toxicologic margin of safety.

This brings us back to the queries, "Where are the young and old and what are their traditional foods?" and "What determines or limits their choice or use of foods?" Traditional diets, especially the foods considered as feast-day or prestige foods, are pleasurable diets to those of the particular culture. These foods may even seem revolting to one of some other culture, yet the food may be most nutritious. The cultural, or even individual, attitude toward a food is seldom, if ever, based on a scientific finding or a property which is scientifically determinable. For example, why do you rebel at the idea of eating guinea pig while the Peruvian considers it a delicacy? Why do you enjoy pork while the Arab considers it unfit to eat? Why do you regard horse or dog meat as unsuitable for the human, or discard eels while the Dutch serve them as a delicacy? Tradition, bias, prestige, religion, superstition rather than science determine much of our food choice.

So, in order to provide through foods the adequate diet we must take cognizance of these factors. Tradition and bias change slowly, even under pressure of prestige advertising. However, they do change, especially in our developed society with its media of communication and advertising, its effective program of agricultural and home economic education, and, most importantly, the revolution in agriculture, proc-

essing, and distribution which has occurred during the rather recent past.

This revolution in food distribution has occurred within the period of my memory. I barely recall the Armistice of the First World War, but subsequently, I have vivid recollections of the two general stores in my home town in Arkansas—stores with shelves of chewing tobacco and snuff, with navy beans in gunny sacks, a hoop of cheese, some salted side meat, barrels of sugar and flour, some potatoes, home canning supplies (buckets, sealing wax, and mason jars), kerosene lamps and "coal oil", sometimes a few head of cabbage, and, in season, maybe some tomatoes and melons. Oh yes, coffee which was either ground in the hand coffee mill at the store or taken home for grinding in the kitchen coffee mill. I almost forgot the inevitable molasses, sugar, salt, overalls, and nails. Pellagra was common among the farm folk in the springtime in those days.

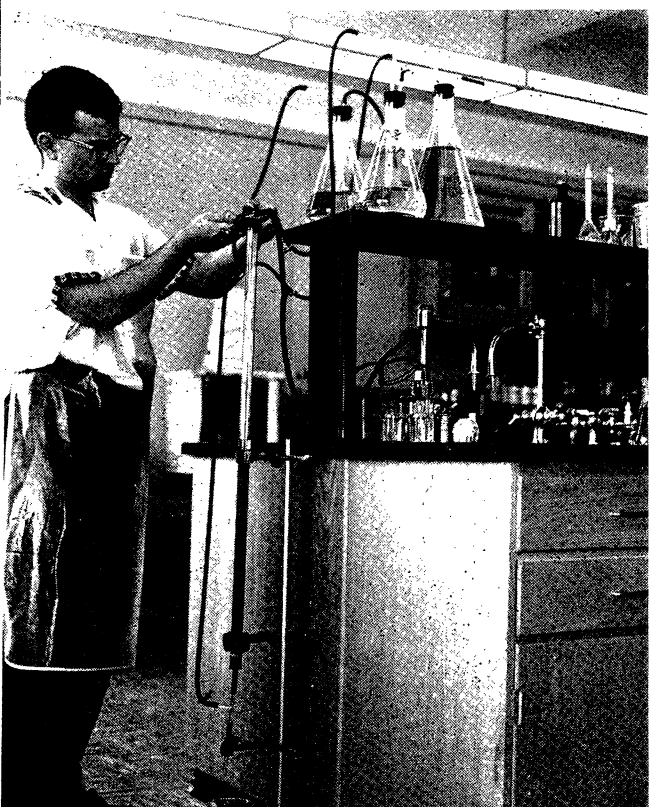
What a contrast to the supermarkets which today have replaced these stores!

"Supermarket, USA" started in Memphis, Tennessee, in 1916. Today it comprises typically 10,000 to 35,000 square feet of floor space with a much larger adjacent parking area. Some 5,000 to 6,000 separate items are stocked, most of which are protected in convenient ready-to-use-family-size packages. Clean, neat, refrigerated fresh vegetable counters which throughout the year are filled with a wide variety of vegetables unknown to most of us in the days of the general store are interspersed with washed and prepackaged raw products. On refrigerated self-service shelves are precut and prepackaged meats, plump tender packaged cuts of fowl, ready-to-cook seafood, a vast array of presliced cheeses, half baked, precooked or frozen breads, cakes, pies, ready-to-cook frozen vegetables, fruits, meats, complete meals, convenience food of every description—all individually packaged in sanitary, consumer-appealing, transparent or windowed packages. The customer is confronted with an endless variety of canned, frozen, dehydrated, or precooked ready-to-eat foods. There are prepared breakfast foods, miniature packages of almost an equal variety of foods prepared especially for babies, or even special dietetic foods for those on low-sodium or other special diets. There is even an array of pharmaceutical supplies, including vitamin pills, in the store or the adjacent drug store. Couple this selection with a customer whose purse is reasonably filled and you have one major answer to the question why pellagra and other deficiency diseases have disappeared in the United States. You also see why the concept of the adequate diet must now consider the usefulness of above-adequate intakes and their limits.

Other speakers have noted the problem facing future generations of Americans in maintaining this position of nutritional abundance. In closing, I wish to add but one thought related to this problem:

Increasingly we have and shall continue to become dependent for our food supply upon the wisest and most effective, economical combination of agricultural and industrial production as blended by the food technologist. There will be greater use of by-products not now widely employed in human foodstuffs. This will call for scientific assessment of nutrient quality rather than decisions based on cultural bias.

Increasingly advantage will be taken of the potential for improving the nutritional value of foods through enrichment, improvement, or whatever term you like. Regardless of the term, this improvement will make use of industrially produced nutrients to extend and improve agricultural products. Again, cultural bias must not limit this. Scientific and economic considerations should be the major determinants. Industry and agriculture are not in competition in the world of foods—they are mutually dependent upon each other and we today—and more in the tomorrow—are dependent upon both.



Removal of acids from a starch preparation in an ion-exchange column.

The Role of Chemistry and Technology in the Development of Modern Foods

Emil M. Mrak
Chancellor of the University of California, Davis

THIS is indeed a great event and I am flattered to be invited to be a participant in the dedication of this building. I am particularly glad to witness firsthand this manifestation of advanced thinking in the State of New York. This facility will play an important role in the progress that lies ahead for the agricultural and food industries of New York. With the staff at the Experiment Station and with the facilities that are within this building, this State will have leadership rather than "followship". I am looking ahead to the results, both applied and technical, which will pour forth from this plant. Some will find use in the very near future. Other results will take some time before finding application, and still others will add to our stockpile or savings account of information which may not find application for many years, if at all. In any event, the latter will add to the enrichment of our knowledge relating to the basic principles of food science and technology.

The title of this paper emphasizes the role of the chemist and technologist in the development of modern foods. The total field of food science and technology is, of course, much broader than this.

Food science or food technology is an interplay of disciplines, of points of view, and of trainings. It is a spectrum—a full spectrum—of effort from applied to highly theoretical.

In the days of old, which were not so many years ago, food preservation was carried on largely in the home. The methods were those that were timeworn with which we are so familiar. Some items were canned; others, frozen through the winter; and still others, dried or fermented. The development of commercial preservation and the great food in-

dustries is really quite recent. As a matter of fact, the person who did the first work on the microbiology of canned foods is still alive and active—I mean no other than Dean Prescott of MIT. While he worked on the spoilage of canned meats, Marshall of the University of Wisconsin was working on canned corn. It was about that time that canned evaporated milk started to appear on the market. The products, of course, were the result of art rather than science.

Problems relating to spoilage and even safety began to multiply. In some cases, the losses were great, and in others, deaths resulted from eating canned foods. The use of science and technology in this early industry was at a minimum and the procedures were more art and luck than anything else. These processes, of course, had been based to a large extent on principles of preservation that had been used for many years. Drying, salting, smoking, fermentation, and even freezing had been used in one way or another by primitive man. The use of heat and the hermetical seal date back to Nicholas Appert and Napoleon. The use of chemical knowledge for the preservation of foods was nil, although salting, smoking, and fermentation were chemical means of preservation. One can but wonder if some of these processes were introduced today whether the food and drug laws would permit their use.

As indicated earlier, the old thinking related to food technology changed as the field developed, as the industry developed, and as the universities found it necessary to give consideration to food processing. Some of the early workers were experts in the processing of particular crops such as cherries, pickels, prunes, chickens, meats, etc. Furthermore, these early workers may well have been trained as extension men, horticulturists, or perhaps even chemists, who may have strayed and studied food preservation. These workers skimmed the surface by use of trial and error methods and in this manner made some really important contributions. They did not go very far into the chemistry of foods or attempt to explain on a chemical basis the reasons for certain occurrences. They did not have the opportunity to show that nature uses a multiplicity of chemical reactions and chemicals in foods, and of course, they could not very well take advantage of some of these natural chemicals or chemical reactions. Perhaps this was fortunate, for it avoided a certain amount of criticism. Perhaps we may say the less we know about a subject the less there is to criticize.

I would like to believe that in most places today the food scientists working in these areas are biochemists, chemists, microbiologists, or biochemical engineers, rather than men trained in crops, production, or extension.

There was also the specialist in processing—a person who was supposed to be acquainted with the technology of canning, drying, freezing, pickling, or concentration. Then there were those who were concerned almost entirely with the utilization of surplus crops and others who were concerned with the conversion of grapes into wine. These specialists had a variety of backgrounds, but their interests were extremely broad. Their basic thoughts were directed toward ironing out difficulties in the total process, utilization of surplus crops, etc., rather than toward fundamentals.

As the food industries grew, the number of problems grew, and the industries grew because people learned to accept the processed products. In some cases it was essential for them to do this if they were to eat. After each great war there was a movement of people to the cities, and no longer could they rely on the farm and home preservation for their food. They were compelled to rely on the commercial packer more and more. The problems of consumer acceptance of which we are so well aware today, in the earlier days of the food industries were not as serious as they are today. Apparently, the sales problems and competition were not as great as they are today. But, there were technical problems, and plenty of them. The philosophy of food science was gradually directed toward the solution of these problems.

I can remember when the problem of botulinus poisoning was extremely serious insofar as certain low-acid foods were concerned. Here was a serious problem that not only raised havoc with the canning industry in general, but particularly in the area of low-acid canned food products, so it was necessary to initiate a crash program to solve the problem. Bacteriologists and technologists were called on to study the organism, the conditions under which it grew, the process, and processing times. As may be expected, the bacteriologists rode high and many considered them to be the ideal food scientist.

Unfortunately, the innocent packers who had distributed the canned olives were unaware of the technological problems involved in canning low-acid foods, so they had no scientists around their plants at all. There might not even have been a person who understood the use of "hydrometers" or the meaning of "salt concentration". The whole industry was an art rather than a science, and unfortunately, the art was not sufficient to protect the people against the ravages of *Clostridium botulinum*.

Botulinus was only one of the tragic occurrences in the development of the food processing industry. Shortly after World War I there was a slowdown in the movement of canned products out of California. As a result, canned items that were normally considered stable remained in

the warehouse for months or even more than a year before being moved to the market. These cans started to swell, and no one knew why. It became so serious that a machine was developed to test the vacuum in cans automatically and discard those too low for shipment to market. This problem proved to be a chemical problem concerned with the manufacture of tin plate. In this case, chemists were called on to solve an extremely difficult problem relating to the corrosion of tin plate. The development of a new type of tin plate solved the problem and has been of inestimable value to the American consumer as well as to the processor. Upon the solution of this problem, we find the chemist in high repute and considered the ideal food technologist. There have been many such occurrences and the chemists have been relied on more and more to solve problems relating to food acceptance, stability, convenience of use, safety, nutritive value, and food performance.

Not so many years ago the Food and Drug Administration began to look with disdain upon insect infestation of many of our dried fruits and staples. As a result, it was necessary for the industries to develop and apply protective measures against insect infestation and actually to control it to a point where the food was completely free of insects. At first entomologists were involved in the problem; however, it remained for the chemist to develop fumigants, methods of application, and conditions for fumigation. Here, then, was a case where we find people trained in two disciplines working together as food scientists.

About the termination of World War II some question was raised concerning the safety of the lacquer coating in cans. Was material absorbed by food packed in these cans, and if so, was it safe? Were flakes of lacquer that might get into the foods safe or could they be harmful? These questions resulted in an extensive program to learn about absorption of materials from lacquer, the effect on animals, etc. In this case we find chemists, biochemists, pathologists, nutritionists, and a whole galaxy of different types of scientists working together to solve a single problem. The results of the study showed conclusively that the lacquers are safe and the consumer, as well as the processor, is well protected. Such extensive and expensive investigations, carried on to a large extent by chemists and technologists, have served to give the consuming public a continuing food supply and a perfectly safe food supply. Where would we be without such studies? I am afraid some of our city dwellers might not find the abundance and diversity of food they enjoy today.

The examples I have given indicate the gradual evolution of food preservation from one of an art to one of science and technology and

of the food technologist from a person with a broad and superficial training to one with an intensive scientific training.

World War II presented many new problems relating to foods. It took some time, however, for us to realize that the foods packed for peacetime conditions were unsuitable for the rigors of wartime conditions in foreign theaters. For example, food shipped to North Africa deteriorated rapidly in the hot desert environment. As may be expected, acceptability and nutritive value decreased rapidly. When troops refused to eat rations that had undergone storage deterioration, it became necessary to organize a research program to cope with the problem. The so-called Committee on Food Research was appointed to develop a research program. For the first time, to my knowledge, many disciplines were brought together to consider the total picture relating to the Army food program. Chemists, biochemists, bacteriologists, chemical engineers, nutritionists, food technologists, and a person trained in acceptance were included on the Committee with the result that for the first time a real full-spectrum program relating to food problems was worked out. This Committee established the needs for investigations in many fields by specialists. Some of the studies started were applied in nature, while others were quite fundamental. Studies were conducted to learn the basis for appetite and the importance of stress on food patterns and environment to food preference. There were also studies relating to the effect of storage deterioration and the retention of nutritive values. Here, then, for the first time, was a very extensive program aimed at understanding why the consumer would prefer certain foods and the conditions under which he would eat them.

It was realized early that all foods, except perhaps salt and peppercorns, may undergo deterioration during storage. This in itself was a new philosophy because prior to the War many of us considered canned, dried, and smoked foods stable and able to survive any conditions. This, of course, is anything but true. Dried foods undergo the so-called "browning reaction", canned foods may lose flavor or the can may very well corrode or swell, and some foods become infested with insects, while others become rancid. In all cases, the edibility decreases, and most certainly the nutritive value goes down. Such losses are important even today. As a matter of fact, the FAO has estimated that storage losses caused by rats, insects, and fungi annually amount to as much as 33 million tons of good food, enough to feed the entire population of the United States for one year. According to Robert Brittain, this means that if one person out of every 14 in the world should die yearly from starvation because of the real lack of food to go around, we could

say quite literally that he was done to death by predators. This is ironical for I am certain that much of this loss can be avoided through the use of safe chemicals developed by the chemists and applied by the technologists.

The impact of the research program, general plan of operation, and philosophy of the Committee on Food Research was indeed great. As a matter of fact, the background laid by the activities of this Committee has influenced greatly changes in the food industry today and the philosophies relating to areas of study are still sound. Perhaps the only factor now taken into consideration in addition to those set forth by the Committee on Food Research is that of performance. This relates to the performance of a processed product as compared with the fresh. Dried egg white may be used as an example. Without the performance characteristics expected of fresh egg white when making a sponge cake, we probably would not have the very convenient prepared sponge cake mixes we have today. In this connection, we may very well express our appreciation to the food chemists and the development of safe chemicals. Who would want to go back to the old and unreliable method of making sponge cakes in the home? Perhaps a few "die hards".

After the War the development of new foods occurred at a very dramatic rate. The great developments, of course, were in the many convenience foods such as sponge cake mix, that appear on every grocer's shelf. These items have literally disenslaved the housewife. They have transferred hours of work from the home to the food processing plant. They have enabled the housewife to serve with ease a diversity of fine nutritious foods of consistent quality. I have often thought it would be interesting to obtain some data on the hours of work that the housewife has been saved and the increase in nutritive values of our foods as a result of these developments. If I am speaking for the chemists today—here is the place to do it—for it has been through the studies of these men, their development of new processes, and the use of safe chemicals that these great advances have been possible.

Such developments are proceeding at a more rapid pace than ever. The advances in food science will, of course, benefit the consumers and, naturally, the farmer who produces the raw materials. More than ever, therefore, there is a need for scientists trained in the fundamental disciplines of chemistry, biochemistry, microbiology, chemical engineering, etc., with an orientation to or point of view of the food technologist. There is also the need for the food technologist who thinks in terms of the total process. In recent years it has become apparent that

these people must work together and they in turn must work with those concerned with the production of raw materials. It is apparent today that we cannot separate the characteristics of the raw material from quality and yield of the processed product. It may be said that the interest of the food technologist should start with the product from the time the seed is planted or the egg laid until it is processed and finally consumed.

As a result of this full-spectrum type of thinking and the interplay of various disciplines, it has been necessary to call on people trained in other areas for assistance. Certainly the home economist, as well as the agricultural engineer, the entomologist, plant pathologist, nematologist, and others all play a role in this total picture. The home economist adds the understanding of the utilization of food, the agricultural engineer adds the equipment used in harvesting, transportation, and processing of the raw material. Pomologists, entomologists, plant pathologists, and nematologists may well carry on procedures that will influence the finished product. Certainly this is true in connection with the use of pesticides. In doing this, he must have some understanding of what the residues may do to the food, the taste of the food, and consider them from the legal aspects. On the other hand, the food chemist is the one who must in the end translate the possible influences of all these cultural practices to the eating quality, nutritive value, safety, and even storage stability of the processed product. For example, the Lovell variety of peach, when dried, darkens very rapidly in storage. I am quite certain that the plant geneticist who may have developed this heavy bearing fruit wouldn't have thought of the "browning reaction". Then again, certain agricultural chemicals may result in off-flavors in a canned product only months after storage. I am certain the well-intentioned "plant pestologist" would not have thought of this when he applied the control material. Yes, the food chemist must be alert to the full spectrum of food production and processing.

The full-spectrum approach, as we have it today, has and will result in many more dramatic changes. Thus far, it has resulted in the production of many convenience foods, a great variety of foods, lower cost, safety, a continued food supply, and certainly a reduction in waste, all of which are advantageous to the producer and consumer as well as to the processor. Examples of the changes brought about by these people may be cited *ad infinitum;* however, I will merely mention a few here.

There are many dairy products, some of which have been in use for many years. Evaporated milk was one of the first canned products

developed. One cannot help wondering if it were developed today whether or not it would have the continued high acceptance that it has had. There are so many products today and the tendency is so strong toward the preservation of the natural flavor, I doubt whether or not evaporated milk would sell if introduced today. However, we do have fresh milk delivered to our door every day, and I can assure you this has not been by accident. An enormous amount of research has gone into the maintenane of quality, stability, and safety of this "taken for granted" product. The time may very well come when we will have a single-strength canned milk so that we may buy it by the case and take it home. This is something for the future chemists and technologists. We do, however, have an instant dried milk which is being used to the extent of many thousands of tons per year. It is highly palatable, and above all, a convenient product to use. Perhaps the time will come when we may have an instant whole milk powder. Great strides are being made in the utilization of whey. Studies in this area have reduced the cost of lactose and give great promise of finding a use for the high quality protein of whey, which heretofore has been wasted.

The poultry industry has made tremendous advances as a result of research and technology. I recall very vividly the days when New York dressed poultry was all that one might find in the market. If there was anything that I disliked, it was poor chicken. It had what I termed the "wet dog odor" and most certainly the undesirable internal taste and sometimes the gall bladder bitterness. In those days I conscientiously avoided poultry, even in restaurants. Today, however, this is all a thing of the past, and we can expect to buy in the market fresh chicken of very fine quality and as good as anyone can obtain from the farm. The eviscerated poultry on the market today has an excellent flavor, and, as may be expected, the consumption of poultry has increased enormously. This great advance is now taken for granted, yet it is the result of great effort on the part of food scientists.

If it had not been for chemists working on poultry products, we probably would not have been blessed with the instant cake mixes to which I have already referred.

There are many cereal products, particularly instantized cereals and convenience mixes. There have been changes in flours so that we can expect year in and year out to buy flour with the same characteristics. The variability is held to the minimum because of the procedures worked out for blending and milling. We now have a continuous bread process, and investigations on an instant bread mix are promising. These are important to the consumer for they should enable a greater uniformity and even economy.

Consumer-minded technologists and chemists have worked out dried fruit products that have a greater consumer appeal and good storage characteristics. Ordinarily dried fruits contain 18 to 25 per cent moisture, but such fruits are quite chewy and require considerable effort to eat out of hand; yet, there are consumers who like to eat dried fruits out of hand. The technologists observed, however, that if the moisture content could be raised to nearer 30 per cent, it would be easy and delightful to eat dried fruit out of hand. In other words, it would increase consumer acceptance. At the same time, such products are perishable and undergo microbiological spoilage. A team of workers, including a chemist, a technologist, and a microbiologist, was able to work out a method of preservation of high-moisture dried fruits by the use of epoxide gases. To prevent explosions and to meet the requirements of the insurance underwriters, the epoxide gas was mixed with carbon dioxide. At first this was done by using dry ice, but subsequently, a chemical engineer developed a procedure for purifying flue gases which were then mixed with the epoxides. Without the chemist and the use of the sterilizing gas, these fine products would not have been possible.

Canned fruits have been improved so that they are more uniform and have better stability and quality than ever before. Technologists and chemists have worked out procedures whereby the so-called "case yields" have been increased for pears and clingstone peaches. By "case yield" is meant the number of cases of canned fruit per ton of fresh product.

While working with a post-harvest physiologist, a food technologist had the occasion to observe that fruit ripened at relatively lower temperatures seemed to mature more uniformly. This was verified when pears were picked under carefully controlled conditions, cooled, and then stored in ripening rooms at about 67° F, 90 per cent relative humidity. All the fruit ripened at the same time and was high in flavor. The fruit was removed from the ripening room, permitted to stand overnight, and then it was canned. There were no losses from over-ripened or under-ripened fruit, and flavor was at a peak. Studies are now under way on the chemical nature of the flavor, changes in composition, and enzyme activity. This work has resulted in economy and improvement of quality insofar as the consumer is concerned.

Studies on clingstone peaches have also resulted in dramatic changes in case yield and quality. Where a few years ago the canner expected to get something like 46 cases per ton of canned cling peaches, today he should be obtaining 57.

Insofar as vegetables are concerned, perhaps the most interesting and spectacular results in recent years have been obtained on tomatoes

and tomato products. Here is a pack that is used extensively throughout the world. The raw material varies greatly from year to year, from area to area, and above all, from state to state. Problems relating to quality, stability, and uniformity are tremendous. As a result of extensive studies, highly colored tomato products are available to the consumer. The uniformity of composition is also better than ever before. We can expect great changes in the handling of tomato products in the future. It appears to me that the time may come when all tomatoes will be harvested mechanically. The products may then be taken from the mechanical harvester to a trailer, where they may be washed, steam heated, crushed, and separated with the juice running into a following tank truck and the waste into the field. The tank truck would then be hauled rapidly to the cannery where the product would be processed and the total cost of the operation, I believe, would be less than the present procedure.

In following through on such a procedure, however, the chemists and technologists will find plenty to do. They must be aware of the changes taking place in the tomato because the pectin content and consistency are important in tomato products, and in this connection, they will follow the activity of pectic enzymes very carefully.

Much may be said about processed vegetables, but it suffices to indicate that if it had not been for the chemists and technologists, such a great variety of canned and frozen vegetables would not be available today. While speaking of frozen foods, it should be pointed out that we have a tremendous variety of prepared and semi-prepared frozen foods as a result of an enormous amount of costly research. Many of these foods which are so popular today would not be available if it were not for chemical studies and chemical additives.

A great deal has been said about chemicals in foods. They are essential to prevent waste, preserve quality, prevent deterioration, and improve nutritive value and acceptability. Without these our food pattern would indeed be limited and uninteresting and once again the housewife would be needlessly spending hours in the kitchen. Yes, if it were not for the careful and safe use of chemical food additives, we would find ourselves in a very unhappy situation with respect to the availability of foods today. The foods available to us today are more nutritious, safer, and have better acceptance than ever before. It is true that chemicals are added as preservatives, nutrient supplements, agents for coloring, flavoring, and to improve functional properties, as processing aids, and for control of moisture, acidity, alkalinity, and certain physiological activities such as ripening.

If we compare the marketing of foods today with the procedures used 50 years ago, we find some very striking differences. Practically everything from steaks to tomatoes and from enchiladas to deep sea trout is packaged today. This, of course, was not the case 50 years ago. At that time, every fly had an opportunity to hop from the sugar to the ham or from the jellybeans to the dried beans. Flies have been outwitted and eliminated from the stores, and the foods have been protected by the use of packaging materials. Packaging materials and procedures are being improved continually. Furthermore, they are well tested from the standpoint of safety before being used. Here is a place where the chemist and the engineer have worked hand in hand with the technologist to maintain a full-spectrum point of view. This has added greatly to the convenience, sanitation, and safety of our food products. Most of us have forgotten what these great contributions of the chemical industries have meant to each and everyone of us. Perhaps some of you have seen the lady of the house, or even the man, shopping in foreign markets with a loosely-knit shopping bag, or perhaps a flour sack. The unwrapped food is all dumped in together and much to his surprise, an anchovy may well find himself lost in a head of lettuce or a maze of mushrooms. He may be even bothered by a fly or two or perhaps many. It is so easy to forget and so difficult to realize what advances we have made and how much the chemists have done for us.

Practically all of these dramatic advances have resulted, in one way or another, from chemical studies and the development and use of chemicals. This applies to packaging as much as to other chemicals. Recently a great deal has been said about chemical additives, and particularly the residues resulting from agricultural chemicals. Some of these find their way into foods through rather involved routes. They may result from direct application on the farm or subsequent application during storage. In other instances, the chemicals may find their way into foods through ingestion by animals and thereby appearing in the milk or meat. Tolerances have been established by the Food and Drug Administration for these types of chemicals. The use of chemicals is essential, and as one person put it, the question may confront us as to whether we wish to live to 90 and die as a result of chemicals in food or die at the age of 30 from starvation. Although this expresses the situation very well in making a case for the legitimate and logical use of safe chemicals in foods, I would go even further. During our 90 or 30 years of survival, do we wish to go back to a drab existence on staples and a life requiring 6 to 8 hours a day in the kitchen? This amounts to one-third to one-quarter of the lives of the female members

of the family, if we assume they are the ones to do the cooking. I would say the answer is an unqualified "No", and since the scientists agree with this, they have devoted much effort to the safety and nutritive value of foods. As indicated earlier, these efforts have given us a safe, nutritious, convenient, diversified, and above all, adequate food supply. For this we can be grateful.

There has been much talk about over-population and the anticipated shortage of food. There is no doubt in my mind whatsoever that the food scientists can cope with their share of the problems far better than the social scientists. Up to a point we can make better use of existing food resources, and we should be able to increase the supply of raw material. Eventually we might even produce synthetic foods. As a matter of fact, some believe that we will be confronted with a deficiency of energy long before we run out of food.

At a recent conference on Humanity and Subsistence held in Switzerland and sponsored by Nestle Alimenta, I discussed certain aspects of this problem. I should like to quote certain paragraphs from the paper I presented:

"Fish meal has been produced for animal feeds for many years. It is well understood that in the production of this product oxidation occurs rapidly and intensively. Such meal, however, is not acceptable for human consumption. In line with this, several attempts have been made to produce an edible fish meal. Apparently, most of these have been dismal failures, although I have seen one fish meal that appears to be of good quality. However, there seems to be some question concerning the economics of the process. Recently it has been suggested that a process involving the spray drying of completely disintegrated fish followed immediately by extraction with a nonpolar extractant could very well be an economic process that would produce a highly edible protein and a fish oil for commercial use.

"The possibility of processing food material of salt water origin is intriguing, but this brings up the whole matter of food resources from the sea. Walford has indicated that if we limit ourselves to tradition and speculate on the basis of available data, it looks as though the total world production of food from the sea could increase in the natural course of events only by a factor of something less than two. On the other hand, if we speculate boldly about the resources of the sea and think in terms of possible products such as protein flours and pharmaceuticals, then the possibilities of enlarging the use of sea resources might expand very greatly. Our use of the sea as a source of food and other biological raw materals is technologically and philosophically about 200 years behind our use of the land. In this connection Walford states that if we really desire to exploit the sea fully and if it is the knowledge that we need to accomplish this purpose, we had better make the necessary costly investment and put full effort into the job of acquiring that knowledge.

"The greater use of microorganisms for the production of food is promising. Much has been done on algae, particularly *Chlorella,* but in order to achieve practical production, carefully controlled studies and a considerable period of time are needed.

"It has been pointed out that whereas land plants are about 2 per cent efficient in utilizing the sun's energy, algae under controlled conditions should be able to show at least 20 per cent conversion of solar radiation into chemical energy. In single cell algae, all cells that grow, photosynthesize. This is not true of land plants.

"The work on *Chlorella* to date indicates problems in aeration, protein and fat utilization, and color and taste. At the same time, it has been stated that 6,200 square feet of culture space should produce enough *Chlorella* to fill the protein needs of a family of five or six. The protein content is higher than in brewer's yeast or peanuts, but it is less than in skim milk. A quarter of a pound of *Chlorella* would provide the daily requirements of all vitamins except C.

"There has been speculation about the production and use of synthetic amino acids. If we can use certain of them as dietary supplements for chickens, it appears feasible that they should be used as supplements for human foods. There is the question of whether or not we may expect the production of all necessary amino acids some day and whether or not these might be compounded into some sort of acceptable food. These offer tremendous problems, but how can one say they are insurmountable?

"Some have speculated on the production of proteins from vegetable matter. The storage proteins from grain are deficient in only a few essential amino acids—principally lysine and methionine. These are made up today by use of animal proteins, an inefficient procedure. The logical procedure then would be to supplement with synthetic amino acids which even today are cheaper than meat.

"Of course, much has already been done by some of the larger companies on the development of vegetable protein foods that have many of the qualities of meat. While I have not had the opportunity to see any of these, I am told that when first made, the flavor is reasonable and the texture and appearance are good. One does wonder, however, if they really have the texture characteristics of a beefsteak and whether or not the desirable chewiness of natural meat is present. It is my understanding that this is one of the most serious problems in connection with vegetable proteins. Yet, the creation of vegetable proteins from soybeans or other legumes does not appear to be an impossibility. One of my friends said recently that if the money spent on the production of nylon was available for the construction of synthetic food products, we would certainly have them. We already have on the American market a synthetic powder that, when reconstituted, has the appearance and taste of a citrus product. It has been said that if a satisfactory tomato powder is not produced in the near future, we may expect synthetic 'tomato' powders. The sky is the limit insofar as such foods and food substitutes are concerned.

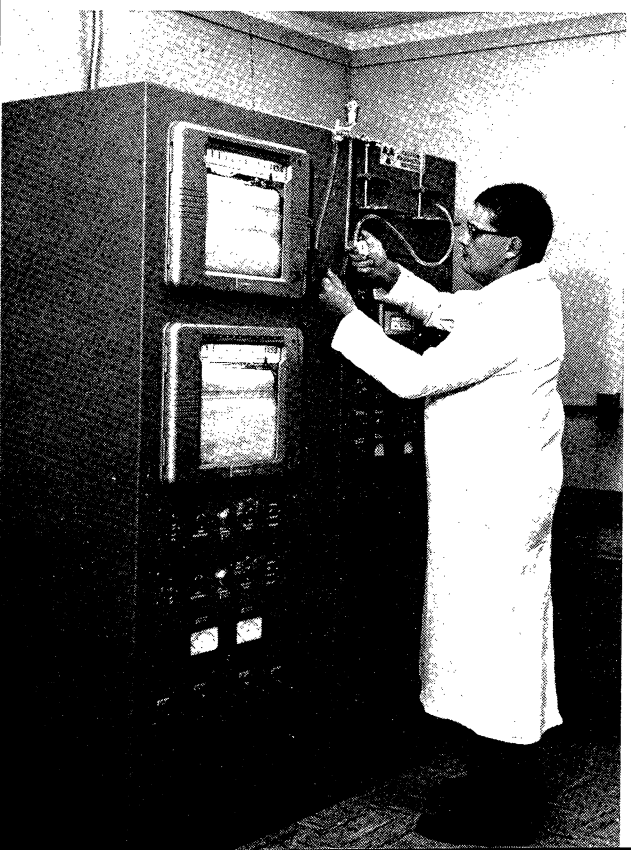
"If economically feasible, why not manufacture edible carbohydrates

from straw or even waste paper? The consumption of paper in the United States alone is about 35 million tons, or 400 pounds per person per year. If half of this were to be recovered and converted, it would, according to McPherson, produce about 180 pounds of edible carbohydrate or about ½ pound per person per day. This amount of carbohydrate would provide about 900 calories, or a little less than one-third the daily requirement.

"McPherson has also pointed out that fatty acids could be made from petroleum, although he admits that we need to learn more about the role of fats in nutrition.

"We already produce vitamins very cheaply, we know a great deal about mineral requirements, we have done much with synthetic flavors and can do more, so if the time comes when there is a need, why not synthetic foods—not in pill form, but bulky edible form?"

In conclusion, it is easy to state that the food chemists and technologists have added tremendously to our abundant life, our health, and our convenient life. As for the future, the sky is the limit. We can continue to expect advances that will benefit all of us—the grower, the processor, and the consumer.



Identification of aromatic flavors in a chromatograph.

Public Education and Food Attitudes

Philip L. White
Council on Foods and Nutrition, American Medical Association

A GUIDING principle in food advertising is to be believed. Believability is much more important in the food field than, say, in the automobile field. Everybody knows that Buick isn't the best car on the road so they don't take it very seriously when the advertiser claims it is. All the automobile advertiser is doing is trying to create an image to establish an attitude about his car. Credulity is rather incidental—nobody takes his claims very seriously. Prestige, appearance, performance, and sometimes economy influence attitudes about automobiles.

Attitudes towards foods, knowledge of the combination of foods into nourishing meal patterns, the judicious selection and preparation of foods, on the other hand, depend upon many factors and influences. Certainly parents and relatives are the most influential in establishing attitudes, but nutrition education in general and food advertising in particular exert important influences as well. Since nutrition education and food advertising are the techniques that inform the public of the principles of nutrition and of new concepts, an examination of each is in order.

Public Institutional Education

Techniques used by educational institutions disseminating information about nutrition come out a poor second when contrasted with those of the advertiser. Our public institutions spread their messages through workshops and formal classes; most of their pamphlets, charts and exhibits are hopelessly dull; they use press releases from speeches or research reports, most of which are hopelessly complex; they use film strips and movies usually prepared by someone outside the organi-

zation; they use textbooks or references written at too high a level, and so forth. Thus it is not surprising that the main source of *new* information for most women appears to be radio, television, newspapers, and magazines. Unfortunately, much of this new so-called information is misinformation.

Nutrition education today is too complex, too detailed, confused and conflicting to be effective.

The average homemaker is not equipped to judge many of the claims and statements she hears daily. She is confused about the role of fats in heart disease. She is under the impression that milk is an all-purpose wonder food for children. She is not sure what complete proteins are, but she begins to think they should be in every food. She does not know how to evaluate food fads. She cannot distinguish between recommended dietary allowances and minimum daily requirements. She does not understand what adequate nutrition is and has been frightened into unduly valuing the role of extra dietary supplements and vitamins. She does not comprehend the overall principles of weight control and tends to place undue emphasis on individual foods.

From our observations and from the United States Department of Agriculture regional surveys, we have concluded that while the homemaker does not know very much about the proper use of foods, she has some concern for good nutrition. However, she cannot be motivated to do anything about it when her family appears to *her* to be healthy. People in the United States are not health conscious. If they are concerned, it is about disease, not health. Even our medical schools can't seem to get very excited about preventive medicine.

When I attended the National Food Conference in March, 1958, I was appalled to hear so many condemnatory things said about food habits in our country. If you believed all that was said you were left with the impression that the good people of Iowa were starving and that malnutrition was rampant all across the U. S. A. The solution to the problems uncovered by the United States Department of Agriculture and the Roper Survey was to have people eat more and more foods. For a period following the conference the theory was if we can get people to eat more, we could thereby reduce our farm surplus. Turn the human stomach into a garbage can. The welfare of the farmer became the criterion of national nutritional health. A practice, still prevalent, is to promote individual foods as essential to health simply because they are seasonally plentiful. I am afraid our Department of Agriculture and some state departments are guilty of such over-promotion.

What has gone wrong? For one thing, teaching techniques are out of date—all too often undue emphasis is given to individual foods—people have not been motivated to look upon health as an objective in itself; rather, avoiding disease seems to be the motivation. Our scientists and educators cannot themselves agree upon principles and are creating confusion in both educational and promotional programs. Wholesale fortification of foods with vitamins has come about partly because of the profit motive, but partly because food manufacturers have misunderstood the message of the nutritionist. The nutritionist has failed to prevent or control this vitamin horsepower race. To the average homemaker dietary insurance is based upon vitamin pills at least to the tune of $500 million worth of sales each year. The widespread success of the food faddists undeniably confirms that nutrition education to date has been only partially successful. We have not accomplished as much in 20 years as we might have.

Certainly it is obvious that there is more and more material being prepared and distributed by educational institutions and public agencies. While much that is being accomplished is good, I believe a thorough examination is called for.

Sometimes the scientists and educators who interpret research findings for the nutrition worker in the field are eliminated altogether. Recently, the latest research findings have been going directly to the people—not so much for their information as to encourage them to change habits to conform with the latest findings. Thus we are getting all tangled in amino acid imbalance, complicated fatty acids, sterols, hormones, lipoproteins, and vitamin-mineral interactions.

Profit Motives

In contrast, the techniques and accomplishments of the food promotion and advertising industries have become increasingly skillful.

The mad scramble for the consumer's food dollar becomes more intense each year. On a national level, food manufacturers firmly and at times, brilliantly establish their brand names and create their images through far-reaching mass media. At the local level, the homemaker is bombarded with newspaper ads, flyers, free samples, and posters. At the food market, package design, shelf spacing, colors—all are geared to the fraction of a second when a product might be sighted. If the housewife blinks as she moves past a shelf space, a sale may be lost. Still, the most important thing is the brand name and the identifiable package—identifiable in a fifth of a second.

With so much at stake, the large manufacturer cannot afford to be

careless in his advertising—and indeed rarely is. Just how far he will go is suggested by the following incident: One advertiser's study of dog owners had revealed a lack of specificity in the brand images of dog foods. Many people seemed to feel that just because one dog food was cheaper than some other dog foods, it wasn't as good. Consequently, it was felt that steps should be taken to improve the quality image, possibly by raising its price and to develop clear points of superiority or difference in the product itself.

In this connection, it was noted that a sizable group of dog owners seemed to suffer from "gnawing nutritional anxiety" about the food they gave their dogs. It was thought this anxiety might be allayed by new varieties of dog food. Several possibilities were suggested, including special dog foods containing eggs, extra protein, and what was described as health additives; a low-fat dog food for summer promotion; a dog food consisting of meat patties; and a dog food stew with vegetables. A number of ads were suggested—"New Brand X packs more protein than any other leading brand." Others headed "New dog food discovery has twice the protein of any other brand"; "Time to feed new summer dog food—fat reduced for hot-weather feeding"; "New dog food—the first 24-hour dog food with Protein Reserve"; and "Now—a dog food that strengthens teeth and fights decay —New Dog Food with Fluorides." It was suggested that the name be changed to "New Dog Food Prime". Prime is a natural as a brand name for a dog food because "it says meat, it says quality, it says health and it says it in one syllable".[1]

This shows how far an advertiser will go when economics is the only consideration. Unfortunately, this kind of thinking also determines many new products for human beings. I realize that there is just no comparison of the financial resources available to the two agencies being compared—the advertiser vs. the educator. After all the food industry spends about 11 billion dollars in advertising. But remember that educators have a captive audience of all the people between the ages of 6 and 17 and several million through college. Therefore, the educator has the advantage during the important formative years and the advertiser has the advantage before and after formal education.

Now advertisers are very astute in picking out research findings and educational concepts in order to adapt them to a promotion campaign. The publicity given to the findings of dietary surveys often based on food habit studies alone—the emphasis on vitamins in nutrition—the

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[1] Shaw, Spencer. "More smooch in the pooch", from This Amazing Advertising Business, by the editors of Fortune. *New York: Simon and Schuster. 1957.* (Pages 119–131.)

researches into the possible role of diet in heart disease—and the emphasis recently given to the importance of protein and amino acids in nutrition—may well be the underlying cause of a slow but steady approach to undue artificiality in our foods.

The National Research Council's Food and Nutrition Board and the American Medical Association's Council on Foods and Nutrition have laid down some fundamental concepts regarding the addition of specific nutrients to foods. These concepts are being ignored and nobody seems to be getting very excited about it.

Advertising Techniques

Let me tell you about our efforts to examine the advertising of the food industry in general. My staff has been carefully scrutinizing national food advertising looking for abuses in nutrition information. We have found that the vast majority of the responsible firms make no health claims at all. The order of the day is to use marvelous full color prints of the most attractive dishes imaginable, in order to build an irresistible image.

We applaud this practice, and the other currently popular appeal to mother's concern for her children. It is a little disappointing, though, that almost always when a nutritional claim is made or a nutrition story is told it is in some respect, incorrect or misleading. Here are some statements which have appeared in recent months which we believe tend to confuse the consumer.

The meat industry, for example, is finally being hit where it hurts the most—in the image—in the image of meat as the source of high-quality protein. Now that vegetable proteins can be mixed or supplemented with amino acids to yield a high-quality protein, food products so confected are being directly compared with meat and milk proteins. In the current campaign by the meat industry they have added two to the list of essential amino acids. One meat packer now states in his ad "Meat Protein is complete Protein—not all protein is! Meat Protein supplies a perfect balance of all ten of the essential aminos a body needs regularly."

Now notice what is said about nutritious oyster stew: "Gourmets have always prized oyster stew as delectable . . . superb! Invalids, octogenarians, and dieticians know oyster stew, loaded with vitamins, minerals, and glycogen, as the most nutritionally perfect food on the American table." Do you agree this is maybe a little far fetched?

Here is some public education about fresh oranges: "Many of the 50 known health values in a fresh orange are found mostly in the 'meat' of the fruit. In fact . . . fresh oranges provide 10 times more of the im-

portant *bio-flavonoids* and *protopectins* than frozen orange juice and fresh oranges give your family all of the vitamin C."

You will note that benefits to be derived from bio-flavonoids and pectins are no longer advertised. However, this is surely an excellent example of unwarranted implication.

Another example is taken from margarine advertising: "All your vitamin A in 3 pats a day." This margarine manufacturer carefully defines 3 pats as totaling 1.8 ounces. These are pretty fat pats! Three average pats of ordinary margarine total only 0.8 ounce. One would need 7 pats of average size to fill your minimum daily requirements for vitamin A with this product. Three average pats would contain only about 1,760 I.U. of vitamin A, a lot of vitamin A, but not "all your minimum daily requirements".

In theory an education equips one to distinguish between desire and need. Advertising, on the other hand, does not distinguish the difference. The only justification for an advertisement is to motivate a person to purchase a product by informing him of the product's merits. Of course, only promotion of real merits will assure continuing purchases. No ad can fool people indefinitely.

In a talk given to the Advertising and Selling course of the Advertising Club of New York, Walter Weir, chairman of Donehue and Coe, Inc., made a cogent point about the reason for truth in advertising, as follows:

"Why adhere strictly to the truth?" he asked. "Why not exaggerate —just a little? Keep within legal limits, of course, so you and your client will not be sued; but to be just a little more certain the copy will sell, why not claim just a little more than the product will or can do? They're only words you're using. And if the product doesn't move in the volume expected, some other agency will get the account. Besides, the overriding purpose of advertising is to sell.

"I'm sure you have had thoughts such as these running through your head at one time or another, If they seem a little rumpled and unsightly on the moral side, you found them completely proper and even correct on the economic side.

"Only they aren't.

"If you cause consumers to buy your client's product because of the claims you make for it—and, once they buy it, they find the product does not live up to those claims—obviously, they do not buy a second time. They turn to another product—and your client only suffers. It is a scientific, not a moral fact, that a lack in the product cannot possibly be compensated for by a lie in the advertising.

"It is for these reasons that I urge you, if you wish to create successful advertising, to stick to the facts, to eschew exaggeration, to avoid the little white lie no matter what your temptation to employ it. It doesn't work. No mater how much we wish to delude ourselves, we wind up

facing the inescapable facts of life. We confront reality—not life as we might like to imagine it. And advertising which deludes the public, which deceives it no matter how slightly, is unscientific, is advertising which flies in the face of reality."

There are a great many responsible firms who are doing a good job —but like the public health nutritionist—can do a better, far more important job. The food industry, in common with the nutritionist, is concerned about food faddists, and has excellent reason to help dispell misinformation about foods, if only for its own protection against irresponsible competitors. As the American Dairy Association recently pointed out, a growing problem of the food industry is "to keep from being lost in a welter of claims and counter-claims for 'miracle' products that are here today and gone tomorrow—gone with a big pocketful of consumer cash that will never, then, be used to buy the foods that have brought Americans their high level of good health and enjoyable eating—all this points up the need for supplying consumers with understandable food facts".

Blueprint for the Future

Well now, what should we be telling the consumer or the public and how should we go about it?

Obviously, at least a minimum knowledge of food values is essential in family meal planning. It is important to know some major food sources of the essential nutrients. It is important to know a number of acceptable substitutes for these major sources. It is important to know how to prepare foods containing vitamins and minerals that may be lost or are easily destroyed by heat and oxidation. It is important to know that most nutrients are needed every day—that they cannot be stored to any great extent in the body.

All of this can be boiled down to a simple concept: Eat a variety of foods every day, including citrus and other fruits; vegetables, including yellow and green leafy varieties; milk and other dairy products; meats, legumes, and enriched cereal foods. This concept is the foundation upon which to build a minimum, yet sound knowledge of foods and nutrition. It is the concept of the four-group food plan developed by the Harvard University Department of Nutrition and used almost country-wide. The U. S. Department of Agriculture has done the most to promote the basic 4 plan.

Nutritionists are, in a sense, food salesmen. They emphasize in their teachings the importance of foods as sources of nutrients. They highlight groups of foods which contribute similar nutrients. They tell

people how to prepare foods. Isn't this pretty much what the food industry also does?

Let us try to find a common ground upon which the educators and the advertisers can meet. The industry is helping to support nutrition research at an unprecedented level. Would everybody not also benefit from more support for nutrition education?

It appeared for a time following the 1958 National Food Conference that a National Institute of Nutrition Information might be born. There were at least three attempts. Finally, the National Farm Bureau Federation pulled things together and the National Food Conference was reborn under the banner of the National Youthpower Congress. This is a federation of trade associations and food industries dedicated to improve the nutritional status of teenagers by supplying program ideas and informational materials to state groups. I have been privileged to work with them and regret that I haven't had more time to devote to it. To me one important feature is that this group has agreed that it is undesirable to use the conference as a guise to sell surplus food.

This organization has tremendous potential, and can become a potent educational force. It already has organizations in most of the states. I believe that if our educational institutions, our food industries, and our advertising firms investigate this organizaiton, they would find it worthy of sincere help.

There is another significant development you may not be aware of. The Food and Nutrition Board has appointed a committee to survey what has already been done regarding attitudes toward food and nutrition, changes in food habits and dietary practices, and the teaching of nutrition to families and children. This committee has been charged to develop basic principles underlying sound nutrition procedures and provide guides on methods in nutrition education. It will need support and encouragement in its most difficult task.

Several industries have already established excellent programs designed to orient people towards making wise food selections and to orient people towards the achievement of an adequate diet. While many of the food trade associations narrow this program to a given class of foods, certain of them do an outstanding job of overall nutrition education. Their materials are creative, they are modern, they are sincere. The National Dairy Council, The American Institute of Baking, the National Livestock and Meat Board, the Wheat Flour Institute, are a few with which I am best acquainted.

Right here, among ourselves, there is tremendous untapped potential for clarifying the nutrition story for the public. As educators, we can

look for more creative approaches. If we are researchers, we can speak up if our findings are distorted after they leave the laboratory. If we are in important industrial or governmental positions, we can initiate and lend our support to better overall nutrition education programs.

In this country of abundance, everyone should be able to attain a high nutritional level. Teamwork and concerted efforts as exemplified in the dedication of the Food Research Building will accomplish much towards that end.

Modern taste panel equipment aids the food scientists in quality evaluations.

What Lies Ahead in Nutrition *

John B. Youmans
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Washington, D. C.

THE opportunity to speak on the subject of "What Lies Ahead in Nutrition" comes, I believe, at an unusually opportune time. I am reminded of a statement by Sir William Osler in his Galstonian Lecture of 1885, which an associate of mine recently brought to my attention, and which I would like to quote:

"It is of use from time to time to take stock, so to speak, of knowledge of a particular disease, to see exactly where we stand in regard to it, to inquire to what conclusions the accumulated facts seem to point, and to ascertain in what direction we may look for fruitful investigations in the future."

If we substitute "nutrition" for "disease", this statement, while not profound, is, I believe, particularly applicable at the present time in the field of nutrition for the following reasons. In nutrition today, we are at the end of one era and on the threshold of a new era. The present marks the end of a period which ushered in the age of the vitamin, the amino acids, and, to some degree, the trace minerals. It saw a decline of interest and research in the macronutrients, gastrointestinal digestion and absorption, and nitrogen balance as such. It became a time when discoveries of new vitamins popped like a string of fire crackers; when the nutritional etiology of diseases such as beriberi, scurvy, pellagra, rickets, and keratomalacia was established—almost, we thought, established in final detail; it witnessed the complete acceptance of the concept of deficiency disease—disease caused

* This material has been reviewed by the Office of The Surgeon General, Department of the Army, and there is no objection to its presentation and/or publication. This review does not imply any indorsement of the opinions advanced or any recommendation of such products as may be named.

not by a positive noxious agent, but by the absence or relative deficiency of a beneficial, a necessary, agent. Clinical signs and symptoms of diverse nature were confidently linked to deficiencies of single nutrients, though it was seen that some deficiency diseases could be multiple. It was a period of rapid advance, not only in the basic fields of physiology and biochemistry, but in clinical and public health nutriiton, resulting in a few years in such a diminution in the classical nutritional deficiency diseases, pellagra, scurvy, and rickets, that today little of them remains to be seen in many countries.

As was inevitable, progress slowed; inevitable because the mine which was being worked—that is, the concepts, the amount of basic knowledge, the techniques—became exhausted or the seam very thin. Some years ago, I predicted that no new major nutritional deficiency diseases would be discovered, that is, that no additional major disease would be found to be caused by a nutrient deficiency.[1] In general, that has been nearly true; but refinements have occurred.

Research in a given field of science does not progress at a steady rate but by intermittent periods of peaks and plateaus, and sometimes valleys. It is, however, the slack periods or plateaus which are the time of preparation for the rapid advance. It is a time when new ideas accumulate, when isolated facts are discovered, when relationships are recognized, when applications from other disciplines are made, and when techniques from technological advances become possible. Then, fission occurs, and there is a sudden, explosive advance. It is on the threshold of such an advance that we stand today.

Nutrition is such a broad subject and covers such a wide range of interests that, in discussing the shape of things to come, it is helpful and even necessary to limit myself to selected areas and to deal with each more or less separately, though there will be some overlapping. Also, since I do not possess a crystal ball, nor would be able to see anything in it if I had one, it will be impossible for me to define specifically what is ahead. Rather, I shall indicate the lines and directions along which study and research will probably proceed over the next quarter of a century, and I shall, when possible, offer some suggestions as to what may be the result of such research.

For our purposes today, I shall discuss nutrition in terms of the basic sciences, and clinical nutrition as it relates to the individual and to populations. There will be some overlapping, for basic research surely can be done with man as a test animal; but much of clinical

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[1] Youmans, J. B. Nutritional Deficiencies: Diagnosis and Treatment. *Philadelphia: J. B. Lippincott Co., 2nd Ed. 1943.*

nutrition is the application of new facts. However, research of this kind, such as epidemiological research, is respectable. I shall have little to say about agriculture or food technology as involved in preservation and processing.

It is fitting that I begin with the basic sciences, because it is to them that we look for the new knowledge which makes possible advance in the field of applied nutrition.

After a rather long period of quiescence, there is returning interest in the macronutrients. The great interest in atherosclerosis and degenerative disease of the heart and arteries has focused attention on the fats, fatty acids, and phospholipids. This interest, however, is becoming much wider than simply an interest in the amount and type of fat ingested and the levels of fat and related compounds in the blood stream. The entire story of fat in relation to nutrition and disease, including its absorption, its intermediary metabolism, its relation to blood clotting and to body composition in relation to such factors as sex, age, and senescence, and balance between it and other energy nutrients, is under study. Of significance in relation to the intimate metabolism of fats are the studies of fats and mitochondria of cells—particularly in the liver. It is significant that interest in fat has swung away from the essentiality of fat or fatty acids, and the disease process relating to their lack, to the abnormalities or harmful effects (direct and indirect) caused by "excessive" intakes, and by disorders which influence the metabolism of fatty acids or modify the deposition of fat in various organs. There is also renewed interest in fat as an immediate source of energy to tissues.

Much remains to be done in the field of proteins. Advance, I believe, centers around the individual amino acids. Quantitative requirements for man remain to be determined and, in particular, the interrelationships of the essential amino acids. Disorders of nutrition resulting from the effect of excessive intake of individual amino acids, or imbalances of two or more, will present both basic biochemical and clinical problems, as will what might be called the pharmacologic effects of the amino acids. An example of these complex relationships is the effect of leucine on blood sugar levels.

In the field of the carbohydrates, excessive intakes still remain of great importance and interest stimulated by studies of body composition to be referred to later. Again, however, interrelations of carbohydrates with other nutrients will receive attention, an example of which is the effect of carbohydrates on the utilization of lysine. In another direction, interest has been aroused in digestive mechanisms, particularly in

relation to the intestinal flora. Stimulated by certain observed discrepancies between apparent nutrient energy intake and physical state and performance, question has arisen concerning the posibility of utilization of cellulose by man. The possibility of an adaptive mechanism, perhaps arising from a dormant or vestigal ability in man, whose ability in this respect is usually considered nil, remains to be determined.

Among the vitamins, the mechanisms of the action of such important vitamins as A and C remain obscure. While considerable progress has been made recently in respect to C, vitamin A's mode of action as well as much concerning its interrelationships with carotene must still be discovered. The question arises, whether current methods of measuring vitamin A activity, such as blood levels and liver content, have any very close relation to the actual activity of the vitamin in the tissues.

Although the situation is more clear with respect to certain of the "B" vitamins because of their participation in enzyme systems, there is still a wide gap in our knowledge of how they act, or fail to act, in relation to such tissue changes as those seen in the lips, tongue, and skin.

Among the vitamins there still are several for which the requirement for man, primarily the quantitative requirement, remains unknown. Among them are vitamin K, folic acid, pyridoxine, and pantothenic acid. The essentiality of vitamin E and many other aspects of its relations to man, if any, are obscure. With the vitamins we again see large and important future fields of interest—interrelationships, imbalance, and their influence on enzymes. An example of the first is the influence of levels of intakes of vitamins A and E on the requirements of vitamin K.[2] Closely related are the antagonistic actions of isomers. The effect of pyridoxine on the depletion of certain enzymes is an example in the other field.

In the field of minerals much remains to be discovered. The role of many of the trace minerals must be defined and the current interest in magnesium in its relation to human nutrition is a good example. Recently, a new technique, at least new in its application to nutrition, namely, radioisotopic scanning of such organs as the liver, may make possible better quantitative studies of such minerals as zinc and man-

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[2] Mellette, S. J., and Leone, L. A. Influence of age, sex, strain of rat and fat-soluble vitamins on hemorragic syndromes in rats fed irradiated beef. *Read at Meeting of American Institute of Nutrition, Chicago, April 15, 1960.*

Matschner, J. T., and Dorsy, E. A., Jr. Role of vitamin A in nutritional hypothrombinemia in rats. *Read at Meeting of American Institute of Nutrition, Chicago, April 12, 1960.*

ganese. Studies of transmanganin are indicative of other studies which will enrich our knowledge of the trace minerals.

Interest need not be confined to trace minerals. After decades of research, the behavior of two, possibly the most studied minerals except perhaps iron, namely calcium and phosphorus, remains obscure, particularly in relation to bone. The recent symposium on calcium testifies to our lack of exact knowledge in this area.[3]

In clinical nutrition we can conveniently distinguish between nutrition related to the individual, often a patient, and nutrition concered with groups of individuals—public health nutrition or the nutrition of populations. However, the basic problems are essentially the same, varying somewhat according to areas of emphasis and techniques.

One area of clinical nutrition which is relatively new and of increasing interest and importance is that of genetically induced or inborn errors of metabolism, which may result in disturbances in nutrition, as a rule by blocking the chain of enzymatic action. Increasingly, efforts will be made to detect these instances for the insight they can bring to the mechanism of action of nutrients and hence to a wider understanding of nutrition. They may provide clues leading to better or even presently unavailable diagnostic tests. Although not of great clinical importance as cases of disease, because of their relative rarity, they may be more significant than appears at present because non-overt forms may exist in larger numbers. Also, they may serve to explain annoying and disturbing discrepancies in correlation of observations which cause trouble in interpretation of clinical and laboratory findings. This is an area where the clinician, working with the basic scientist, can contribute importantly to a better knowledge of nutrition.

One of the most important problems to be solved in the future in clinical nutrition is the relation of various physical (morphological) and functional (physiologic and biochemical) abnormalities to certain vitamins or combinations of vitamins, a deficiency of which has been thought to be the cause of these abnormalities. Certainly numerous surveys have failed to disclose a sufficiently close correlation between intakes of vitamin A, riboflavin, and ascorbic acid with hyperkeratoses, angular stomatitis, and gingivitis, to permit the use of the physical signs as satisfactorily reliable indices of deficiencies in these vitamins. This is not to say that these lesions do not occur as a result of such deficiencies. In individual instances and under small, closely controlled experimental conditions, their connection seems clearly established. However, because of variations in severity, lack or weakness of spe-

[3] Symposium on Effects of High Calcium Intakes. *Federation Proc.*, **18**:*1075, 1959.*

cificity, and lack of understanding of the basic biochemical mechanism causing the lesions, these physical signs are unreliable for certain diagnosis. The lack of understanding of basic biologic mechanisms is well exemplified by the relation between vitamin A and perifollicular hyperkeratosis and it seems likely that a greater knowledge concerning the mode of action of vitamin A locally without reference to blood levels, and a clarification of the exact role of carotene, may be the line of investigation which will explain the relationship. In addition to these examples, there remain many other opportunities to link physical signs with nutritional disorders as well as to discover abnormal functions and tests for them which are reliable and can be used clinically in medical practice as well as in the surveys of nutrition of populations.

Reference has already been made to body composition in discussing fat and fatty acids. In clinical nutrition the body composition is of importance in determining the state of nutrition in relation to energy intake and in relation of fat to lean body mass. Although present methods of measuring lean body mass and, conversely, the amount and percentage of fat, are too complicated to be useful in ordinary clinical practice or in nutrition surveys, it may be that, by proper selection and measurement, standards can be set up which will make it possible to use indices which will give approximate values. Combined with this, studies of body composition in relation to age, sex, morbidity, stature, and morphology, as well as dietary patterns, may lead the way to better dietaries. Related to this is the development of standards of weight, for body weight remains the most practical clinical measure of over-all nutrition as far as body mass is concerned. It is well nigh incredible that as of the present no suitable standards of proper weight related to age, sex, and in particular body build, exist. One of the first tasks of the future undoubtedly is to devise more accurate and suitable standards of this nature. It should be noted that such standards would be as useful, if not more useful, in detecting true overweight or obesity, as in detecting undernutrition.

In discussing body composition, so far, I have related it simply to fat and lean body (muscle and skeletal) mass, protein and fat as such, and nutritionally relating to the energy and protein components of the diet. There are other aspects of body composition, however, which are important and new techniques which are going to make it possible to measure them. I refer to the electrolytes and in particular to potassium. Using whole body counters for measuring radioactivity, it is possible to determine the total body content of this electrolyte and already such information is being used not only to measure certain compart-

ments of body mass, but as a means of studying the process of aging under varying conditions.

In the past, efforts to relate disorders of nutrition, notably nutritional deficiency disease, to other disease, especially infectious disease, have been singularly unrewarding. In the future, there will be increasing interest and work on such relationships both as an etiologic factor and in relation to complicating and sequential illness. An outstanding example forecasting future developments is the growing realization of the probably important role of nutrition in cholera, the essential manifestations of which are not well explained by current concepts, and knowledge of the pathogenesis of the disease and infectious disease in general. Only this week in Atlantic City, a paper was read relating the intake of dietary fat to familial Mediterranean Fever, perhaps another example of an inborn area of metabolism.[4]

Before coming to my final major point of discussion of "things to come", I wish to mention three techniques for the study of nutrition which, in the future, will do much to alter our knowledge of nutrition in many of its aspects. I refer to the use of germ-free animals and of simplified, purified "chemical" diets in man. Neither technique is altogether new but have to date been mainly in the development state and have by no means reached their greatest usefulness and importance. The important beneficial as well as harmful influences of the flora of the gastro-intestinal tract in animals and man is well recognized, but to distinguish the various factors and elements has been difficult if not impossible until recently. With germ-free animals, it is not only possible to determine the effect of a lack of intestinal organisms but to discover the effect of providing one or more selected organisms, not only *per se* but under an infinite number of conditions. So far, important observations have been made, some of them according to predictions but others of a strikingly paradoxical character. Recent developments may make it possible to conduct without danger similar observations on human subjects under controlled conditions.

The use of synthetic diets in man offers somewhat the same opportunities in the sense that they make it possible to study in a more effective manner the influence and effect of chemically pure, individual nutrients in a variety of relationships, which will help to unravel the mysteries of the multiple and combined action of nutrients. Although planned primarily with their use in space in mind, they offer much

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[4] Mellinkoff, S. M., Schwabe, A. D., and Lawrence, J. S. A dietary treatment of familial Mediterranean Fever. To be published in the *Proceedings 73rd Ann. Meet. Association of American Physicians (held at Atlantic City, May 3, 1960)*.

promise for the study of nutrition under more prosaic terrestrial conditions.

I cannot close this part of the discussion without referring to the great influence which the phenomenal advance in instrumentation will exert in the future.

I come now to the last item of my discussion of nutrition in the future. You may have noted as I have talked certain recurring themes which may be indicative of the direction nutrition and nutrition research will take in the years to come. One is the merging of nutrition with general metabolism, so that nutritional disease tends to become more a part of general internal medicine. There is increasing emphasis on the individual. There is a growing awareness of its relation to other disease. In the field of public health nutrition, there is an increasing interest in the need to obtain greater specificity in relation to cause and effect.

Also, it will have been noted that much of what I have said and discussed has had to do with the positive side of nutrition, i.e., overnutrition, such as obesity, and in respect to other nutrients than calories. This is in distinct contrast to the situation some 30 or 40 years ago. As I have pointed out, that time ushered in an era characterized by the concept of disease due to the absence of something, a nutrient, the concept of "deficiency disease". We have now perhaps come to a reversal. I am rather firmly convinced that the most important problem to come in nutrition in the coming years is that of overnutrition. To some this may be as hard to realize and accept as that of a deficiency state. In some respects it should not be. The disease obesity and its danger are relatively well recognized and appreciated by the majority of people. To those concerned, to some extent perhaps overconcerned, with the undernourished in many lands, the concept of overnutrition, at least on a massive, worldwide basis, may seem fantastic. Yet, I predict that within the next 40 years malnutrition and starvation in their usual sense will be reduced in the world to the relatively small amount which tends to persist, because of a variety of complex causes, in even such a prosperous nation as ours. To the prosperous, well fed person, to whom a liberal if not an abundant available food supply is to some degree an unconscious measure of success, an overweight of 10 pounds may seem scarcely to deserve the designation of nutritional disease. Yet such a situation does to some extent exist and will exist increasingly, unless prevented.

I am, however, more concerned with a more subtle effect of overnutrition. I refer to its effect on senescence and the aging process. I

have written of this in more detail elsewhere.[5] Others have added their voice and their evidence to the thesis. Here I shall only sketch the main outlines of the potentials as I see them.

The key points in the picture are the word "optimum" and the "definition of optimum" as it relates to nutrition and, in particular, to human nutrition. Today, so far as I know, no one knows what is meant by optimum nutrition—of one or more, or all nutrients—or the effect of optimum nutrition. The purpose of good nutrition and of optimum nutrition varies with the subject. For milk cows it could be said that optimum nutrition is that which would provide the earliest, largest, and longest output of milk of the desired sort (butter fat) at a suitable cost ratio. For a pig the optimum nutrition would be that which produces a pig of the best weight and composition of flesh in the shortest time at a suitable cost. For a beef animal it is similar to that for a pig. For race horses, physical performance, speed and endurance as well as sound underpinning combined with large size and early maturity, are the desiderata. For all breeding stock there are special requirements.

What are the objectives for man? Positive health, freedom from disease, physical perfection, and a long life and happiness are likely goals. So far, it has been almost impossible to determine the influence of nutrition in producing such results, except to some extent the absence of deficiency disease, because of the influence of other factors, notably disease not of a nutritional nature. In particular it has been impossible to describe the optimum nutrition. It is also impossible, or at least it has not yet been done, to describe the optimum in terms of physical perfection and long life. How large or small should we be, how long should we live? The posible answer to the latter is "as long as we are healthy, physically active, and happy". No one knows how long man can live and still have these attributes. But does it possibly have any relation to size or physical development? At present we are concerned —greatly concerned—over the increasing incidence of degenerative disease, mainly of the cardiovascular system, and death at early ages. This despite, but made more apparent, by declines in other causes of death, notably infectious disease. Is this related to body size and development? Possibly. There are theories but only bits of evidence. Clues may be seen in the following.[6] Underfed rats live longer, as shown

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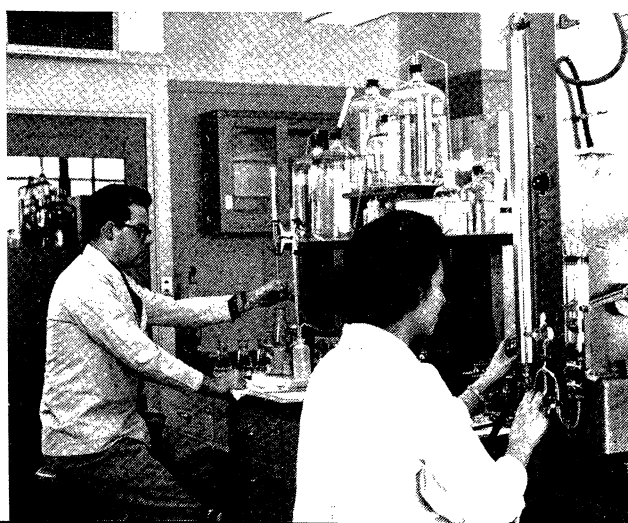
[5] Youmans, J. B. Nutrition, aging, and longevity. *Proc. 40th Ann. Meet. Medical Sec., American Life Convention, 1952.*

[6] See footnote 5.

by McKay. Small, lean people live longer. Rings on certain stunted, undernourished trees indicate a much longer life than that of more fortunate trees of the same species. On the other hand, the populations of many fortunate countries, including our own, show increasing size of the individuals of the population and, to some extent, more *rapid* growth. Overweight girls have been shown to mature at an earlier age as measured by the menarche, and the children of well-fed populations show an earlier closure of the epiphysis. On the other hand, children underfed or undernourished have a delay in the closure of the epiphysis and reach their "normal" size at a later chronological age.

What determines one's natural maximum age? Aside from certain influences of heredity, is it determined and indeed predetermined (except as modified by external influences) by such a "time" mechanism as maturation? If so, would not early maturation result in early senescence and might not nutrition affect the occurrence of the maturing action? I know that an answer to such questions cannot be given now; but perhaps such an answer may be one of the things "that lies ahead in nutrition".



Studies on apple slice respiration following irradiation.

PART II. FOOD AND WELFARE

Presiding: CHARLES E. PALM, *Dean, New York State College of Agriculture*

Introductory Remarks

By William I. Myers

Professor Emeritus, Farm Finance, and former Dean, New York State College of Agriculture

IN 1941, Vice President Henry Wallace, after a visit to Mexico, suggested to President Fosdick of the Rockefeller Foundation that the economic status of that country would be raised if some organization could help them to improve their food production by modern scientific methods. The idea appealed to the officers and trustees of the Foundation and a committee of three distinguished agricultural scientists was sent to Mexico to investigate the situation. This group included Professors E. C. Stakman of Minnesota, Paul Mangelsdorf of Harvard, and Richard Bradfield of Cornell.

The recommendations of the committee were favorable, the Mexican government issued a cordial invitation, and in 1943 a modest agricultural program was established in cooperation with the government. One of the major parts of this program was an operating group of well-trained scientists to demonstrate on the spot modern scientific methods of increasing production of crops by plant breeding, fertilizers, and pest control. The other was a program to train young men of Mexico and other Latin countries to carry on such a program themselves as soon as possible.

The Mexican program has grown steadily over the intervening years in spite of periodic changes in political government. Vice President Wallace's observation was correct. The striking improvement in food production, especially wheat, corn, beans, and potatoes, has released foreign exchange formerly required for food imports and has stimu-

lated economic progress. Increasing responsibility has been given to young trained Mexican scientists as they became available and some parts of the program are now being handled entirely by them.

The success of the Mexican program led to requests for similar help from many other Latin American countries. In response, operating units of scientists were established in Colombia in 1949 and in Chile in 1955. In addition, a program of grants and fellowships has been provided for other countries of Latin America to strengthen research and education in sciences related to agriculture.

More recently, the Rockefeller Foundation agricultural program has been extended to the Far East, again after investigation and favorable recommendation by Doctor Bradfield and Dr. R. F. Chandler. First a program of fellowships and grants-in-aid was provided for the Philippines, Japan, and India. In 1958 the Foundation accepted responsibility for staffing and advising the postgraduate school at the Indian Agricultural Research Institute at New Delhi. And in 1960 the International Rice Research Institute was established at Los Banos in the Philippines as a joint project of the Ford and Rockefeller Foundations.

The leader of this agricultural program from a small beginning in Mexico in 1943 to the present worldwide scope is our speaker, Dr. J. G. Harrar. He was born in Ohio, obtained his A.B. at Oberlin, his M.S. at Iowa State, and his Ph.D. at Minnesota in 1935. Prior to getting his doctor's degree he spent four years as Professor of the Department of Biology of the University of Puerto Rico. After completing his graduate work he spent six years at Virginia Polytechnic Institute, serving successively as Assistant Professor, Associate Profesor, and Professor of Biology; and two years as head of the Department of Plant Pathology, Washington State College. He is the author of many scientific publications and has received honors too numerous to enumerate.

In quality of staff, in dedication of purpose, in effective cooperation, and in scientific achievement, the agricultural program of the Rockefeller Foundation is the finest example of technical cooperation in the world today. The success of this program, as of any other, is due to many factors: The encouragement and support of former President Fosdick, Dr. Warren Weaver, President Rusk, and other associates; the high standards of the Rockefeller Foundation; and the dedicated service of many able scientific associates.

A generous share of the credit for these achievements is due to the leadership, the ideas, the imagination, the diplomacy, the drive, the hard work, and the philosophy of the man who served as Director from 1943 to 1960. In addition to these duties, during the past year he has served as Executive Director of the Committee on Subtropical Africa for the National Academy of Sciences. I am glad to introduce Dr. J. George Harrar, Vice President of the Rockefeller Foundation, a scientist with a worldwide experience and outlook.

Food in National and International Welfare

J. G. Harrar
Vice President of the Rockefeller Foundation

AMERICANS today are the best fed people in the world. Thanks to our rich natural resources and their efficient utilization by agriculture and industry, we enjoy an unlimited and continuous variety of appetizing and high-quality domestic and exotic foods. Thus, to many persons, it is almost inconceivable that serious limitations on available food supplies are anywhere a major factor in human health and welfare. In the presence of abundance it is difficult to realize that more than one-half of the 2.8 billion inhabitants of the earth are undernourished. As Americans, we are indignant that this is the case and generous with our contributions for aid to our less fortunate neighbors.

Much has been spoken and written on the subject of world food supplies and numerous action programs have been initiated to help ameliorate human want. While I fully share the concern that many feel at the shocking disparity in standards of living throughout the world, I am equally preoccupied by the necessity for emphasis on the total spectrum of the problems of the less advanced nations.

Although gifts of food and, more particularly, the establishment of sound programs directed toward increased local food supplies are of great value in a variety of ways, it is unrealistic to assume that these efforts alone are a solution to the problems of the food-deficient nations. Certainly adequate food supplies and happiness are not equated in our society. We all recognize the absolute necessity for an adequate diet as basic to the enjoyment of a healthy, productive, and satisfying existence, but we do not think of food as the goal of humanity. Our own sophistication should make us aware of the fact that the solution of the imbalance in food resources among nations is only

one of the many vital considerations which underlie the goal of international peace and prosperity.

We are told that a hungry people is an unhappy people, prone to ill health and limited life expectancy during which they are susceptible to any ideology appearing to offer hope for the improvement of their lot. With this thesis I would agree, but would add that well-fed prisoners are rarely contented whether their fetters be chains of iron or those of hopelessness. When food is the critically limiting factor, it is obvious that attention to this need is basic, but unless appropriate measures are taken to provide opportunities for self-improvement, the distribution of food surpluses merely puts a comma in a life sentence.

As a prelude to broader considerations, I should like to comment on agriculture as related to world food supplies. The invention of agriculture was the single accomplishment which permitted man to establish stable communities, create social structures, and bring about division of labor for the common good. Now some 10,000 years after the beginnings of husbandry, there are in the world today substantial numbers of social groups whose food-gathering habits encompass the entire evolutionary history of agricultural practice. There are tribes who still pursue their food and are limited to those aliments that they can gather or catch; some dwell in the nomadic state, and others exist in the most primitive forms of agrarian societies. Still others have progressed to the use of hand implements, animal power, and a few elementary machines. In its most advanced state, agriculture takes maximum advantage of power-driven equipment for every facet of production in conjunction with soil amendments and a variety of chemicals essential to the protection of crops and livestock and the processing and preservation of their products.

Agriculture has never been an easy way of life. Primitive farmers, who gradually learned to cultivate indigenous plant species and to domesticate a few forms of wild animal life, found it necessary to put in long, arduous hours of labor in order to produce adequate food supplies for family and community needs. And the heavy physical labor and long hours traditionally associated with the practice of agriculture still persist in much of the world. The concept that food production, especially in the humid tropics, is so facile that farmers in these areas develop habits of indolence is erroneous. Serious public health problems and improper diet have been largely responsible for limiting the physical capabilities of rural populations in the tropics and this fact, in conjunction with the lack of adequate equipment and facilities, has resulted in excessive manpower requirements and low yields.

In spite of the almost insurmountable difficulties confronting primitive farmers, some have shown great ingenuity in reaching the solution to formidable obstacles. An early technique for the utilization of land too steep to plow was the construction of terraces. These often were carefully engineered and required enormous investments in time, manpower, and skill for their construction and maintenance. Striking examples of this are still apparent in Ceylon, the Philippines, Lebanon, and elsewhere. A still more highly developed form of terracing is apparent today in much of the rice bowl of Asia, where paddies are carried up sloping terrain in a beautifully engineered fashion. Certain dwellers in arid or semi-arid regions, faced with the choice of migrating, existing as nomads, or developing engineering techniques to collect and utilize efficiently all available moisture, chose the latter. Their success in this endeavor is clearly manifest in the catchment and irrigation systems developed by the early civilizations in the Middle East and by the Mayas and Incas in the Western Hemisphere.

A most interesting and important result of the migrations and agricultural activities of earlier civilizations was the distribution of crop species and domesticated animals from their places of origin throughout the world. Although it might be expected that indigenous crop species would be primarily confined to those areas in which they occur in nature, this is not the case. Over the centuries, society has selected approximately a dozen plants as the sources of two-thirds of all human food. This selection is not based on origin, but rather upon palatability, adaptability, and productivity. Thus wheat, which has an Afro-Asian origin, is the most widely planted crop in the world wherever it can be grown. Sorghum, another African crop, has become increasingly important in the Western Hemisphere during the past 50 years. Rice, with its origins in Asia, is still grown most intensively in the so-called "rice bowl" of Asia, but it has become widespread in most of those countries in which it can be successfully propagated. Maize, potatoes, and sweet potatoes, all of American origin, are especially important in the Western Hemisphere but have been widely accepted and utilized in a variety of forms in most of the temperate and tropical countries. Finally, the soybean, which has been of such great significance in feeding the Far East, has found a place in many countries of the West with significant benefits. The fact that rice, wheat, corn, sorghum, potatoes, and the pulses are internationally popular makes it somewhat simpler to help those in need through the distribution of surpluses of these foods to areas in which they are known and desired.

It is frequently stated that the general application of Western tech-

nology to agricultural production on a worldwide basis would readily result in doubling or even tripling annual food production. There is little doubt that this statement is accurate, but there is no possibility that this goal could be realized within any foreseeable period of time. The evolution of agricultural technology depends in the first instance upon the availability of adequate national resources and their rational utilization. Thus, countries may be barred from attaining satisfactory production levels by size, climate, physiography, and the size and development of indigenous populations. Political boundaries are at best illogical and the course of history has produced countries of tremendous size and potentialities at one extreme and at the other those that are so minute as to be virtually microscopic communities surrounded by larger nations. Only under exceptional circumstances is it possible for these small nations to provide any substantial fraction of their total food requirements. Countries whose climate is too cold or too dry, or whose terrain is unsuited to agriculture, or whose natural resources are severely limited do not find it possible to develop a stable agricultural pattern to provide food for the nation and surpluses for trade purposes. Finally, there are areas where the populations are so sparse and scattered that there is an inadequate labor force for agricultural purposes, in contrast to others where population pressures are so intense that it has become the practice to divide and sub-divide each job in an effort to give a modicum of employment to as many persons as possible.

It is futile to speculate on the possibilities of any sort of crash effort to convert the less well-developed countries to Western levels of agricultural technology in a short time span. The vital role of adequate natural resources has already been described, but of equal importance is the educational level of the agricultural labor force. In too much of the world little or no education in the Western sense is available to the rural populations. Thus they would be unable to take full advantage of the technologies of modern agriculture even if they were to become immediately available to them. In fact, the lack of understanding as to the necessity of maintaining a balance between natural resources and production is bringing about the gradual destruction of important resources. Shifting patterns of cultivation, the indiscriminate use of fire, overgrazing, monoculture, and other practices which lead to the exhaustion of soil fertility, erosion, stream pollution, and the destruction of forests and pastures have proceeded apace in many areas.

Educational deficiencies manifest themselves in every facet of social organization. Public administration for the planning of national development and the use of mineral and other resources, the establish-

ment of school systems, communication, transportation, and the encouragement of agriculture and industry must depend upon sufficient numbers of well-trained leaders. Public health measures cannot be successfully instituted without trained professionals and a public educated to accept these benefits. Today, progress in many areas is severely limited by the destructive effects of many diseases that have been brought under control elsewhere. Smallpox, yellow fever, tuberculosis, Bilharzia, and malaria, as well as numerous parasites, are responsible for the death of untold thousands and the ill health of millions more. Serious as are the diseases themselves, they are made more so by the fact that their victims are usually undernourished and thus without the natural defenses of healthy bodies. When this condition prevails from childhood, morbidity figures are high and life expectancy figures are low. One of the saddest direct products of malnutrition is the number of children whose symptoms of Kwashiorkor and other deficiency diseases signal the melancholy future.

Against this background, the more fortunate nations can not hope to feed the rest of the world even for a short period of time. Neither can they expect to fill quickly the void in the education and understanding of millions of the underprivileged. Whether we like it or not, millions are doomed to live and die much as did their forebears. However, help can and is being provided in many ways. Gifts of food and other supplies are helpful as emergency measures and loans are extremely useful in support of economic development. More important still are efforts directed to the training of nationals to serve their country's needs. This requires maximum effort and the support of indigenous programs for the education and training of personnel and collateral programs to provide training abroad for selected individuals who will become teachers, lawyers, economists, physicians, engineers, and others during the years to come.

Special circumstances have thrown upon the United States a heavy and disproportionate burden in foreign aid since World War II. We can not be expected to bear this same proportion of the needs of the decades ahead. Other countries are in a position to make a larger effort to meet the technical and capital requirements of the less developed areas. Certainly United Nations organizations are important instruments of foreign aid and should be further strengthened, but there is need for many more bilateral and multilateral programs as well as for others under the auspices of private organizations. Effort must be made to bring more emphasis to bear on all forms of technical aid to assure that these are catalytic individually and synergistic in concert. It is not necessary for each underdeveloped nation to repeat all of the stages of

development which lie between its present state and modern standards, but the rate of progress will inevitably be conditioned by the speed at which educational progress toward stable and organized social patterns occurs.

Thus far I have not discussed the more distant future, but rather have confined my remarks to the present and immediate future. I do so in the belief that if the world can not learn to resolve the fundamental problems which face it now, worry about the future may be a fruitless exercise. Many are greatly preoccupied about explosive increases in population and available future food supplies. I think we should be equally worried about the present. The world is not now feeding its present population properly, so that future calculations must be extrapolated from failure.

I have complete faith that continuing research and its applications will result in technological advances even more dramatic than those of the past 40 years. I believe also that many countries will, during the next several decades, make tremendous advances toward a reasonable degree of self-sufficiency. Thus, while there will still be hardship and misery for millions during the years to come, I believe that if we can avoid war or economic exhaustion from massive armament efforts, the world will gradually approach a better balance between the nations of the world with benefit to all.

On the other hand, the arithmetic of population increase is incontrovertible. As standards of health and comfort improve, life span increases and infant mortality decreases. I think no one denies that this means a growing population. I find neither profit nor comfort in the discussion of the issues as currently drawn. To me the issue is not sectarian, but simply human. Since biological laws are immutable, in the absence of catastrophe, population will increase rapidly. This increase will continue to place greater and greater pressure on available food supplies and dwellings, on technology for the production of goods and full employment, on transportation, and on the land itself. I think that for many years to come we can at least maintain and perhaps even improve our present position. Eventually, however, society must decide on the sort of world it wishes to live in. Our great cities have already created more human problems than they have resolved. Our conquest of physical disease is apparently being neutralized by the increase of mental ills and we have not learned to live at peace with our neighbors. Vastly increased numbers of persons will inevitably further complicate and compound our problems. Ultimately, we must decide to stabilize world populations at a level compatible with human dignity and prosperity or suffer the chaotic consequences which will surely follow.

PART III. THE DEDICATION CEREMONY

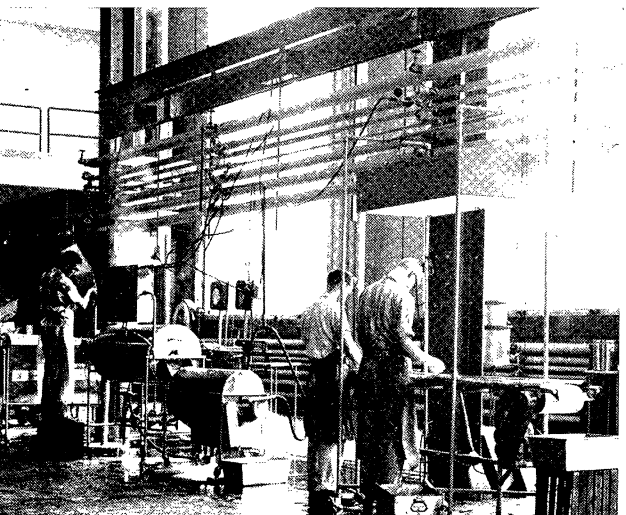
Presiding: DEANE W. MALOTT, *President of Cornell University*

PRESIDENT MALOTT: This is one of those very happy occasions when we put a new facility into use for purposes of great importance to the future of education, of science and research, and of the economy of the State of New York. We have a long program, and without any further remarks I shall present the speakers who are listed in the program.

Dr. Thomas H. Hamilton is one of the newest administrators of New York State and presides over one of the country's largest and most complicated educational institutions—The State University of New York—functioning on many campuses throughout the State.

Educated at DePauw and the University of Chicago, he has taught at Lawrence College in Wisconsin, Chatham College in Pennsylvania, the University of Chicago, and Michigan State University where he was Vice-President for Academic Affairs.

We welcome President Hamilton on this occasion, as our colleague through our Contract College responsibilities, by which Cornell and the State University jointly serve the people of New York State.



Pilot plant line for processing peas.

Research and the Commonwealth

Thomas H. Hamilton
President of the State University of New York

IT is personally gratifying to be associated with an institution and with a State which together could cause to be built the structure which is the object of our attention today. I am still sufficiently naive architecturally to view with wonder a building of such dimensions, utility—and yes, beauty. And it is a thing of beauty, not only in its form and proportions—but, additionally, as the embodiment of an idea. Viewed in this larger way, it seems to me that it attains its ultimate significance as it contributes to and serves the end for which it was designed, and as it relates that end to the agency which caused it to be built. The end I speak of is man's study of nature; the agency is, of course, the State of New York.

The fact that the public, through its representatives, should choose to invest four million dollars to facilitate research does not strike most of us as either novel or inappropriate, and I would agree that it is neither. However, in this day of expanding governmental services—when the demands for highways and hospitals and a host of other things mount—there are, indeed, some who would question its wisdom. These people might even concede that research is important, but they would have us believe that it can be more suitably fostered by private citizens, either individually or through philanthropic foundations. And, of course, the arguments which can be marshalled in support of this position are numerous.

The first of these is characterized by a kind of arch-conservatism. It says, in effect, that "it never used to be done this way and so why start now"? And this point of view is both right and wrong; it is wrong when you consider that this Experiment Station in Geneva has represented the research interests of the State of New York for nearly 80

years and that the land-grant colleges and universities are about to celebrate the hundredth birthday of the legislation which brought them into being. But it is right when you look down the much longer corridor of recorded history. In fact, it can be said that prior to the foundation of public universities there was no such thing as public support for the creative research scientist. For centuries he was left to his own devices, to cadge a shilling or a mark where he might find it and to let out the tentacles of his inquiring mind so long and so far as his imagination and his money would allow. Asking questions with the hope of finding answers was a luxurious pastime before the nineteenth century. If a poor man had an idea which he felt compelled to explore, he was forced to watch it wither before his eyes, unless he could somehow attract the favor of a wealthy patron. Research was necessarily the province of the man of means and could be conducted only in those hours of the day which an independent income set aside as free. Newton's researches were made largely in his own home, and Sir Robert Boyle investigated the elasticity of gases, not just because he possessed an inquiring mind, but because he possessed a sizable estate to go along with it. To look at an earlier age, I think it would be safe to say that had it not been for the court of Florence, Galileo's name would be unknown to us today.

Of course, the Renaissance concept of patronage was a grand and glorious thing and it is directly responsible for much that we cherish in our cultural tradition. Based upon a love of man and a legitimate pride in man's creative ability, it fostered the experiments of scientists just as it encouraged the poet's sonnets and the madrigals of the court musician. But it was necessarily sporadic and inconsistent. It belonged to an age long past and it fitted the graceful, aristocratic temper of that age very well.

But our world is a far different thing in many respects, and can no longer stand patiently by in hopes that a truly creative mind will, through blessed accident, come by the means to support its exploration of the unknown and unguessed. It is the nature of science that the answer to a question asked tends to generate, in geometrical fashion, still other questions and other problems. And at this point in time, after a century of prolific scientific activity, our world is filled to overflowing with problems challenging to the mind of man and whose solution will, it is hoped, redound to the general welfare. This very building which today we dedicate will be utilized by men devoted to the solution of one of the world's pressing problems, the problem of food supply for growing numbers of human beings. I would maintain that

we have neither the leisure nor the heartlessness to forsake a systematic and well-supported investigation of this subject on the off-chance that it will be supported in another way.

Now my imaginary antagonist would probably concede all this, but he would point out that I had missed his meaning. He would grant that the machinery and support of basic and applied research were far too important and too expensive to be left to the unsystematic efforts of individual men—he would acknowledge that hospitals would be little more than rest homes without the remarkable findings of medical research, and that our national posture in the world would be disappointingly different than it is if the secrets of the atom had remained undisclosed. But he would point out that the great resources of our private enterprise system can achieve this systematic approach, and he would direct my attention to the millions of research dollars that annually are invested by our industrial and business firms. And, of course, the truth of this would stagger me.

Being a ruthless fellow, he would doubtless follow this up by asking if the public universities did not have enough to do in this day and age simply in discharging their teaching responsibilities. And I would have to admit that it appears that they have more than enough to do. Why, then, should the public university spend public funds on research which industry can do equally well? While there are a number of answers to this question, perhaps the most important one is that if and when the universities stop doing research, they simultaneously stop being universities. It is a misguided notion that would isolate teaching what is known from finding out what is not. As Whitehead has reminded us, knowledge or truth cannot be thought of as an inert thing, a static mass of meaning which is susceptible to a single process of ingestion. The professor who attempts to live his academic life off the fat of his doctoral thesis soon finds both his students and himself subsisting on a sub-standard intellectual diet. The university community, and all who belong to it, must share a commitment to preserve and profess what is known, to discover the new at the same time, and to bring order and coherence to both. If it is nothing else, the university is a microcosm of the learning society, and this means that its devotion to learning must be shared by both students and faculty. Without research, a university ceases to be a university.

It has been observed,[1] too, that whereas the basic motive behind successful industry is, quite properly, to provide service for a profit,

[1] C. A. Elvehjem. Basic Research and the State University. *Symposium on Basic Research, Amer. Assoc. for Advancement of Science, 1959, page 95.*

the basic motive of the university is to discover and test the truth of things. The implications of this difference are far-reaching. Industry has concluded that at least three to five years are required before there are dividends from any one research project. On top of this, it is estimated that only one project in eight is ever considered successful. The important thing here is not that this ratio may act as a deterrent to industrial research as such, but rather in the particular definition which industry must give to success. The success of such a research project must necessarily be measured in terms of the market value of the product to be affected. The project cannot be so judged until its expense has been covered by the profits realized from its implementation. On the other hand, the university seldom takes note of the percentage of experiments that fail to turn out in the way they thought they would. As a matter of fact, negative results are often considered as important as positive results, for in either case the end of the university has been served—*knowledge* has been gained; the idea is true or it is false. In the lexicon of the university, profit is knowledge.

I believe it is axiomatic not only that the universities must do research, but that they are the best places in which the best research can be done. It is in the university that one should most likely find the atmosphere of freedom so essential to the inquiring mind. Here is an institution which recognizes the power and nobility of ideas and which, as a consequence, orders its values in such a way as to give first priority to truth for its own sake. In this sense, it is our society's counterpart to the private patron of the sixteenth century. To it come men and women who have recognized that it is more ennobling, more essential to their deepest need, to accumulate knowledge than amass material goods; who ask for little beyond the freedom to try out their thinking and the support and encouragement of their fellow citizens.

Today, in dedicating this facility, we are, in effect, bearing concrete testimony to the keen interest which the citizens of this State have manifested in research. We would be less than forthright if we did not recognize that the public which raised this building and which will support its tenants, has done so with the expectation of material benefits to itself. And there *will* be benefits, of a scope and nature which, though hard to predict, will without doubt extend beyond the borders of this State to reach the farthest corners of the world.

But I shall persist in the belief that, by and large, the members of our society have higher motives for their support; that each of us, however haltingly, recognizes that the most distinctively human characteristic of man is his capacity to add to the store of knowledge which

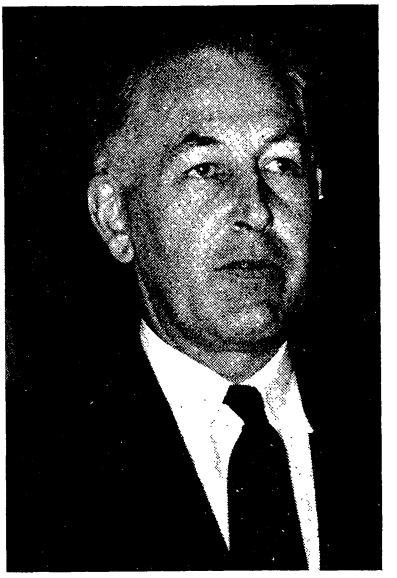
is his inheritance; that a generation fails of its human promise when it merely conserves the old. The questions we ask of life, the large and the small, the profound and the elemental, are asked by everyone of us. We mislead ourselves when we suppose that only the professional is curious. We *all* question and formulate answers with varying degrees of success and this is precisely the reason why each individual man has assigned to his collective embodiment—the state—the obligation to assist and support those who give most promise of arriving at the truth of things. It is, thus, through the research agency of the state, the public university, that each citizen is permitted to share in the process of discovery which is his human right and necessity.

I cannot but conclude that this is rationale enough for the investment we see before us . . . for it is an investment, not just in brick and mortar, but in hope and faith in the seemingly unlimited capacity of man to find things out about himself and his world. Human beings only rarely have a more ennobling purpose, the state, seldom a more solemn and fruitful responsibility.

reparing samples for taste anel. A well-equipped test chen is also available.

The Significance of Agricultural Research in the Development of an Improved Food Supply

Erwin L. Peterson
Assistant Secretary, United States Department of Agriculture



PRESIDENT MALOTT: From Washington comes to our campus here today the Honorable Erwin L. Peterson, Assistant Secretary of Agriculture. He has been in charge of Federal-State relationships in the Department since 1954, and has under his cognizance the supervision of the Agricultural Conservation Program Service, the Agricultural Research Service, the Farmers Cooperative Service, the Federal Extension Service, the Forest Service, and the Soil Conservation Service.

With all of these responsibilities of his, we are honored indeed that he has been willing and able to give his time and energy to our program here today.

I AM honored for the privilege of participating with you in these ceremonies dedicating this fine new food research facility.

Cornell University and the people of New York State are to be congratulated for the vision and support which makes this new laboratory possible.

All of us take justifiable pride in this modern addition to our physical capacity for the conduct of agricultural research. We are even more proud of the system of research and education of which it is a part—of the Land-Grant College and University System. The idea which generated this organization has proved to be one of the most unique and fruitful ever conceived. This idea recognized that knowledge, particularly scientific knowledge, could be practically applied to provide better living conditions and a fuller life for the people of a young and growing nation.

It recognized that the accomplishment of this purpose required the wide dissemination of such knowledge; that mechanics, artisans, farm-

ers, laborers, needed to acquire an understanding of the forces of nature which they applied to serving human wants and needs if the fruitfulness of the earth was to have its fullest meaning to mankind.

It recognized that the pursuit of knowledge for the purpose of better service to mankind is a compelling objective for a society organized within the framework of a Christian civilization, wherein we recognize that we cannot fully serve ourselves individually or collectively except as we first serve those with whom we are associated.

As we dedicate this facility we also dedicate ourselves to constantly seek the triumph of knowledge over ignorance—of truth over superstition. To do so we each within our own capacity seek to extend the frontier of human knowledge—a frontier limited only by the capacity of the mind of man.

We seek to assure the gains thus far achieved by stimulating the student, the teacher, the research worker, the science administrator, the educator, to grasp the meaningfulness to human well-being of the fund of knowledge which has stemmed from this remarkable system of education.

This unique system, a peculiarly American invention, made higher education the property of all who would avail themselves of it irrespective of social status or economic attainment. That it has succeeded in diffusing widely among our population a growing fund of knowledge and a capacity for its application is evident on every hand. Productivity of American agriculture is the envy of the world.

The application of science and technology to the production, processing, and distribution of food has released our people from bondage to the land and made possible the building of a great industrial nation where more goods and services are more widely distributed among more people than in any other nation on the face of this earth.

This achievement is not an accident. It is the result of the vision and the foresight of those who founded the Land-Grant College and University System and conceived the idea of applying science and technology to the matter of producing and supplying food for our people and who recognize that the real frontier of human endeavor was the constant extension of knowledge to the purposes of man.

Even now, other peoples in other countries are attempting desperately to emulate this peculiarly American concept.

The age-old dream of enough food for everyone is in many parts of the world still only a faint light, and even as this goal stimulates other peoples in other lands, we here are challenged to further extend, for the benefit of ourselves and perhaps of mankind, the achievements we have attained.

While we have within the food industry a very great scientific capacity, there continues a vast array of problems needing further investigation. These problems occur in production, in assemblage, in processing, in transportation, in distribution, in merchandising.

Our food supply is of wide variety, of high quality, in form convenient for use, nutritious, and meets the highest standards of safety. Yet, in the food chain there are many losses which occur, both quantitative and qualitative.

Equally significant is the relationship between the productive demands we put upon our land and its continued capacity to produce the quantity and quality of foodstuffs which our expanding population will want and need.

Pests and diseases are a constant threat to both the adequacy and the quality of our food supply. Techniques and processes in production affect the quality and consumer acceptability of foods which are processed. The scientist and food technologist, therefore, have an important part to play in determining what happens to food as it is processed which results from either its physiological or chemical characteristics and which in turn are affected by the productive techniques and environmental factors found in the production processes.

The fact is that no part of the food chain operates in isolation from any of the other parts.

The results to be obtained within this new facility can be most far reaching. They can have impact at point of production and equal impact at point of consumption. Processing is not yet so far advanced that it is able to capture all the factors of freshness, the delicate flavors and essences which characterize the fresh product and carry them unimpaired through to final product.

Neither do we know all of the chemical components within all of our foodstuffs. Nor do we know all the characteristics of those components which affect either their palatability or nutritional values.

The task of preserving all of the raw product values, both physical and esthetic, continues to challenge the food processors. Our attention thus far has been pointed primarily at better ways and means of preserving food, thus extending its value in time.

While measurable advances have been made in preserving values in terms of physical and esthetical quality, this latter field remains one of great challenge. Moreover, many preserving processes add more to the cost of the end-product than is accounted for by the cost of the raw materials. Effectuating economies, therefore, in food processing is another challenge to the scientist and the food technologist.

If we are to capture in the food field all of the values of science and technology, we must, it seems to me, find ways between the producer and the consumer to reduce costs so that, at prices acceptable to the consumer, values may return to the producer adequate to keep him in business, enable him to protect his production resources, particularly of land from which future production must come, and return to him a standard of living sufficient that our more able young people will find the production of food commodities a challenge worthy of their attention.

A casual examination of the food industry makes it unmistakably clear that chemicals of many kinds and varieties are now being used and will continue to be used for many purposes. What is the full impact of this circumstance upon the Nation's food supply?

Certainly a major challenge to food science in all of its aspects is to determine the limits within which the growing use of chemicals may be accomplished with safety, for today we cannot have the variety, quality, or quantity of food we want and need without the beneficial use of a wide variety of chemicals. And, as we move into the Atomic Age it may be necessary for science to determine feasible means of decontaminating raw food products should contamination occur. We already know how to do so with respect to some foods and some contaminants.

At probably no point in the food chain has greater progress been made in achieving food safety, quality, and convenience than in food processing. Food safety and food quality are closely associated. Food safety is a complex of many things. It is cleanliness—the absence of dirt, filth, bacterial contamination, any kind of extraneous invaders, whether they constitute a hazard to health or are merely esthetically offensive. Safety and cleanliness cannot be separated. Actions to maintain cleanliness also result in preventing health hazards. Contamination may occur in production handling, processing, or distribution. It may even occur after the food reaches the family kitchen. Safety and cleanliness cannot be separately achieved.

The food processing industry which takes raw products and subjects them to a wide variety of processes, packages them in a wide variety of containers, and thus extends their useful life, has perhaps done more to provide clean, nutritious, safe, healthy, palatable foods than has any other single part of the food industry, but its task is never-ending.

The scientist working in food processing has the continuing task of ferreting out all the probabilities of food contamination and developing ways and means to quickly and economically avoid those probabilities.

In another sense, safety is the absence of economic fraud. While fraud itself may not constitute a health hazard, it does represent the absence of moral standards. Safety and truthfulness are inseparable. Integrity is an essential to consumer confidence.

One lot of a processed food which falls below standards to which consumers have become accustomed can undo the efforts of many years in the building of a reputation by a food processor for quality of product. The scientist and food technologist then have the challenge of developing those methods of food processing which enable the processor to at all times maintain constancy of standard, admitting that such standard has both moral and economic validation.

Responsibility for food safety resides at every point in the food chain. Government is incapable of physically maintaining surveillance on a constant basis at every point where food is produced, processed, packaged, or distributed. While Government can and does provide reasonable standards, it cannot of itself assure those standards are constantly adhered to.

Competition under our competitive enterprise system, competition for consumer acceptability and consumer confidence is, in my opinion, an equal if not more potent policeman over food standards both of safety and quality. Government's role in food safety is then supplemental to and not in substitution for moral and economic incentives which motivate the private competitive enterprise system. Government should, and in fact does, exercise a general surveillance over the food industry to identify actual or potential hazards, inform the industry of them, and where necessary acts to prevent their occurrence.

But Government action itself cannot be exercised in a vacuum of ignorance. It, too, is dependent upon the scientist and the research worker to determine what is hazardous, where and how the hazard is introduced into the food chain, and by what means it may be overcome. It is thus apparent that the American food suppy in its quantity, quality, convenience, nutrition, and wide dispersal is itself a product of science and technology made usable through education widely dispersed and widely applied. The continuance of this kind of a food supply is dependent upon the capacity of agricultural science in all of its phases—production, assembly, processing, transport, storage, distribution, merchandising. If we are to maintain this kind of a food supply for a growing population, then we must maintain whatever scientific capacity is required to assure the attainment of that objective.

The dedication of this fine new facility then is in fact a rededication of all of us to assure the triumph of knowledge over ignorance, to

assure the dissemination of that knowledge, to assure its practical application, and to attain an equitable distribution of the fruits of that attainment among all who constitute the food chain.

To say that we have attained the ultimate in food processing and preservation is to say that we have eliminated the frontiers of knowledge and now know all there is to know about this subject. Obviously, such is not the case.

Our knowledge of nutrition is incomplete.

We do not yet know how to take the qualities of freshness through the preserving processes. Moreover, our present processing and preserving steps are largely directed toward extending the useful life of the raw product as it comes from our farms.

Is it not conceivable that we will sometime break down the several components of a given food and reassemble them in prescribed quantities and qualities and forms to create an end-product entirely different from the raw product, more nutritious, more palatable, more healthful, generally more beneficial to its users?

I have long been intrigued by a common product—cake mixes. It might be said that cake is cake, but in the modern food store is a cake mix with an orange flavor, one with a chocolate flavor, one with vanilla, one with banana, caramel, and almost *ad infinitum.*

Here the processor has taken a basic ingredient—wheat—taken from it certain components, added others, to literally create a food which is pleasant and appealing to a wide variety of tastes.

In one of our laboratories I have eaten dried milk wafers. Some taste like strawberries, others like apples, some like prunes. I understand almost any flavor can be imparted.

Is it conceivable that the food scientist can in fact from nature's products literally create foods which assure complete nutrition, freedom from disease, assurance of health, vigor, and human longevity?

Is there now somewhere locked up in a human mind an idea of practical and economical means of taking the fruits of the earth and extending them to all mankind?

This is in reality, it seems to me, the challenge to food scientists.

This is the dream of further extending what was here so long ago commenced, and what has here meant so much to the development of a great nation, of a free, prosperous, healthful people.

The modern frontier of science and technology continues to beckon and to challenge. We here today dedicate this fine new facility, but do we not even more dedicate ourselves to the continuous triumph of

knowledge over ignorance and the application of that knowledge to human betterment everywhere for all people? I am sure that we do.

Let us then this day determine to devote our energies to providing that posture in the agricultural sciences adequate to the attainment of this objective. In doing so we must remember that agriculture is but one competitor for the use of scientific resources, but let us remember too that agriculture is the most fundamental of the occupations of humankind; that before people may build great cities or great Nations, they must be fed; that before human intelligence can be devoted to great works, the human body must be sustained. It is for us who represent agriculture to see to it that agricultural science is sufficient to this end.

So, congratulations to Cornell University and to the people of New York State for what you have so well provided, remembering that this laboratory and the opportunity it affords to those who will work in it is of itself the product of an earlier idea—the idea which conceived and brought to fruition the Land-Grant College and University System and with it a Department of the Federal Government to serve the agriculture of this nation and by so doing to serve all the people of this nation. The abundance, the variety, the quality, the convenience, the availability, the economy of our food supply is dramatic evidence that the service has been good.

Let us see to it that those who may come after us can also say that the ideas we here generate were fruitful, that the vision we here create of wider service through more and better food to the betterment of mankind was soundly conceived.

Relationship of the Agricultural Experiment Station to the Department of Agriculture and Markets

Don J. Wickham

Commissioner, New York State Department of Agriculture and Markets

PRESIDENT MALOTT: Long a familiar and respected figure in the agricultural life of our State, Don J. Wickham, Commissioner of Agriculture and Markets, was graduated from Cornell in 1924. He has held many a top post in professional organizations, including the presidency of the New York Farm Bureau Federation with a membership of 77,000 farmers.

He is a trustee of the State University and is currently serving as an *ex-officio* Trustee of Cornell University.

IN taking part in the dedication of this new Food Research Building today, I find myself torn between using my few minutes as a farmer to extol its value to farmers of the State, or as Commissioner of Agriculture and Markets to explain briefly about its place in the cooperative relationship between the Department of Agriculture and Markets and the Experiment Station in the service of the agricultural industry of the State. I shall, however, pursue the latter.

The Declaration of Policy under Article 1 of the Agriculture and Markets Law contains the statement that "it is the policy and duty of the State . . . to increase through education, research, regulation, and scientific means the quantity, quality, and efficiency of its (agricultural) production." Nowhere in the Law, however, is any of the research responsibility delegated to the Department of Agriculture and Markets. The Department is content to leave basic agricultural research in the capable hands of Cornell and the Agricultural Experiment Station.

It appears that back in the 1890's the association between the Com-

missioner of Agriculture and the Experiment Station was quite direct. The following is quoted from pages 674–675, Laws of New York, 1893, Vol. 1:

"The institution known as the New York agricultural experiment station, established in the Village of Geneva for the purpose of promoting agriculture in its various branches by scientific investigation and experiment shall continue under the control and management of a board of trustees. Such board of trustees shall be known as the board of control of the state experiment station and shall consist of nine members appointed by the governor. Their term of office shall be three years. The governor shall be a member of the board by virtue of his office. Such board of control shall annually elect a president from their own number and appoint a secretary and treasurer to hold their offices during the pleasure of the board. Such board of control shall have general management of the station and shall appoint a director to have oversight and management of the experiments and investigations which shall be necessary to accomplish the objects of said institution, and may employ competent and suitable chemists and other persons necessary for carrying on the work of the station.

"Such board shall have the direction of the expenditure of all moneys appropriated to the institution and annually make a full report to the commissioner of agriculture of their proceedings, receipts and expenditures. No member shall receive any compensation for his services as such; but shall be paid his necessary traveling expenses and those expenses incurred by him by an actual attendance upon the meeting of such board. The board shall make such rules and regulations, subject to the approval of the commissioner of agriculture, as may from time to time become necessary to carry out the objects of the station."

The Commissioner back in those days also had the control and management of the State Weather Bureau, but although both the Station and the Weather Bureau have been divorced from the Commissioner's responsibilities, it seems to me there are as many problems connected with the job now as when my predecessors were closely involved with the Experiment Station and the Weather Bureau.

Our official association with the Experiment Station has for sometime now consisted of having the Station make for us analyses of seed samples, pesticides, feed and fertilizer samples, and under certain conditions seek the Station's help in identification of destructive insects and plant diseases as well as methods of controlling these pests. We join with Geneva in printing bulletins on the results of these tests.

Samples of seeds taken by our horticultural inspectors in our Division of Plant Industry are sent to Geneva for tests to determine their purity, germination properties, weed seed content, and content of inert matter. This has been done since about 1909 when New York's first

seed law became effective. Our goal this year, by the way, is 3,000 samples of seeds to be picked up by our inspectors at the retail level and tested at Geneva.

Samples of economic poisons, such as insecticides, pesticides, and fungicides, likewise are taken by our Division of Plant Industry and sent to the Experiment Station for analysis. A bulletin on the findings of tests on these economic poisons similarly is published on a cooperative basis comparable with the annual seed bulletin.

The Station is of invaluable assistance to us in our Food Control work. Inspectors attached to the Division of Food Control take feed and fertilizer samples which are sent to Geneva for analysis. The importance of this work in enforcing the Agriculture and Markets Law as pertains to feed and fertilizers is pointed up by some 3,000 annual samples of feed and approximately 800 annual samples of fertilizer all analyzed at the Experiment Station. The results of those analyses determine our action when any discrepancies are found in the manufacturers' statements of what their products contain and the actual contents as determined at Geneva.

I have no doubt that you are fully aware that our Department has a well-staffed food laboratory in Albany in which we make many hundreds of analyses of foods every year in enforcing the Pure Food Law.

In order to supplement the work of our own laboratory, and also in order to take advantage of the modern facilities of the new Food Research Building, we are just negotiating a contract with the Experiment Station for the testing, identification, and/or analysis of additives, pesticide residues, and anti-biotics in food products to determine the safety thereof. The staff people at Geneva will instruct selected personnel of our Albany Food Laboratory in the procedures used at Geneva.

This will make a saving in costs and I trust show the cooperation between our State agencies.

New York's new pesticide law just signed by Governor Rockefeller and which takes effect January 1, 1961, calls for the samples of such materials to be submitted to the Experiment Station for examination, analysis, and testing. For this purpose the Station may establish and maintain a pesticide laboratory and employ experts to do this work.

Work on food additives will also be done as the need requires.

The new Food Research Building is going to be of great value to our Department in the time ahead and will serve a great need in our agricultural industry to give our consumers the best and safest of food.

The Interest of the College of Agriculture in Food Processing Research

Charles E. Palm

Dean of the New York State College of Agriculture

PRESIDENT MALOTT: Our next speaker is Dean of Cornell's New York State College of Agriculture. An entomologist, Doctor Palm was formerly Director of Cornell's Agricultural Experiment Station at Ithaca and Director of Research in both agriculture and home economics.

A Texan by birth, an Arkansan by upbringing, he has been on the Cornell team since 1932.

THIS is a proud day for Cornell University and for the New York State College of Agriculture and its two experiment stations under Cornell's administrative jurisdiction. We are proud and very happy that the New York State Agricultural Experiment Station has received this magnificent new research laboratory that becomes the home of the Department of Food Science and Technology. This thrilling climax to years of our hopes and dreams and plans adds strength to the facilities already provided by the State to speed agricultural progress. This new laboratory will also benefit millions of consumers in the Empire State through improved food processing research.

The Governor of this great State, Legislative leaders and their colleagues, officials of the Budget Office in Albany, the New York State Department of Agriculture and Markets, and the State University of New York have given their generous support. The architects and construction firms should receive due recognition for their efforts which have resulted in the finest research facility of its kind to be found anywhere. Our gratitude is also extended to the New York State Canners and Freezers Association and to the farm organizations whose encour-

agement and support were both helpful and meaningful. Much credit should go to Director Heinicke and to the staff members of the Department of Food Science and Technology for their foresight and determination to plan for a structure which is functional and superbly equipped to provide the research so essential to leadership in the food industry. To all who had a part in providing the laboratory, we say, "thank you very much"!

Agriculture in our State is big business and everybody's business. Total gross farm income is almost one billion dollars a year. But agriculture is more than farming. It has an effect on every segment of New York's population—the business community, the economy, and the consumer. More than 200,000 persons in the Empire State are employed in moving farm products to consumers. Manufacturing, wholesaling, and processing of food products account for close to an annual billion-dollar payroll. Our consumers spend more at the retail level for food and beverages than any other State. Cash receipts at food stores alone total about five billion dollars a year.

One segment of this big business operation in our State—food processing—had its beginning nearly a century and a half ago. Rapid expansion during the latter part of the nineteenth century saw many processing plants built in western New York. Today, well over 100 firms, operating more than 150 plants, process more than 90 different products. In 1958, processors paid our farmers nearly $40,000,000 for fruits and vegetables. In terms of volume, eight of their processed fruits and vegetables ranked first in the nation.

Like all other industries, the canners and freezers have felt the impact of change on their operations. Their needs for assistance reach into all areas of the College of Agriculture's operation—from trained personnel, to new varieties adapted to processing, to disease and insect control, and ultimately, to many problems related to the processing of a top-quality product. The outstanding faculty of our Experiment Station here at Geneva directs its principal efforts to problems in the processing field.

Historically, the College and its Experiment Stations have been close to the people they serve. We will appreciate very much the continuing support of growers and the industry in our new programs that can be undertaken with the new facilities. Research has always been important to progress. With the rapidity of change that confronts us today, constant effort must be made if we are to maintain leadership. Unless we do, we cannot direct some of the changes that are bound to come in the future. Research, and its application, can prove to be the key to our strength in agriculture.

Development of the Research Program at the New York State Agricultural Experiment Station

Arthur J. Heinicke

Director of the New York State Agricultural Experiment Station

PRESIDENT MALOTT: It is a particular privilege for me to introduce the next speaker, Dr. Arthur J. Heinicke, Director of the Experiment Station and chief executive officer of our Geneva campus.

He reaches our mandatory retirement age on July first of this year, closing his eighteenth year as Director of this distinguished service to the agriculture of New York.

He has been a tireless and energetic worker which has gained for him through the years the confidence and respect and professional esteem of agriculturists throughout the State.

It is appropriate indeed that the dedication of this splendid facility should come at the close of his distinguished career.

THE dedication of the new Food Science building is the beginning of another step in the further development of the program of scientific research at the New York Agricultural Experiment Station. The occasion also marks the fulfillment of a promise made a generation ago by those having jurisdiction at that time of the work at Geneva.

After the Station became a part of Cornell University in 1923 under a plan that made for efficiency and economy, it was decided to coordinate and integrate the agricultural research carried on at Ithaca and Geneva, and thus eliminate unnecessary duplication. The research relating to general farming, poultry, and dairying was to be gradually transferred from Geneva to the Ithaca campus, and with the funds thus released the remaining work at the Station was to be strengthened, with special emphasis on the production, protection, and utilization of horticultural crops used for food processing.

The transition was finally completed in 1943 when the dairy herd at Geneva was eliminated, and the work in dairy manufacturing was transferred to the Ithaca campus. At that time, Dean C. E. Ladd took

the opportunity to restate the policy of the University with respect to the future development of the Station. This statement was reiterated by Dean W. I. Myers a year later, and still remains the guiding policy of the Cornell administration in 1960 under the present Dean, C. E. Palm, whose jurisdiction includes the Experiment Station at Geneva.

In an article in FARM RESEARCH, July 1943, the late Dean Ladd wrote, "Those of us at Cornell who are charged with the administration of the Experiment Station at Geneva are definitely committed to a program of expansion of the work at the Station along certain well-defined lines. All (those concerned with this policy in Ithaca and in Albany) are agreed that the Experiment Station is to be developed and enlarged as a horticultural research institution, with 'horticulture' interpreted in its widest sense. . . ."

Within the province of a horticultural experiment station Dean Ladd envisioned the processing and preservation of fruits and vegetables by canning, freezing, and dehydration. He recognized that much work had already been done at Geneva along these lines; for example, the early work by Dr. L. L. VanSlyke on the chemical composition of sugar beets, fruit juices, and dairy products; the preliminary research by Babcock on the determination of butterfat in milk; the pioneer work of Dr. George A. Smith and L. A. Rogers on cheddar cheese; that of Dr. Robert S. Breed on establishing sanitary standards for milk by a method of direct microscopic examination and of Dr. H. A. Harding on spoilage of canned peas; the classic work on the color compounds in grapes by Dr. R. J. Anderson; basic work by Dr. D. K. Tressler on preservation of food by quick freezing, and important researches on pectin, sauerkraut, fruit juices, tomato, peas, and other fruit and vegetable products by the staff still with us at the Station.

Even though much had been accomplished, Dean Ladd indicated in his statement that, "scarcely a beginning has been made when one contemplates all that might be included in a research program on food processing. Here the chemist, the bacteriologist, and the food technologist will find almost unlimited opportunities". And he predicted "we feel confident that the technical assistance, equipment, and building will be provided at Geneva for the enlarged program".

The appointment of a Director of the Station in 1942 from one of the departments concerned with horticulture on the Ithaca campus of Cornell was regarded by Dean Ladd "as the first step in this enlarged program". The Station staff has taken this suggestion seriously and with the leadership and continued encouragement from those in administrative authority on the Ithaca campus, their Director has tried

to cooperate wholeheartedly by making sure that the Geneva campus kept abreast of the Cornell tradition of progress beyond the first step!

H. E. Babcock, Chairman of the Cornell Board of Trustees in 1942, saw to it that the enlarged program outlined by Dean Ladd was implemented from the very outset. He persuaded Governor Thomas E. Dewey to recommend a special appropriation of $26,000 to strengthen the work in food processing at Geneva, and a bill authorizing this investment was subsequently passed by the Legislature in 1943.

A further concrete recognition of the increasing importance of food processing in the agricultural economy of the State was the establishment of the Department of Food Science and Technology in 1945 by combining the work of the Departments of Chemistry and Bacteriology under the leadership of Dr. Elmer Stotz, now head of the Department of Biochemistry at the University of Rochester. It is fortunate and very appropriate that the research in food science at the New York Agricultural Experiment Station is closely associated with that of departments concerned with the production of raw products. For example, new varieties of fruits and vegetables developed by breeding or grown in the Northeast Regional New Crops introduction gardens can be tested for processing qualities as well as for nutritive values and other characteristics of the raw product; and the influences of cultural treatments such as pest control, fertilizer, and irrigation can be studied in both the fresh and the preserved state of the product.

The initial assignment made by Dean Ladd to the new Director was to draw up recommendations for the Post-War Building Projects required at the Station, and on August 15, 1942, a food research building for the Geneva campus was included in the official list of projects to be submitted by the Cornell Trustees to the Budget Office of New York State.

After several years' deliberation, notice was received on June 5, 1945, that the Post War Planning Commission had approved the Food Processing Building at the Station, and that an architect had been assigned to prepare the plans. In due course, these plans were approved by the Cornell University Trustees and by the Public Works Commission, and on April 1, 1946, the State Legislature made an initial appropriation for the building. The money was reappropriated in 1947, '48, '49, and '50, since construction work on the Food Research Building was held in abeyance during these years because a central heating plant was not available. In 1951, on account of the war in Korea, all funds previously appropriated for all building projects that were not actually under construction at that time were cancelled.

On the recommendation of Governor Dewey, the State Legislature

made a new appropriation for a food research building at Geneva on April 1, 1954. After several months of careful consideration, the Public Works Department and the State University decided to discard the plans made almost a decade earlier, and to start anew. Shreve, Lamb, and Harmon were commissioned as architects for a new version of the building. Ground for the new Food Science Building was broken even before the plans were complete, by Governor Averell H. Harriman on October 4, 1957, on the occasion of the celebration of the 75th Anniversary of the establishment of the New York State Agricultural Experiment Station. This unusual procedure accelerated the final development of plans, and on January 24, 1958, contracts were awarded. Construction of the building was finally underway on March 18, 1958.

The contract called for the completion of the project in December 1959, but a steel strike in the summer of 1958 and the delay in demolishing the old Chemistry Building which is still not complete as of today, seriously interfered with the schedule. Hopefully, the building will be complete so that one can use the main entrance before the present Director retires on account of age June 30, 1960.

The building we will dedicate today will cost almost 3½ million dollars when finally finished, and the equipment will cost about $500,000. As a token several new technical positions have been provided under Governor Nelson Rockefeller's administration so that these complex facilities may be properly staffed and maintained. Additional professional help, we hope, will be forthcoming, within the next few years.

The new Food Research Building is one of the most complete structures of its kind in the United States. It provides the most modern scientific research facilities for the promotion of an agricultural industry of growing importance in New York. A two-story pilot plant with about 8,500 square feet of floor space will make possible the testing of new developments and applications of research in full-scale food processing operations, and several experimental processing units may be operated simultaneously in investigating products whose ripening seasons overlap.

Other features of the building include well-equipped chemical and bacteriological laboratories, storage rooms with controlled humidity and temperatures ranging from 120° above to minus 40° below zero Fahrenheit, a cobalt source of 4,000 curies for the study of food preservation and other effects of irradiation on biological materials, an experimental kitchen with specially equipped taste panel booths, a small animal laboratory for nutrition studies on processed products, a small greenhouse for plant physiology investigations, a machine shop and

drafting room for the construction of experimental pilot units, and many other unique facilities and devices needed in modern research.

The Food Science building with its laboratories for the thorough investigations of biological materials and phenomena, and its pilot plant for experimental tests, symbolizes the comprehensive scientific work characteristic of the Station's program that includes both basic and applied phases of research required to fulfill the broad purpose of promoting the agriculture of New York State. This program that carries out the purpose of the Station is based on the philosophy that a sound agricultural industry must be built on a firm foundation of exact knowledge, developed in the spirit of pure science; knowledge that can be tested by carefully controlled experimentation and proved to be really true and dependable in practical affairs. With such a reliable and trustworthy beacon, instead of mere opinion, serving as a guiding light, those engaged in agriculture need not ask, "Who is this that darkeneth counsel by words without knowledge?" Research in its popular form is now a widespread and useful occupation that covers many forms of activity from the cradle to the grave. What we need in agriculture and many other branches of knowledge is more science in research!

Our forefathers did not expect those engaged in agricultural research merely to dip into a fund of knowledge that could be applied if and when it was needed to solve the practical problems of food production. In 1843, for example, James Wadsworth, the President of the New York State Agricultural Society—the precursor of the Agricultural Experiment Station—stated that, "Our chemists and geologists will not, we may be sure, rest content merely to serve as industrious gleaners, after the Davies, the Leibigs, and the Johnstons of other countries, but will push forward into ample domains which even these astute discoveries have not penetrated." He also expressed the wish that the Association over which he presided "would help to spread far and wide the new lights of science and the results of experiments that explain not only the workings of nature and the practices of the art of agriculture, but open up an inexhaustible field of new combinations and novel results".

The new Food Research Building with its many complex devices that serve to increase the efficiency of the workers, and enable them to observe and record many natural phenomena that are beyond the normal human senses of perception, will provide excellent facilities for scientists who have been trained in basic academic disciplines, such as mathematics, chemistry, physics, biology, and bacteriology.

To serve agriculture best and help solve the immediate and the future problems with which we at the Station are concerned requires scientists of many different specialties and with varying individual talents who can effectively use the tools and techniques appropriate to their fields. All, however, must have a profound regard for the scientific attitude of mind, and a clear concept of the importance of original creative work carried on with devotion and enthusiasm in spite of difficulties and discouragement. Science, as love is said to be, "is a many splendored thing", and offers a rewarding career for broadly trained chemists, biologists, and many other scientists interested in food, health, and agriculture.

It is gratifying to note that many of the same societies that, with the strong support of Cornell University (even before it was interested in the management and control of such an institution), advocated the establishment of the original Station in 1880, also urged the construction of the new Food Science building several generations later. These societies are the New York State Agricultural Society, the State Grange, the New York State Horticultural Society, and those formed more recently, such as the New York State Vegetable Growers Association, the New York State Canners and Freezers Association, the New York State Farm Bureau, and the Conference Board of Farm Organizations.

On our way across campus from Jordan Hall to the new building one may go by the original building on the Station grounds, now over 110 years old. This building was so modern at the time the Station took possesison in 1882 that Director Sturtevant could boast of running water with one outlet on the first floor and two in the basement. It is still in use today as a laboratory and office building by the Entomology Department. The modern Food Research Building that we will dedicate today has innumerable outlets for hot, cold, and distilled water, electricity, steam, gas, and compressed air. It should last at least as long as the original Station building.

We trust that the show of confidence in the work of the Station by the practical groups of farmers and food processors of the State which helped to persuade our representatives in Albany to provide funds for the improved facilities for agriculutral research at the Station, will continue to be merited; and we hope that it will continue to be fully justified by future accomplishments of a well-trained and devoted staff in food science under the present headship of Dr. D. B. Hand, and by other supporting scientific activities of the Station staff as a whole.

Introduction of Governor Rockefeller

PRESIDENT MALOTT: Cornell University, under private charter from the State of New York, is a unique, pioneering institution that bridges the gap between privately and publicly supported higher education. Today we are indebted to the tax payers and Legislature of the Empire State for this most modern laboratory, which is to house the Department of Food Science and Technology. This structure is a tribute to scientific progress and to the fine relationship Cornell has enjoyed with the State through the years.

We are proud today to be associated in this project with the vigorous and growing State University of New York, in which our State-supported divisions are constitutent units. Cornell is mindful of a deep sense of responsibility in serving the needs of the young people of New York, as well as in carrying on research that benefits millions of people dependent upon the economy of New York State. It has been Cornell's responsibility to use wisely the generous funds which the State has entrusted to us in growing amounts.

We of New York State look forward confidently to the future, pioneering years in which this unique pattern of educational opportunity may continue to point the way here within the State, and indeed, far beyond her borders. This new research building which we dedicate today will make its mark in the field of agriculture and food science down the long years of the future, contributing further to the intelligent and economical cooperation between the resources of privately supported education and the vast potential of a responsible state.

Since the New York State Agricultural Experiment Station at Geneva was placed under the control of Cornell University as a unit of the College of Agriculture in 1923, its work has made vast contributions to the welfare of the people of this State and the rest of the world. Cornell's predominance has been maintained unchallenged through the years. While the State-supported colleges have been subject to the budgeting controls of the State, the academic management and program have been Cornell's own.

The Governor of our State, Legislative leaders and their colleagues, and the Budget Office in Albany deserve our thanks for having given their support to the successful completion of this splendid facility.

Governor Nelson Rockefeller has been always a friend to agriculture and to education, as well as an advocate of scientific progress. As the chief executive of New York State he is also an *ex officio* trustee of Cornell. It is therefore most fitting that he has joined us in the enthusiastic dedication of this research building and the fine equipment it contains. I am honored to present to you Cornell's trustee and New York's distinguished governor, the Honorable Nelson Rockefeller.

Address by the Hon. Nelson A. Rockefeller

Governor of the State of New York

I HAVE just come from Ovid, where I dedicated a plaque commemorating the establishment of the first agricultural college in the United States one hundred years ago. Now we meet here to dedicate the most advanced food research building in the United States. It becomes apparent that all past agricultural progress is only a prologue. Or, to use the vernacular, we haven't seen anything yet.

The past progress in agricultural production has been tremendous. During the Civil War, for example, it took eight farmers to feed one urban resident. By 1940, one farmer produced enough for almost 11 people. But in the last 20 years, farmers have more than doubled their productivity. Today, one farmer produces enough for 25 people. Truly, this revolution in agriculture is just as astonishing and just as important as the industrial revolution. And this new building, the men who will direct and operate it and the research that will be performed here, will be a powerful factor in spectacular new progress for the farmers, food processors, and consumers, not only in New York but throughout the United States.

The completion of this new Food Science and Technology Building is such a milestone of progress and so valuable an achievement for the people of New York that I want to pay special tribute to some of the groups and individuals who played a major part in bringing it about. My congratulations go to Dr. A. J. Heinicke, the Director of this Experiment Station, who has done so much to make this building a reality that it stands as a monument to his perseverance, his leadership, and his dedication to his work. We shall miss Dr. Heinicke's services when he retires this July. But we will continue to benefit from the secure foundations for progress that he has laid, and we hope to call on his wise and experienced counsel for many years to come.

My congratulations go to Dr. David B. Hand, the Head of the Food Science and Technology Department of the Experiment Station. I

think we can all imagine how delighted Doctor Hand must be with his shining new facilities. And I think we all know that he and his staff will make outstanding use of them. Great credit for the development of this laboratory goes also to Bill Myers, who retired last summer as the Dean of the College of Agriculture at Cornell and who played such a fine part in Cornell's thoughtful supervision of this Station. Charlie Palm has done an excellent job as Bill Myers' successor. He will give this Station and the new laboratory continuing superb guidance.

I want to acknowledge with admiration and gratitude all the study and work that New York farm organizations and the New York State Canners and Freezers Association did to secure the original appropriation for this building in 1945 and to carry on their campaign for these facilities until they are now finally complete. The money for this laboratory was appropriated while Tom Dewey was Governor. Averell Harriman broke ground to start its construction. It is a tremendous pleasure for me to finish the job.

Now let us turn to a consideration of what this laboratory will mean to us in the future. This laboratory will increase the efficiency of food production and of food processing. That means that it will be of direct and specific benefit to New York's farm population. It will be of direct and specific benefit to 150,000 workers in the State who are engaged in the food processing industry and who today take home $600,000,000 a year in wages. Through the research done here, New York's farmers and food processors will not only remain competitive but will be able to increase their incomes and improve their individual welfare. Beyond the farmers and food processors, all the consumers of New York State farm products will be better off. They will enjoy safer, more wholesome, better preserved, and better tasting food. Thus this new laboratory will make an appreciable contribution to the health and happiness of millions of families.

This contribution will be of great and specific benefit to New York State but will in no way be confined to it. Scientific research and development know no geographical boundaries. The work done here will be freely shared with all our American fellow citizens who are interested in it, so that producers and consumers everywhere may profit from it.

Two factors which have been of great importance in the development of our Nation's vitality are represented in this ceremony:

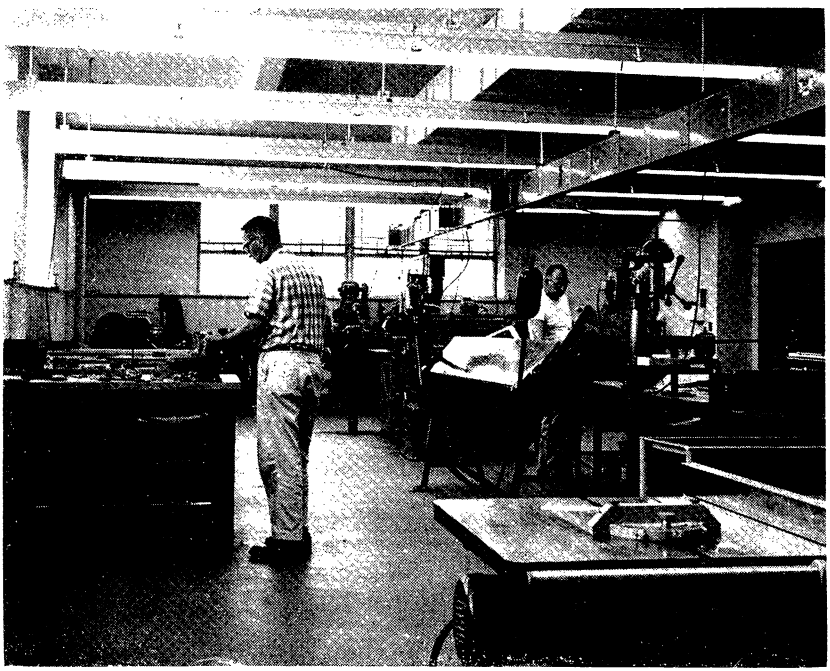
—Cooperation between the people and their government,

—And progressive research and development.

This new laboratory grew out of the wishes of the people. Moreover, it is a fine example of the cooperation between research and develop-

ment and the people. Scientists and technicians serve the people. Their work—the work that will be done here—is not dedicated to the purposes of the State, but to the well-being of the people. Research and development have brought breath-taking advances in our own time—and will bring even more startling advances in the future.

These advances do create dislocations and do require readjustments. But since research and development in this country are guided by a concern for people, we are willing to make readjustments because we know that they are a small price to pay for progress that benefits everyone. And through the constructive cooperation of scientists, the public, and government, we can minimize the shocks and enlarge the rewards of change. Therefore I welcome the addition of this food science and technology building to our State's accelerating economy. Let us all take away from this ceremony not only pride and confidence in our progressive agriculture, but also renewed pride and confidence in our progressive America—the hope, the shining example of freedom, the touchstone for the aspirations of all peoples.



Pilot plant equipment and other devices can be constructed as needed in this modern machine shop.

About the New Facility

A FOOD research building to permit the development of the program of the Experiment Station at Geneva was first proposed in 1942 as part of the State's Post War Building Project. The proposal had strong support from farm groups, the food processing industry, and other representative agricultural interests in the State.

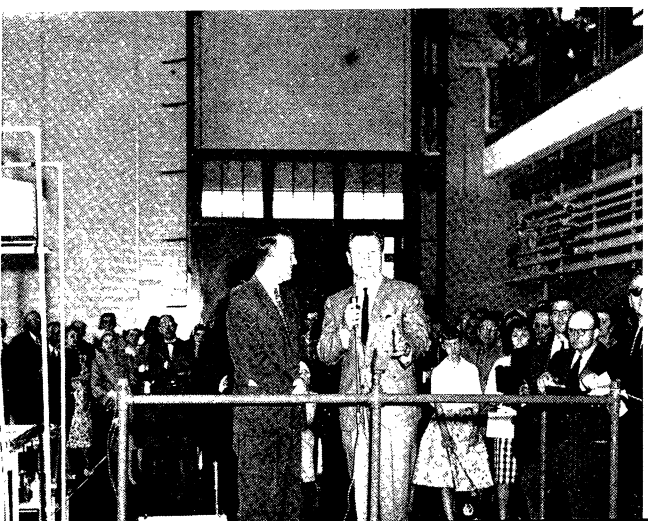
The first appropriation was made in 1945, under Governor Thomas E. Dewey's administration. The Korean War delayed this and similar projects, but ground for the new building was finally broken in October 1957 by Governor Averell Harriman during the celebration of the 75th anniversary of the founding of the Experiment Station. Actual construction got under way early in the spring of 1958 and Station personnel began moving into the new quarters March 2, 1960. Formal dedication exercises, led by Governor Nelson A. Rockefeller, were held May 5 and 6, 1960.

The building is of brick and limestone construction. It has three stories with a floor space of approximately 60,000 square feet. A sub-basement and pent house accommodate automatically controlled machinery required for operation of various facilities in the building.

Special Features

A special feature of the building is a two-story pilot plant with approximately 8,500 square feet of floor space. A truck entrance and movable bridge-crane make possible the use of full-scale commercial food processing equipment. A number of experimental processing lines may also be operated simultaneously in the study of products whose ripening season overlaps, as for example, sour cherries and snap beans.

Special units also make possible the study of specific operations, such as evaporating, filtering, clarifying, drum drying, flash freezing, essence recovery, dehydration, centrifuging, spray drying, and so on. A three-story-high steam ejector provides a vacuum for some of these units.

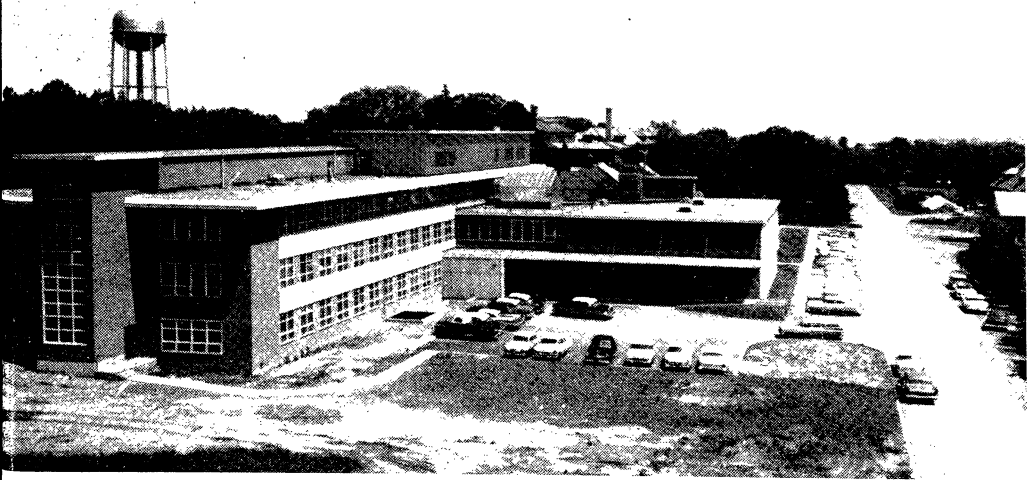


Governor Rockefeller pressing a button to activate an apple processing line in the pilot plant to symbolize the dedication of the building. Doctor David B. Hand, Head of the Department of Food Science and Technology, is at the left of the Governor.

A cobalt-60 radiation source with 4,000 curies of initial activity in a specially constructed radition chamber will make possible research on radiation as a means of food preservation. The source will also be used to study the effects of ionizing radiations on plant tissues, insects, and for other purposes.

Other features include well-equipped chemical and bacteriological laboratories, a fully equipped machine shop for construction of small-scale experimental processing equipment, storage rooms with controlled humidities and temperatures ranging from 120 degrees down to minus 40 degrees Fahrenheit, an experimental kitchen and modern taste panel booths, a small animal laboratory for nutrition investigations, a greenhouse on the roof of the pilot plant for plant physiology research, air-conditioned rooms for housing sensitive instruments, a drafting room, a glass-blowing and marking room, a dark room and photo laboratory, a media preparation and sterilizing room, and specially equipped laboratories for chromatography, isotope studies, micro-chemical investigations, and pesticide, fertilizer, and feed analyses.

The chief aims of food research at the Experiment Station are to increase the efficiency of the food processor and the producer of raw materials, especially fruits and vegetables, so as to keep New York producers and the processors in a competitive position with other areas and to assure the consumer an adequate supply of high-quality, nutritious processed foods.



Rear view of Food Research Building, showing two-story pilot plant