Are We What We Eat?  
Nutrition and Health

BY S. J. Ritchey

The saga of human nutrition and the improvement of human health in the United States is really reflected in the efforts of many scientists who believed that human performance and well being—whether mental or physical—depends primarily on what man eats.

We know much more about human nutrition than we did 100 years ago and we hear much more about health problems related to the consumption of foods. Tremendous progress has been made in agriculture production methods and in food science and technology to assure a safe, wholesome food supply for the American population. Scientists in the State Agricultural Experiment Stations have, most appropriately, provided a significant measure of leadership in these areas.

Progress in human nutrition may be measured best by the knowledge that many nutritional related problems have been conquered. Life expectancy of the average American has increased significantly from about 40 years of age at the turn of the century to approximately 70 years at the present time.

Deficiency diseases, such as rickets, goiter, pellagra and scurvy, have disappeared from the scene in most American communities. Advances in nutrition have improved the health of new-born children and provided the basis for avoiding anemia early in life and for normal growth and development of the child so that its full physical and mental potential can be attained.

The development of human nutrition in the setting of the Agricultural Experiment Stations and the land-grant universities is a most interesting story. Among leading States in this work were Wisconsin, New York, and California.

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Nutrition, a relatively new science, evolved from the basic sciences of chemistry and physiology. Very early investigators, primarily Europeans, initiated nutrition studies as they attempted to understand the physiological utilization of food in supporting the essential processes of life, including growth, reproduction and lactation.

Nutrition research moved to the United States as colleges and universities were organized, but the founding of the land grant institutions and the Agricultural Experiment Stations was the catalyst for systematic research. Agricultural research, in the form of nutritionists, chemists, and physiologists located in the animal and plant sciences, contributed a vast amount of knowledge basic to both human nutrition and food safety. Admittedly, their priority was enhancing the production capabilities of agriculture enterprises, but their basic contribution to human nutrition should be acknowledged.

The science of nutrition has progressed during the last 100 years from a meager understanding to the point that most of the essential nutrients seem to have been identified. Most nutrients have been isolated in purified form and the biological functions of many are reasonably well understood. Nutritionists have speculated that life could be sustained, although probably not enjoyed, through a supply of purified nutrients. But the search for ever more nutritional knowledge continues to be a fascinating story.

One of several pioneers was W. O. Atwater, director of the Connecticut Agricultural Experiment Station, who organized and became the first director of the Office of Experiment Stations in the U.S. Department of Agriculture (USDA).

Atwater was a leader in determining the components of food essential in meeting the physiological needs of men. Through the efforts of Atwater and his associates, a large number of basic foods were analyzed for groups of nutrients.

Our present food composition tables, the best known and most complete of which is Agriculture Handbook No. 8 issued by USDA, are based upon this very early work. The handbook is currently being revised. Through the years, professionals in nutrition, dietetics, and related health sciences have depended upon these composition data. USDA continues to update and improve these food data, as the task is never-ending but essential. Information is provided from a wide variety of sources, including the experiment stations, USDA’s laboratories, and private industry.

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Ohio project seeks to determine effect of polyunsaturated ruminant fats on sterol balance of college women. Top, preparing food for diet study. Above right, eating diet meal. Above left, diet analysis.

Through a long series of studies in the early 1900’s the nature of vitamins began to be uncovered. In 1914 McCollum and Davis at Wisconsin reported the discovery of vitamin A. This fat-soluble vitamin was related to night blindness in domestic animals and eventually was demonstrated to function in the regeneration of a pigment, visual purple, in the eye. That pigment is essential to normal sight in both man and animals.
Pennies to Avert Blindness

This early work provided the scientific basis for supplementing foods with vitamin A so that the American population can be assured of obtaining needed amounts of the vitamin. However, not all populations in the world are so fortunate; literally thousands of children in the Orient are permanently blind because they have not received the amount of vitamin A for normal functioning of the eye. The real tragedy is that the condition can be prevented for only a few cents per child each year.

In 1919, Steenbock and Gross related vitamin A to foods with yellow color, such as carrots and sweet potatoes. Plant pigments, carotene and others, were found to have vitamin A activity. Later, carotene was demonstrated to be provitamin A.

Pioneer researchers in nutrition were concerned with the identification of all nutrients, or those substances required for life and health. For many years the belief existed that the major components of food were sufficient, but slowly experimentation was accomplished to show that food contained other essential compounds.

Vitamin D has been the center of an interesting, and, in many respects, a frustrating search. Rickets were recognized very early in the history of nutrition as a dietary problem as large numbers of young children were afflicted with weakened and bent limbs. Investigators implicated several nutrients, including calcium, phosphorus, vitamin A and vitamin D.

Elmer V. McCollum and coworkers at the Wisconsin Experiment Station separated vitamin A from the rickets curative agent and called the nutrient “vitamin D” in 1922. The benefits of vitamin D were clearly outlined and led to the fortification of foods, resulting in the control and almost complete eradication of rickets. But the metabolic function remained a mystery until very recently when H. F. DeLuca at Wisconsin, through a series of studies, unraveled the nature of this vitamin’s activity.

Vitamin D is a clear example of the slow and sometimes tedious evolution of knowledge in nutrition, as well as in other sciences. Though the role of most nutrients is known, many facets of biological activity and the implications for human health and well-being are still under investigation.

Through studies by G. K. Davis at the Florida Experiment Station and others, knowledge of the inorganic elements in nutrition has advanced materially. The relationships of calcium and phosphorus to bone development, growth, and the prevention of
A western regional research project in nutrition used this mobile health laboratory during the late 1940's. Scene here in Oregon includes a physician and bacteriologist. Director of project is in dark dress in foreground.

Rickets were recognized early in nutrition research in this country. But research with the trace elements, or those inorganic nutrients needed in very small amounts provides some interesting examples of valuable contributions.

Several nutrients such as protein, iron, folic acid, and vitamin B₁₂ are important in the essential functions of oxygen transport and the control of nutritional anemias. As early as 1925, Hart and his associates at Wisconsin showed that a trace element, copper, was required for iron to be utilized in the synthesis of hemoglobin, the important oxygen transporter in the blood.

**Zinc and Sex**

Zinc was recognized as an essential nutrient in mammals in the 1920's by researchers at the Georgia and Alabama experiments stations. But the real impact in human populations has been recognized only in recent years. Dwarfism and impaired development of the sex organs of the male were identified in several population groups around the world. Eventually, these maladies responded to supplementation of zinc so that sexual development and growth was restored in the children.
Zinc is now recognized as an essential element for the human and a daily allowance was recommended for the first time in 1973. The recommended intake for children is based upon research accomplished at the Virginia Agricultural Experiment Station.

Perhaps no nutrient has been as controversial as fluorine, now recognized by nutritionists and by public health officials as important in lowering the incidence of dental caries or tooth decay. Several investigators from experiment stations in Arizona, Michigan, New York and Wisconsin are instrumental in proving that fluorine was active in mottled tooth enamel, an unsightly condition found in populations with water supplies containing 6 to 8 parts per million of fluorine.

Studies by these and many others led to the accepted concept that fluorine, at concentrations of about one part per million in the water supply, will reduce significantly the amount of dental caries in the population.

The saga of niacin, one of the water-soluble vitamins, is most important because it portrays the immediate application of information from basic research to the solution of human problems. Work at the Wisconsin Experiment Station, together with that of Goldberger and associates, showed that blacktongue in dogs was analogous to pellagra in the human and the two maladies could be cured by the same dietary supplements.

*Ending the South's Pellagra*

During the early part of this century, pellagra was rampant in the southeastern United States where the major staple was corn. Application of information from the basic research led to fortification of corn products available through normal market channels. Pellagra was eradicated in the region.

Since World War II, nutrition scientists have recognized that protein malnutrition is a major problem in many parts of the world. Researchers from many disciplines have focused their attention on improving the quantity and quality of protein in foods.

Scientists in the experiment stations and at land grant universities made key contributions to our present knowledge about protein nutrition. Certain amino acids, the components of proteins, were found to be essential in the diet of man by W. C. Rose in the 1940's and early 1950's. Dietary needs for these essential nutrients were described from studies by Rose at Illinois and by Ruth Leverton at the Nebraska Experiment Station.
Wisconsin molecular biologist developing laboratory procedures for quickly finding varieties of bean seeds high in total protein and methionine.

This work evolved from earlier classification of dietary proteins into animal and plant sources or into first and second class proteins based upon the capability to support growth and other vital processes.

J. B. Allison at Rutgers, in New Jersey, and H. H. Mitchell, Illinois, were among the investigators who defined the biological role and the efficiency of utilization of protein in several species, including man. These studies became the basis for initiating programs to alleviate protein malnutrition in the developing countries of the world.

Considerable progress has been made in nutrition research through a mechanism unique to the Agricultural Experiment Station system. This approach, known as region research, brings together researchers from several states to work on common problems.

School Age Nutrition

An outstanding example is the series of studies designed to define the nutritional needs of preadolescent children. These studies, accomplished by personnel in the Southern region, represent the most comprehensive research about nutrition of the school age child. The focus has been on protein, but data on vitamins, minerals, fats, energy and numerous interrelationships have come from these studies.

Recommendations for protein needs of the growing child, based upon balance studies in which a range of diets varying in
Iowa studies energy metabolism and utilization of nutrients by women: Left, collecting respiratory gases during controlled exercises on treadmill. Center, helium chamber measures body volume so percent of body fat can be estimated. Right, analyzing gases.

protein level and composition were fed, have come from the regional work. Investigators have provided data for loss of protein through the skin of the growing child. These data have proved useful in establishing realistic guidelines for populations in many parts of the world.

Researchers in schools and colleges of home economics within the experiment stations have provided significant leadership in understanding the dietary habits of people and in applying fundamental information to people. A regional research project in the North Central region concerned with food consumption behavior of children is an excellent example of this type of research. A research project is currently underway in the Southern region to relate the food habits to growth, development and nutritional health of growing children. A study in the Northeast is determining nutritional needs during critical periods in human development.

Although human nutrition is only one small part of the total research program in the Agricultural Experiment Stations, important contributions continue to be forthcoming. A major advantage for applied work in human nutrition in the experiment station environment is the possibility of close coordination of re-
search with disciplines involved in the production of food. Teams of researchers can work on production yields, genetic improvement of crops, and utilization of these products for human consumption.

The team effort at the University of Nebraska where investigators from agronomy and human nutrition are cooperating to study the use of cereal grain by human subjects is an example. Feeding the world population and achieving optimum health must involve many scientists from a wide range of disciplines.

The relatively new science of human nutrition will continue
to make significant contributions to the American population. There is much that is known, but much, much more is yet to be discovered and tremendous problems need to be solved.

The nutrition scientist knows relatively little about nutritional requirements of man throughout the life cycle. There is knowledge that nutrition makes a real difference in the health and well-being of the growing child, but few data are available from research laboratories. The impact of nutrition on human longevity is by and large speculative at this point in time. Control of obesity, diabetes, hypertension and other nutritionally related problems is important in our society.

Numerous other problems confront the nutritionist working in applied programs with the infant, the school-age child, the pregnant teenager, the obese middle-age male, and the elderly. Answers to many of their questions depend upon research in the Agricultural Experiment Stations and other agencies concerned with human nutrition and health.

Those nutritionists in the experiment stations and land grant universities have a rich heritage and a tremendous challenge as they, along with scientists in other disciplines and in other institutions and agencies, face the future.