

The Nutrition Foundation, Inc.

REPORT OF

SCIENTIFIC DIRECTOR

JUNE 30, 1945

The Nutrition Foundation, Inc.

REPORT TO THE BOARD OF TRUSTEES

CHRYSLER BUILDING, NEW YORK 17, N. Y.

JUNE 30, 1945

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THE NUTRITION FOUNDATION

THE NUTRITION FOUNDATION was organized by food and related manufacturers in December, 1941, as a sincere acknowledgment of their responsibilities in the protection and advancement of health through scientific progress in nutrition. The basic purposes of the Foundation are: (1) the development of a comprehensive program of fundamental research, providing basic information in the science and nutrition; and (2) the development of an educational program to make the science of nutrition effective in the lives of present and future generations.

The entire program is one of public service, and distinguished representatives of the public serve on the Board of Trustees, the governing body of the Foundation. The Foundation functions chiefly through grants-in-aid in support of research in university centers where there are strong graduate schools in the basic sciences, and to medical centers where there are opportunities for outstanding research.

The quality and independence of the research program is safeguarded by the referee action and counsel of a Scientific Advisory Committee, composed of fifteen outstanding research men, most of whom are in university positions.

A Food Industries Advisory Committee, made up of the research directors, chief chemists, and technical advisers of the member companies, serves as an advisory and liaison group between the Foundation and the executive and technical staffs of the member firms.

The funds of the Foundation are obtained through voluntary contributions from founder and sustaining members and donors. All member contributions are made on a five year basis so that the Foundation may be assured of support for at least five advance years in planning its research program.

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FOREWORD

EVERYONE is thrilled by the precision and apparent ease with which a modern airplane sails off into the sky and later glides to a specific white line at a distant airport. We cannot escape a feeling of admiration for the accuracy and reliability with which each part of the ship has been developed and therefore must have been understood by someone. Then imagine, for a moment, the problem of the biochemist or the physician who tries to understand as clearly what happens to a typical meal inside the body. Fortunately, nature has taken care of most of the details, but the fundamental problem still faces a scientist — he is striving for an understanding of what happens to food inside the body, so that the science of preventive medicine and the practical problems of agriculture and industry can be approached on a rational basis, just as the physicist and engineer need to know the meaning of all the wires and control instruments in an airplane.

Fortunately, most scientists and many leaders in industrial development know the broad relation of fundamental research to success and growth in industry. The food industry, because of its great responsibility for human health, has much in common with the biological sciences that underlie both agriculture and modern medicine.

In brief, we want to find what quantity of each of the forty or more essential nutrients is required for good nutrition, how each nutrient functions inside the body, how each can be used to protect human and animal health, and how each can be measured accurately, either as it functions in the body or as it comes into

being on a farm and later takes its course through a modern factory.

We do not expect an airplane passenger or steward to know how to build an aircraft, nor should one expect the housewife, or chef, or plant manager to know the detailed science of nutrition. But in the background there should be continued explorations and a growing knowledge of principles to chart the course of further progress.

The food industry has made possible a completely unrestricted program of fundamental study in universities and similar research centers throughout the United States and Canada. One could not ask for a more forthright expression of confidence in the value of basic research, or for a more sincere acknowledgment of the interest that the food industry has in protecting the health of the public.

The opportunities to strengthen research and advanced training in the areas where we have started are so great that one cannot feel we have made more than a good beginning.

In looking ahead, few if any features of our national life will be of greater importance than the provision for research to extend the frontiers of human knowledge.

Radio-active elements now (a) provide "tracer" compounds for use in nearly all fields of medical research, (b) furnish the most valuable means of combatting cancer, and (c) give promise of furnishing a source of power with untold possibilities for mankind. It is interesting, then, to re-read a quotation from Madame Curie's father who wrote as follows, in congratulating her upon the discovery of radium:

"What a pity it is that this work has only theoretical interest, as it seems."

REPORT OF THE SCIENTIFIC DIRECTOR

IN ESTABLISHING the Nutrition Foundation, the food industry gave emphasis to two essentially new and fortunate trends in American life: first, a greater recognition of nutrition as a basic factor in public health; and second, a clearer concept of the importance to society of independent scientific research and advanced education. Accordingly, one of our major industries has been strengthened, in harmony with the public interest.

The value of the Foundation's program is not limited to one country. Each advance in the science of nutrition strengthens the fabric of American life, to be sure, but it also serves mankind beyond the limitations of boundaries. Human health, scientific agriculture, efficiency in industry and a democratic approach to education and research—all objectives of the Foundation—represent areas of world leadership that we can strive for wholeheartedly and unselfishly.

ADJUSTMENT TO WAR PERIOD

Although planned and established on a permanent, peacetime basis, the program of the Foundation was undertaken in the midst of war. Projects with a direct service value toward winning the war have been given first preference. A choice between direct and indirect service is extremely difficult, however, in a program of research and education, when the time factor is so uncertain. With the end of World War II in Europe and a shift of forces to the Pacific, demands for food were increased at a time when our reserves were at their lowest level in many years and the prospect of "surplus" food production in this country during 1945 was still uncertain.

On what basis can we decide how much of each major food

to produce, or ship to Europe, or supply to our own soldiers and civilians? At best, there is much guesswork in answers to such questions. There is essential agreement, however, that sound evidence should be established concerning the food requirement of each citizen to provide for health, vigor and efficiency — and with reasonable enjoyment and economy. Sooner or later these two latter criteria must be satisfied.

COMPLACENCY — A DANGER

There is a widespread impression that “America is the best fed nation in the world.” This may be true so far as variety, appeal and convenience are concerned, but there are other striking facts that should warn us against complacency. In every major section of the United States and Canada records of what individuals are eating, careful medical examinations, and detailed observations of the relation between food intake and health, all show unmistakably that we are far from having established a satisfactory pattern of food consumption.

AREAS OF ACTIVITY

The Foundation’s program has been developing in six areas of activity. Although individual projects include more than one basis of interest, the following classification illustrates the work that is under way:

1. Research directed toward discovering and measuring the human nutrient requirements.
2. Studies of the origins and functions of individual nutrients in living organisms.
3. Maternal and infant nutrition studies.
4. Research in which there is direct emphasis upon relationships between nutrition and health.
5. Education, beyond that provided by research grants, to facilitate the application of new and sound information.

6. Work undertaken chiefly as a direct contribution toward winning the war.

SIGNIFICANCE OF AREAS

Until there is much more complete knowledge concerning human nutrient requirements — how much an individual needs of each mineral, vitamin, amino acid, fat and sugar — attempts to reach satisfactory goals in regard to our food supply and eating habits will of necessity remain unsatisfactory.

And until more is known of how the essential nutrients are formed and how they function in living organisms, including the human body, responsible leaders in all areas related to nutrition must remain handicapped in their efforts to solve scientific problems without essential information. Those who know the history of science seldom lose sight of the need for keeping, always, a long-time point of view regarding the value of exploratory or fundamental research.

Abundant evidence has shown that the periods of reproduction, lactation and infancy are times of special stress upon the requirements for good nutrition and health. Because of this it is important to build a sound basis for improving medical and lay practices as rapidly as possible. These are critical areas of human life where scientific advances can be translated quickly into human betterment, with lasting effect.

In the over-all work of the Foundation, we have been sensitive to the need for giving reasonable consideration to current community problems, especially in so far as they bear upon public health and education. These areas of activity, as in searching for the causes of tooth decay, deformities at birth, liver degeneration, and premature aging, make the fruits of more basic research stand out clearly and thus have both educational and humanitarian value. Almost every research group feels a sense of obligation to facilitate the use of newly gained information. The problem is one of relative emphasis. Research men in industry have a primary

responsibility to develop things of a practical nature, whereas university groups have an obligation to advance the frontiers of knowledge. The interdependence of exploration and application can be stimulating to those who work in either field; each gains much from the other and there should be no walls between them.

At the heart of the educational problem is the task of reaching professional people first, so that leadership and lay education will be maintained on a sound basis. The projects supported by the Foundation in this area accelerate the processes by which research becomes useful, but it would be short-sighted to divert too great a proportion of our funds into educational channels.

Nutrition, the science of food and its relation to life and health, is clearly a matter of concern to all phases of the food industry. The problems of warfare have accentuated this relationship with telling effect.

PROGRAM DEVELOPMENT

The Foundation's program is built on a broad basis of advance, rather than to serve the immediate needs of industry. Each member firm is encouraged to develop and strengthen its own research activities rather than in any sense letting the Foundation's studies substitute for the work of their own staff. The two types of program are distinctly complementary rather than competitive.

The primary responsibility of our Scientific Advisory Committee is to assist in guiding the program of exploratory research, while our Food Industries Advisory Committee serves in a liaison capacity between the Foundation and member firms.

The questions which guide the Scientific Advisory Committee in considering grants are essentially as follows:

1. Is the subject matter of the investigation such that the research outlined is likely to yield basic information of outstanding significance?
2. Does the applicant have the personal and professional qualifications that engender confidence in his ability to conduct

- outstanding investigations and maintain a high level of relationships with the Foundation and with the public?
3. Does the investigator have the essential facilities for conducting outstanding research work, including equipment and an institutional environment that is likely to permit outstanding accomplishment?
 4. Is it likely that the funds expended will yield results of greater value on this project than might be accomplished by any other allocation?

Building the program involves far more than allocating grants. There is a constant effort to evaluate the ever-moving research and educational frontier and on that basis, to assist in the initiation of studies that will have the greatest value. Selection of the individuals who can conduct exploratory work to best advantage is even more important than decisions regarding subject matter to be investigated. Organized as we are, there is an opportunity to accomplish a high degree of voluntary cooperation between different institutions and individuals in concerted attacks on major problems. Each group in such a program gains from the fuller utilization of criticisms, experiences and research equipment in other laboratories. The Foundation can still follow a policy of giving fair consideration to independent requests for assistance, without sacrificing this privilege of creative suggestions or initiative.

In the following review of projects that receive support from the Foundation, mention is made only of a few illustrative instances in which significant headway has been made. A complete list of grants made in the respective areas of subject matter and a list of publications that have been based thereon, will be found in the addenda at the end of the report.

HUMAN REQUIREMENTS

Identification of each nutrient that must be supplied to the human body is so difficult, time-consuming and expensive that

“pilot plant” tests are generally conducted with small animals. Even tiny plants, such as bacteria, yeasts and molds serve the same purpose with great advantage. But since each animal species varies in nutrient requirements, there is always a degree of uncertainty until human tests provide clear evidence. Thus we have essentially no information concerning the human requirement for many of the vitamins, for fats, or even for some of the mineral elements such as zinc, cobalt and manganese. Until 1942, there was practically no clear-cut information concerning so fundamental a problem as the human requirement for amino acids, the “building blocks” of proteins. The Foundation has been privileged to share substantially in developing this area of research, and progress has been relatively rapid at a time when there is serious world-wide need for such information.

Dr. W. C. Rose, at the University of Illinois, has established the human adult requirement, in a qualitative sense, for eight of the twenty-three amino acids common to protein foods, at least in so far as they are required for maintenance of “nitrogen balance” (total intake of nitrogen compounds balanced against loss from the body). During the current year, he has extended the qualitative findings to include roughly quantitative data for several of the respective acids. Probably within another year or two years, reasonably good measurements will be available for the entire group. Such work is slow and tedious and requires much rechecking, but its great value is recognized by physicians, physiologists and biochemists the world over. In addition to providing a sound foundation for normal protein feeding, the data will also guide medical practice in regard to intravenous feeding and the use of hydrolysates.

Dr. L. E. Holt, Jr., and his associates at New York University (formerly at the Johns Hopkins University) are also studying the human requirements for amino acids, including special consideration of the functional role of the natural and synthetic amino acids. This group has also developed several improvements in methods of measuring the acids and their derivatives.

Dr. J. R. Murlin at the University of Rochester has approached the problem of protein evaluation chiefly by testing proteins of varying nutritive quality, with and without amino acid supplements, and has thus extended the amino acid work in a valuable manner. Soybean and yeast protein studies, in large degree because of wartime urgency, were studied by Dr. Arthur Smith and Dr. H. E. Carter respectively, at Wayne University and at the University of Illinois. The high quality of these two protein sources, shown earlier in animal experiments, was verified in human feeding tests.

The levels of vitamin intake recommended by the National Research Council were supported by evidence from animal and human experimentation, but a need for further evidence was recognized. The studies by Dr. L. E. Sevringhaus, at the University of Wisconsin, gave additional support to the approximate levels adopted for vitamin C. Reports from the University of Minnesota by Dr. Ancel Keys and his associates have pointed strongly toward lower possible values for vitamins B₁ and B₂.

Biotin, like several other members of the vitamin B complex, can be synthesized in varying degrees by bacteria in the intestinal tract. Conversely, certain raw proteins, especially from egg white and fish, may interfere with utilization of the vitamins. Dr. Helen Parsons and her associates at the University of Wisconsin have given valuable information regarding some of the factors that influence bacterial synthesis and body excretion. An indication that vitamin B₂ excretion is controlled more by intake than by intestinal synthesis, was provided by the studies of Dr. G. T. Lewis at Emory University.

The human requirement for simple fats, aside from fat-soluble vitamins, is very poorly defined. Nearly all recommendations regarding fats in human dietaries are still based upon common practice and personal preferences, rather than upon evidence of a physiologic nature. A grant to the University of Pittsburgh, in support of the work by Dr. H. E. Longenecker and his associates, has aided in studying two aspects of the problem: (1) a

comparative study of the fats characteristic of mother's milk and cow's milk, as a basis for estimating infant requirements, or at least desirable intakes; and (2) studies of adult utilization of hardened fats, because of the importance of the problem in relation to military rations.

The current popular interest in vitamins and amino acids has caused many persons to lose sight of the fact that serious problems are also at hand with regard to minerals. Iron, iodine, fluoride and calcium intakes are still faulty in large segments of our population, and many aspects of their utilization are poorly understood. Meanwhile, blood donor service in behalf of the war effort has accentuated the problem of protection against simple anemias that arise in part from iron deficiency. Three of our projects deal with iron utilization for red blood cell formation, with a bearing upon human requirements. Two projects are providing information concerning the utilization of calcium. Such factors as citric acid, proteins and fats, for example, in addition to vitamins, affect the quantity of calcium that must be supplied.

THE ORIGINS AND FUNCTIONS OF INDIVIDUAL NUTRIENTS

Possibly one should not over-emphasize the fact that even the best physicians, chemists and physiologists have an incomplete knowledge of what happens to foodstuffs inside the body, but unless the truth is faced, there will be costly delays in advancing from our present frontiers.

Seven projects of the Foundation deal chiefly with the reactions of sugars and fats in the animal body. Why is the work important? Perhaps two illustrations will suffice: first, roughly three-fourths of all the energy available to the human body comes from burning sugars and fats; and second, among the baffling but common ailments of modern man, many are related intimately to abnormalities in handling sugars and fats.

At Columbia University, Dr. Hans Clarke and his associates,

Dr. DeWitt Stetten and Dr. Konrad Bloch, have developed valuable leads concerning the role of sugar fragments in the synthesis of fats and "animal starch," including new information regarding the role of insulin and its relation to diabetes. Using "heavy hydrogen" and "heavy carbon" as tracer elements to mark the pathway of sugars, fats and related compounds, they are unraveling some of the mysteries that surround the functions of the liver, muscles and other specific organs in controlling the course of food utilization.

Explorations of this kind, at first, simply lead to a better understanding of normal and abnormal changes in body sugars and fats, but they have a reasonable prospect that in time they will provide a basis for understanding the cause of such diseases as diabetes and fatty livers. If the basic causes can be clarified, preventive medicine then has an opportunity to forestall disease, as we now avoid typhoid fever.

Additional projects dealing with the role of sugars and fats are under way at Washington University, Harvard University, Massachusetts Institute of Technology and Cornell University. These are not projects with a narrow interest in a particular aspect of medicine or of interest only to those concerned with sugars, fats, grains, meats or dairy products — they are important avenues of progress for all who are interested in health and the best use of food.

During the war, chickens became prominent as consumers of protein foods as well as "converters" or suppliers in the form of eggs. Good progress was made by Dr. J. Almquist and associates at the University of California in finding the chick's requirement of amino acids. Each animal studied thus far shows variations from others. Dr. D. W. Woolley observed similar peculiarities in the requirements of guinea pigs.

The pathway by which iron from foodstuffs can be built into red blood cells is being charted by means of radioactive iron in the laboratories of Dr. P. F. Hahn, of Vanderbilt University.

One of the most valuable new research tools in studies of

proteins and amino acids, whether in basic research or in fields of applied science, is the "microbiological assay of amino acids," (using the rate of growth or acid production of bacteria, yeasts or molds, as a measure of an amino acid contained in a given product). The methods are much simpler, less costly, and more rapid than earlier means of analysis, and in many instances they are more accurate. Grants to the University of California (Dr. M. S. Dunn) and to Stanford University (Dr. G. W. Beadle), have been primarily for the purpose of developing such methods. As in many other cases of "apparently exploratory work," the armed forces have had occasion to use the results of these studies repeatedly, because the risks of protein deterioration in foods and medical supplies are of more than passing interest to the Office of the Quartermaster General and the Office of the Surgeon General.

In Professor Beadle's laboratory, the orange-colored bread molds that are used for making accurate measurements of the amino acids have provided keys also to the functions of the amino acids in body reactions. It is fascinating to see the precision with which an x-ray bombardment can destroy the capacity of a cell (and its offspring) to make its own supply of a given amino acid or vitamin. This happens apparently without disturbing other essential parts of the "internal machinery." Such handicapped cells, actually new genetic strains, can then be used to measure the amount of an amino acid or vitamin supplied to them. Hence they become new tools in chemical and medical research.

New microorganisms for vitamin measurement were also introduced during the year by Dr. Vernon Cheldelin of Oregon State College.

Each new vitamin that has been discovered has led chemists and physiologists to search for its mode of functioning in living cells, partly as a matter of curiosity and partly because such an approach is essential in discovering a nutrient's full usefulness. Ten research groups are being aided by the Foundation in giving major attention to the functional role of vitamins, including

A, C, E and four members of the B-complex. The grants to Yale University, Ontario Agricultural College and Purdue University, especially, have aided in exploring the origins of high concentrations of vitamins in common plant foods. The prospect that field crops can be developed with greatly heightened nutritive value, without sacrificing other desirable qualities, is very bright.

One approach to discovery of what the vitamins do inside the body is to search for their derivatives, either as excreted or as found in special tissues such as muscle, liver and blood cells. Notable progress has been made on six of our projects during the year in tracing the chemical steps by which individual vitamins are formed or converted to other compounds in the body. Niacin, the anti-pellagra vitamin, and vitamin B₆ have been studied to special advantage in this respect by Dr. W. A. Perlzweig and his associates at Duke University.

Another widely used approach to identifying vitamin functions has been to examine the tissues and excretions for evidence of abnormality in parallel with a known deficiency. Dr. Ade T. Milhorat at Cornell University and Dr. Karl Mason at the University of Rochester have made distinct progress in their studies of the role of vitamin E. The former has followed changes in muscle metabolism, as measured primarily by excretion products, and the latter has identified peculiarities in muscle pigments related to the vitamin. Common forms of muscle degeneration in children and adults are related to the types of change under investigation by both laboratories.

There are probably no less than three, and perhaps more, vitamins yet to be isolated and identified as members of the "B-complex." Grants have been made to aid the work of Dr. D. W. Woolley at the Rockefeller Institute, Dr. Paul L. Day at the University of Arkansas and Dr. L. C. Norris at Cornell University, in identifying such factors. Because of the poor stability of some of these newer nutrients during processing and storage of foods, they are of interest in regard to army rations, especially for use in the Pacific area. One of them is essential for normal blood

cell formation (both white and red cells) and in enabling monkeys to resist intestinal infections.

Although not always classed as a vitamin, choline is an essential nutrient that is normally supplied in crude fatty materials. A better knowledge of its functional role has been supplied by the studies of Dr. R. S. Riley and Dr. H. C. Hodge at the University of Rochester.

MATERNAL AND INFANT NUTRITION

When the Nutrition Foundation was first organized, there was unanimous agreement by committeemen that maternal and infant nutrition merited special consideration. The periods of gestation and lactation are accompanied by special physiological stresses and nutritive demands upon the mother. Fetal life and early infancy also represent critical periods of development. Accidents and heredity may overshadow the constant need for food and air, but without provision for these two basic requirements there is no possibility that a normal body and mind will develop.

The first project in this area aided by the Foundation was fortunately one of outstanding merit and accomplishment. Dr. Icie Macy Hoobler and her associates at the Children's Fund of Michigan, with a background of rich experience in maternal, infant and child feeding research, undertook an intensive study of the composition of mother's milk, including detailed consideration of the mother's diet and health, as well as having thorough medical and nursing cooperation throughout the study.

The literature contains much information regarding the composition of human and other types of milk, to be sure, but in terms of modern techniques and newly recognized nutrients, the available data were woefully inadequate.

Because of the need for reliable, comparative data on the composition of cow's milk, as a basis for supplementary and emergency infant feeding, Dr. L. A. Maynard and his associates at Cornell University undertook a parallel investigation.

Since differences in composition of fats in the two kinds of milk were known to exist, though of unknown significance or degree, and in view of the complexity of the task of making detailed fat analyses, a third laboratory agreed to cooperate on that phase of the problem. Dr. H. E. Longenecker and associates at the University of Pittsburgh were supplied with representative samples of fat from both sources, including samples of colostrum (early milk) and normal milk. Several new and important points regarding the composition of human milk fat and its relation to cow's milk fat resulted from the study.

Few studies in human nutrition have been so challenging to America as the recent reports by Dr. H. C. Stuart, Mrs. Bertha Burke and their associates at Harvard University. From careful records obtained through a period of several years, it appears that the prospect of an infant being in robust health was four times greater when the mother's diet was good or excellent, compared to the result when diets were poor or very poor. And the risk that an infant would be classed as poor or very poor in health was only one-twentieth as great as when the diet was good or excellent. Their work has been noteworthy in stimulating increased interest in studies of infant and maternal health as well as in pointing toward increased emphasis upon good nutrition. The Foundation's grant for a five year period will enable them to strengthen both their research and their educational work.

Closely related to the above area of interest are three studies based upon the use of experimental animals: one, in which Dr. L. R. Cerecedo at Fordham University has shown that a new member of the vitamin B-complex, "folic acid," is of special importance for the maintenance of lactation in rats; a second, in which Dr. Joseph Warkany at the University of Cincinnati has demonstrated (with rats) the importance of good nutrition during early pregnancy as a means of lessening the incidence of physical deformities in the offspring; and a third, just getting under way at Yale University, under the supervision of Dr. A. H. Morse and Dr. G. van Wagenen, in which a standardized

colony of monkeys will be used. Dr. George Cowgill and Dr. B. G. Anderson are collaborating in the latter study.

It is too early to comment upon the similarity of findings in the different laboratories referred to above, but it is already evident that each group gains much from contacts and discussions with the other. The group at Yale University, for example, has an opportunity to check, under well controlled conditions, the types of observations made by Dr. Warkany and Dr. Cerecedo, bringing the rat experiments one step closer to interpretation in relation to human problems.

PUBLIC HEALTH PROBLEMS IN NUTRITION

It is very important that we should have unmistakable evidence of the relations between human health and current nutritional practices. The trend toward emphasis upon levels of nutrition above those characterized by frank deficiency diseases, is supported ardently by nearly all persons who have had an opportunity to observe carefully controlled animal experiments. There, the evidence is so clear that one can scarcely remain unconvinced. Even with the poorly controlled conditions that characterize most farms, a reasonably diligent farmer can see the gains in livestock health and vigor that are achieved by good feeding, compared to poor feeding, all within a range of variation well above an occurrence of diseased conditions such as pellagra, scurvy and rickets. The latter represent approaching collapse. But where is one to find the "top level?" There is need to see clear demonstrations of the gains in health that can be achieved by better practices in regard to food, not as based upon analogy to animal tests or upon possible over-enthusiasm, but in accordance with a conservative interpretation of good scientific evidence. Steps are underway to obtain such evidence in good medical research centers.

The studies of food consumption in relation to tooth decay in

experimental animals at the University of Wisconsin (Dr. C. A. Elvehjem and Dr. Paul Phillips) have led to valuable results in three respects: first, a new type of experimental animal, the cotton rat, was introduced for such investigations, and it proved to be of outstanding value; second, new information was gained relative to the importance of different types and proportions of carbohydrates in the diet, as influencing the onset of tooth decay; and third, the Research Fellow (Dr. James Shaw) trained on the project has been given an opportunity to assist in developing an extensive research and educational program in dental medicine at Harvard University. A cardinal point in the Foundation's program consists in emphasis upon personnel training for future research in nutrition, in parallel with the development of factual information.

In all, four projects aided by the Foundation have a direct relation to tooth development and several others will build up related evidence more gradually.

A grant to the Public Health Research Institute, New York City, aids Dr. O. A. Bessey and his associates in their further development of new techniques of appraising nutritional status. Their micro methods of analyzing small samples of blood for a whole series of nutrients have begun to achieve remarkable usefulness, especially in group surveys. Only about two drops of blood from a finger tip are required to permit accurate analyses for vitamin A, vitamin C, hemoglobin, plasma protein and phosphatase (an index of early rickets). Rapid progress is being made toward measuring additional nutrients—still with only two or three drops of blood. Such chemical evidence does not remove the need for clinical examination by specialists in medical nutrition, but it provides objective evidence that supplements and often extends beyond the evidence that can possibly be obtained by physical examination. The methods are also of value as general tools of research beyond their initial use in clinical nutrition. At the urgent request of other research centers, arrangements were made for staff members from fourteen laboratories to

receive special training in the new techniques during the early summer of 1945. Many more would have come had facilities permitted.

The problem of estimating the nutritional condition of a patient is often baffling to the physician. One of the major difficulties arises from the influence of time and other variables, at given levels of intake, in causing symptoms to vary. Again, exposures to sunlight, bruising, infections, and quality of protein intake add further complications, so there is little wonder that physicians differ in their interpretation of symptoms such as moderate changes in the tongue, gums, lips, eyes and skin. Dr. Tom Spies and his associates at the University of Cincinnati have been aided in work of this nature. And with less over-all emphasis upon medical diagnosis, similar work has been advanced as a part of the work on eight other projects.

A recent paper from the University of Wisconsin laboratory has thrown new light on the variation in symptoms that arise from vitamin C deficiency. They used monkeys, in which the tissue changes closely resemble those in the human body. Very low intakes of the vitamin caused a rapid onset of the typical signs of scurvy, without characteristic reddening and swelling of the gums. But when there was a long period of moderately low intake, gum conditions like those frequently observed in most areas of the United States and Canada were observed. In a practical sense, the findings strengthen the opinion of many physicians and nutritionists that our population would be benefited in health by an increased consumption of foods rich in vitamin C.

One of the most difficult problems in nutrition is to evaluate the over-all gains in health that might be achieved by intakes of specific nutrients two, three, or perhaps five times greater than the quantities that will protect the body against definite signs of deficiency. During the year, Dr. H. C. Sherman at Columbia University reported on a long series of such experiments with rats, based upon different levels of vitamin A intake. The results

demonstrated gains in health at levels well above those required for normal growth and freedom from specific signs of deficiency. Findings of a similar nature had been reported earlier with respect to calcium and vitamin B₂.

Only glimpses are yet available concerning the possible relation of food intake to cancer. Nevertheless, tangible leads are being explored and will be followed with great interest. Initial studies of liver function in that respect are being developed by Dr. C. P. Rhoads and his associates at Memorial Hospital, New York.

EDUCATION AND PROFESSIONAL TRAINING

In the long run, education in nutrition should assist the general public in securing an optimal type of diet. But where to begin?

Publication of Nutrition Reviews was undertaken as a new type of educational measure, to aid in bridging the gap between research findings and their application. The editors have worked at a high level of objective criticism of the world's current research literature in nutrition, providing an element of confidence and interpretation in regard to sound research findings, and conversely, a note of reservation when published reports are inconclusive or poorly interpreted. Their task is obviously both difficult and delicate, but expressions of appreciation from physicians, public health officials, dietitians, teachers, food technologists, home economists, science writers, biochemists, advanced students and others who are working in scientific fields related to nutrition, have been most encouraging. Complimentary copies have been sent regularly to nutrition officers in the armed services and to a large number of health officers. Through the courtesy of the Josiah Macy, Jr. Foundation, 2,000 copies per month have been distributed to medical libraries of the armed forces.

A Spanish edition of Nutrition Reviews, "Nutricion," is being published by La Prensa Medica Mexicana, in Mexico City, for distribution in Central and South America.

To assist in carrying out special projects of national importance for which government funds were not available, grants have been made each year to the Food and Nutrition Board of the National Research Council. This body has rendered outstanding advisory service to the government throughout the war period.

Because of the serious shortage of physicians who have had advanced training in nutrition, a fellowship fund was placed at Harvard University, under the supervision of Dr. F. J. Stare, for use in behalf of young physicians or dietitians of special promise, who will, presumably, continue their careers in schools of medicine and public health.

The greatest single area of educational assistance is, of course, by means of the research grants which provide for graduate student and post-doctorate fellowships. Approximately two hundred young people of outstanding promise are being trained in the science of nutrition, even though a high proportion of them are now working full-time on war-related projects.

STUDIES DIRECTLY RELATED TO THE WAR EMERGENCY

Every effort has been made to keep the program as effectively geared to the nation's need as possible. The Office of the Surgeon General of the Army and the Office of the Surgeon General of the Public Health Service have been represented on our Scientific Advisory Committee, and the Office of the Quartermaster General has been represented on our Food Industries Advisory Committee.

At the beginning of the war there was urgent need for information on (1) the composition of foods intended for use by the armed forces; (2) the effects of dehydration, storage at high temperatures and large scale cookery upon losses in nutrients; and (3) the effects of extremes of environment and stress upon human nutritional requirements.

Accordingly, many projects were supported primarily because

of their immediate value. Seven grants were made for studies of nutrient losses in dehydrated foods, five dealt primarily with food composition, four supported studies of large scale cookery losses, two were concerned primarily with aviation feeding, and two aided intensive studies of relationships between nutrition and fatigue. Other projects included studies of nutrition in relation to shock, bone healing, resistance to infections, liver injury, partial starvation, tolerance of medicinals, and the availability of hardened fats.

Two years ago, a grant was made in support of work conducted by Dr. Charles Hoagland and Dr. Elaine Ralli at New York University for the purpose of obtaining a better understanding of changes observed commonly in the fatty material of the blood and liver of hospital patients. Within a short time the results provided a critically needed guide for the best measures to use in the diagnosis and convalescent treatment of thousands of men returning from the war fronts, whose livers have been damaged by infections. This particular project was not undertaken as a war measure, but it illustrates the way in which good research keeps turning up new information that has unexpected value. The most important aspect of research is to find and train men who have outstanding ability and character; and then one should help them in their explorations, without too great regard for applications.

Improved techniques of studying bone healing and advances in understanding the need for good nutrition to facilitate rapid healing have resulted from the investigations conducted by Dr. D. M. Greenberg at the University of California.

Dr. A. C. Ivy at Northwestern University has been aided in his studies of aviation fatigue and altitude tolerance with reference to food intake. Special consideration was given to observed changes in vitamin C distribution and to changes in acid-base balance. Both types of change were related to excessive loss of carbon dioxide from the lungs.

At Columbia University, aviation feeding tests have shown

clearly that human altitude tolerance is improved by preflight and inflight meals that are relatively high in carbohydrates. Meals of too low caloric content and long periods between meals were found to impair performance at either high or low altitudes.

Tests within the armed services confirmed the findings and led to improvements in aviation feeding practices. In commenting upon the work supported by the Foundation, Brigadier General Georges Doriot, Chief of the Research and Development Branch, in the Office of the Quartermaster General said: "The application of these findings has resulted in a measurable decrease in the number of those flying accidents which, up to a year ago, had to be attributed to 'causes unknown.'"

Dr. Ancel Keys of the University of Minnesota and Drs. Robert Johnson and W. H. Forbes of the Harvard Fatigue Laboratory received assistance in their extensive studies of nutrition in relation to fatigue. Both groups have worked very closely with the armed forces in field testing, in addition to conducting controlled laboratory tests. Dr. Keys' study of water, salt and vitamin requirements when men are exposed to high temperatures has been of distinct value in relation to military and civilian operations in the tropics. Dr. Johnson has worked closely with the Office of the Surgeon General and the Office of the Quartermaster General in developing laboratory equipment and procedures for use in army field studies of rations.

The armed forces had good reason to be concerned about losses of essential nutrients during food preparation. It is not uncommon for institutional practices to result in specific vitamin and mineral losses ranging from 50 to 80 percent, whereas good practices will commonly eliminate about three-fourths of this enormous waste and provide more attractive foods as a result of the care taken. Grants from the Foundation have aided in such studies by (a) the Southern Cooperative Group, working in Land Grant Colleges of the South, (b) Dr. Margaret Fincke and Dr. V. Cheldelin at Oregon State College, and (c) Dr. Evelyn Halliday at the University of Chicago.

As a participant in the nationwide intensive study of food composition, Dr. W. H. Peterson of the University of Wisconsin shared in a thorough appraisal of the vitamin A value of American butter. The study led to general agreement that a value of 15,000 units should replace the former estimate of 9,000 units.

Most of the war emergency projects have been essentially completed or will be completed during the current year. Meanwhile, experience has shown repeatedly that studies regarded as relatively fundamental and of fairly long duration in 1942, have in fact contributed to the war effort in greater degree than many of the projects originally considered as directly applicable and "urgent." For example:

1. Dr. Rose's work on human amino acid requirements has been of world-wide value in guiding medical war work and army food testing, even though his findings are still far from being completed.
2. The methods of measuring amino acids developed by Dr. Dunn and Dr. Beadle have been used in government work, both to study army rations and in medical research dealing with proteins of critical importance.
3. Dr. Sevringhaus' studies of human requirements for vitamins C and B₂ have been of value in relation to military and civilian feeding plans.
4. The importance of good feeding in relation to convalescence and to resistance against infections has been of increasing interest in both military and civilian activities in the tropics.
5. Progress in identifying new members of the vitamin B-complex, such as directed by Drs. Day, Woolley and Norris, has been followed with active interest by those in charge of feeding the armed forces, because some of the new factors are largely destroyed during dehydration and storage, and, in animals at least, they are essential to protection against anemia and intestinal infections.
6. Physicians and biochemists trained in the newer methods of evaluating nutritional status have been of increasing service

to our armed forces and in the care of civilian populations in occupied areas.

In placing new grants during the year, consideration has been given to their use in providing for placement of outstanding young scientists who have been engaged in war work; this factor will be given increased weight in the year ahead.

The prospect that basic research and education in the science of nutrition might make a major contribution to human betterment has never been brighter than it is today. Favored by nature, in having natural resources with which to produce an abundant food supply and a section of the earth that is relatively conducive to good health, we can scarcely afford to squander our birthright.

G R A N T S - I N - A I D
 CLASSIFIED BY AREAS OF STUDY

Total amount appropriated \$921,190.00

NOTE: The grouping of projects is necessarily on an arbitrary basis in some instances. For example, a study related primarily to public health may also be of distinct value in relation to the war, and vice versa.

The numbers identify the respective grants listed by the Foundation.

Area I: Human Requirements of Individual Nutrients

Total amount appropriated in this area \$110,800.00

PROTEINS AND AMINO ACIDS

- | | | |
|-----|--|-------------|
| 29. | The amino acid requirements of man | \$57,600.00 |
| | W. C. Rose, University of Illinois | |
| 63. | Amino acid deficiency in man and animals | 8,000.00 |
| | L. E. Holt, Jr., Johns Hopkins University and New York University | |
| 70. | The utilization of special proteins in human feeding | 700.00 |
| | H. E. Carter, University of Illinois | |
| 72. | Evaluating foodstuffs for meeting the human protein requirements | 10,500.00 |
| | J. R. Murlin, University of Rochester | |

FATS

- | | | |
|-----|--|----------|
| 21. | Availability of fatty acids in hydrogenated fats | 5,000.00 |
| | H. E. Longenecker, University of Pittsburgh | |

VITAMINS

- | | | |
|-----|---|----------|
| 26. | Biotin metabolism in man | 1,000.00 |
| | Helen T. Parsons, University of Wisconsin | |
| 51. | Minimum needs of vitamins by adult humans | 5,800.00 |
| | E. L. Sevringhaus, University of Wisconsin | |

MINERALS

- | | |
|--|-----------|
| 33. Factors which may alter calcium utilization by the adult man | 14,000.00 |
| F. R. Steggerda and H. H. Mitchell, University of Illinois | |
| 62. Utilization of dietary iron by man | 6,400.00 |
| Julia O. Holmes, Massachusetts State College | |
| 91. The iron requirement of the adolescent girl | 1,800.00 |
| Francis A. Johnston, University of Chicago | |

Area II: Origins and Functions of Individual Nutrients

Total amount appropriated in this area \$274,850.00

PROTEINS AND AMINO ACIDS

- | | |
|--|-------------|
| 1. Development of bioassays for amino acids; reactions of nitrogen compounds in plants | \$28,000.00 |
| G. W. Beadle, et al, Stanford University | |
| 5. Biologically available methyl groups for man and experimental animals; chemical reactions in the liver and kidney | 15,000.00 |
| V. du Vigneaud, Cornell University Medical College | |
| 44. The synthesis and utilization of liver protein | 11,000.00 |
| J. M. Luck, Stanford University | |
| 55. Amino acid requirements and metabolism of the chicken | 2,000.00 |
| J. Almquist, University of California | |
| 56. Separation of mixtures of amino acids by means of chromatographic adsorption | 1,250.00 |
| H. G. Cassidy, Yale University | |
| 75. Micro-biological analysis of amino acids | 12,000.00 |
| M. S. Dunn, University of California | |

CARBOHYDRATES

- | | |
|--|-----------|
| 58. Role of acetic acid in intermediary metabolism | 12,500.00 |
| H. T. Clarke, Columbia University | |
| 81. Carbohydrate metabolism (with the aid of heavy hydrogen) | 17,400.00 |
| DeWitt Stetten, Jr., Columbia University | |

- | | | |
|-----|---|-----------|
| 84. | Pyruvate metabolism with special emphasis on the role of acetoin
W. W. Westerfeld and A. B. Hastings, Harvard University | 12,000.00 |
| 87. | The mechanism of the biological conversion of carbohydrates to fat
Elmer H. Stotz, Cornell University (Geneva) | 9,600.00 |
| 96. | The mechanism of carbohydrate reactions in animal tissues
C. F. Cori, Washington University | 5,100.00 |

FATS

- | | | |
|-----|--|----------|
| 77. | The nutritive role of hydroxy fatty acids . . .
R. S. Harris, Massachusetts Institute of Technology | 7,200.00 |
| 87. | *The mechanism of the biological conversion of carbohydrates to fat
Elmer H. Stotz, Cornell University (Geneva) | |

MINERALS

- | | | |
|-----|---|----------|
| 22. | Fluoride and phosphate metabolism of bones and teeth
H. B. McCauley, University of Rochester | 4,300.00 |
| 43. | The utilization of radioactive iron
P. F. Hahn, University of Rochester | 3,700.00 |

VITAMINS—GENERAL

- | | | |
|-----|---|-----------|
| 1. | *Development of bioassays for vitamins
G. W. Beadle, et al, Stanford University | |
| 3. | Vitamin content of important plant foods . . .
G. R. Cowgill, E. W. Sinnott, and P. R. Burkholder, Yale University | 6,000.00 |
| 54. | Concentration of new vitamins
D. W. Woolley, Rockefeller Institute | 13,000.00 |
| 69. | Nutrition research equipment
F. J. Stare, Harvard University | 600.00 |
| 73. | Nutrient values of soybeans
P. R. Burkholder, Yale University | 2,200.00 |

* Duplicate listing.

79. Comparing growth factors required by mold-like microorganism with those required by the guinea pig 1,500.00
H. S. Loring, Stanford University

VITAMIN A AND CAROTENE

36. Nature and content of provitamin A pigments in tomatoes 25,200.00
P. F. Zscheile and R. E. Lincoln (H. J. Reed), Purdue University
53. Metabolism of vitamin A 8,100.00
H. Sobotka, Mount Sinai Hospital
93. The intermediary metabolism of carotene . . . 3,000.00
H. J. Deuel, Jr., and J. W. Mehl, University of Southern California

VITAMINS - B GROUP

4. Studies of the vitamin B complex with the mouse as an experimental animal 5,000.00
G. R. Cowgill, Yale University
27. Synthesis and metabolism of nicotinic acid in the rat 6,500.00
W. A. Perlzweig, Duke University
42. Thiamine changes in skeletal muscle 1,000.00
J. W. Ferrebee, Harvard University
57. Improvement and development of assay methods for B vitamins 16,900.00
V. H. Cheldelin, Oregon State College
65. Retention of B vitamins in rats on various diets . 8,300.00
E. W. McHenry, University of Toronto
89. Studies in pantothenic acid metabolism 850.00
H. D. West, Meharry Medical College
100. Characterization of compounds containing bound biotin and other vitamins 2,400.00
W. H. Peterson, University of Wisconsin
101. Newer members of the vitamin B complex with special reference to anti-anemia activity . . . 10,000.00
L. C. Norris, Cornell University

VITAMIN C

- 36. *Nature and content of ascorbic acid in tomatoes
P. F. Zscheile and R. E. Lincoln (H. J. Reed), Purdue University

VITAMIN E

- 46. Metabolism of proteins during partial starvation 6,250.00
A. T. Milhorat, Cornell University Medical College
- 97. The nature and significance of a pigment associated with vitamin E deficiency 10,000.00
K. E. Mason, University of Rochester

CHOLINE

- 13. Metabolic fate of choline 7,000.00
H. C. Hodge, University of Rochester

Area III: Maternal and Infant Nutrition

Total amount appropriated in this area \$108,800.00

MATERNAL AND INFANT NUTRITION

- 85. Maternal and infant nutrition in primates . . . \$14,000.00
A. H. Morse and G. Van Wagenen, Yale University
- 99. A study of maternal nutrition in relation to maternal and infant health 47,500.00
H. C. Stuart, Harvard University

NUTRIENTS OF HUMAN MILK AND COW'S MILK

- 12. Quantitative study of nutrients of mother's milk under specific or known dietary conditions at different stages of lactation 12,000.00
Icie M. Hoobler, Children's Fund of Michigan
- 45. Quantitative study of the nutrients of cow's milk under specific or known dietary conditions . . 7,500.00
L. A. Maynard and B. L. Herrington, Cornell University

EFFECT OF DIET UPON LACTATION

- 40. The effect of a high vitamin A intake on the vitamin A content of human milk 5,600.00
H. J. Deuel, Jr., University of Southern California

* Duplicate listing.

74. Growth, reproduction and lactation in rats on highly purified diets 6,600.00
L. R. Cerecedo, Fordham University

CONGENITAL MALFORMATIONS

83. Diet and congenital malformations 10,000.00
Joseph Warkany, University of Cincinnati

COMMUNITY NUTRITION

90. Research and education in community nutrition 5,600.00
F. J. Stare, Harvard University

Area IV: Public Health Problems in Nutrition

Total amount appropriated in this area \$169,950.00

ANEMIA

76. Absorption of iron compounds in anemia . . . \$10,800.00
P. F. Hahn, Vanderbilt University

CALCIUM UTILIZATION

33. *Factors which may alter calcium utilization by the adult man
F. R. Steggerda and H. H. Mitchell, University of Illinois

CANCER

50. Liver function in relation to certain carcinogenic agents 12,800.00
C. P. Rhoads, New York Memorial Hospital

DENTAL CARIES

6. Relation of nutrition to dental caries in the monkey 24,500.00
C. A. Elvehjem and P. H. Phillips, University of Wisconsin
22. *Fluoride and phosphate metabolism of bones and teeth
H. B. McCauley, University of Rochester

* Duplicate listing.

47. Relation of niacin and other B vitamin deficiencies to oral diseases 16,000.00
 Agnes F. Morgan and H. Becks, University of California
85. *Maternal and infant nutrition in primates
 A. H. Morse and G. Van Wagenen, Yale University

DETECTION OF NUTRITIONAL DEFICIENCIES

20. Chemical methods of detecting possible vitamin B₂ deficiencies 3,400.00
 G. T. Lewis and H. S. Alden, Emory University
32. Development of methods for diagnosing vitamin deficiency diseases 25,000.00
 T. D. Spies, University of Cincinnati
95. Development of microchemical methods for evaluating nutritional status 10,500.00
 O. A. Bessey, Public Health Research Institute

INFECTION

39. The relation of vitamin deficiency to susceptibility of monkeys to infection 7,800.00
 P. L. Day, University of Arkansas

LIVER FUNCTION

50. *Liver function in relation to certain carcinogenic agents
 C. P. Rhoads, New York Memorial Hospital
67. Vitamin A, carotene and fat in cirrhosis and fatty infiltration of the liver 10,500.00
 Elaine P. Ralli and C. L. Hoagland, New York University

NUTRITION AND PUBLIC HEALTH

38. Chemical changes in fats associated with breakdown of kidney tissue 3,000.00
 A. Chanutin, University of Virginia
71. Study of malnutrition in a specific area, in conjunction with the educational program of the State Health Department 22,500.00
 W. S. Leathers and J. B. Youmans (W. J. Darby), Vanderbilt University

* Duplicate listing.

NUTRITION AND CHEMOTHERAPY

37. Improvement of the nutritional status of patients to increase their tolerance to chemotherapeutic agents 2,650.00
H. C. S. Aron, Northwestern University

NUTRITION AND WELL-BEING

30. Vitamin A intake in relation to bodily store and well-being at different ages 8,000.00
H. C. Sherman, Columbia University

RHEUMATIC FEVER

2. Relation of nutrition to cellular metabolism, with special reference to rheumatic fever 5,000.00
A. F. Coburn and D. E. Green, Columbia University

SELF-SELECTION

98. Studies on self-selection of diets 6,000.00
E. M. Scott, University of Pittsburgh

TOXIC EMERGENCY FOODS

78. *A new form of food poisoning where vetch and related products were consumed as emergency foods
H. B. Lewis, University of Michigan

VITAMIN DEFICIENCY

92. Investigation of the nature of the ascending paralysis produced in dogs on a B-complex deficient diet and responding to biotin therapy 1,500.00
Susan Gower Smith, Duke University

Area V: Education and Professional Training

Total amount appropriated in this area \$73,400.00

CRITICAL REVIEW OF LITERATURE

24. Review of research literature in the science of nutrition. Publication of "Nutrition Reviews"

* Duplicate listing.

available to scientists, physicians, dietitians,
 public health officials, home economists, nutri-
 tionists, food technologists, science writers and
 others \$48,000.00
 F. J. Stare, Harvard University, Editor

SPANISH EDITION OF NUTRITION REVIEWS

88. Publication of "Nutricion," Spanish edition of
 "Nutrition Reviews," for distribution to the
 Spanish-speaking Americas 5,900.00
 La Prensa Medica Mexicana, Mexico, D.F.

MONOGRAPHS AND RELATED PUBLICATIONS

94. Assistance in the preparation and publication of
 monographs on selected topics where there is
 special need for a critical and comprehensive
 summary of the literature 8,000.00

FOOD AND NUTRITION BOARD

10. *Support of the work of the Board in develop-
 ing and applying the science of nutrition
 R. G. Harrison, Food and Nutrition Board, National
 Research Council

ADVANCED TRAINING IN CLINICAL NUTRITION

86. Fellowship fund for training in the clinical and
 public health aspects of nutrition (physicians
 and dietitians) 7,500.00
 Fredrick J. Stare, Harvard University

CONFERENCES

80. Conferences of nation-wide scope are organized
 from time to time to consider nutritional as-
 pects of education, research and public health 4,000.00

Area VI: Directly Related to the War Emergency

Total amount appropriated in this area \$183,390.00

AVIATION AND NUTRITION

15. Effects of environment on nutrition and meta-
 bolism \$11,000.00
 A. C. Ivy and C. J. Farmer, Northwestern University

* Duplicate listing.

17. Effects of environment on nutritional requirements and cell respiration 33,000.00
C. G. King, Columbia University

BONE HEALING

8. Influence of dietary factors on the healing of bone fractures 10,100.00
D. M. Greenberg, University of California

COOKING LOSSES

7. Thiamine content of frozen and cooked vegetables 2,250.00
Margaret L. Fincke, Oregon State College
9. Effect of large quantity cooking on the vitamin and mineral content of vegetables . . . 5,000.00
Evelyn G. Halliday, University of Chicago
11. Thiamine analysis and stability in cereal products 2,400.00
D. J. Hennessy, Fordham University
68. Conservation of the nutritive value of foods . . 4,000.00
Ruth Reder, Oklahoma Experiment Station

DEHYDRATION

19. Carotene and ascorbic acid content of vegetables preserved by drying 2,400.00
C. J. Koehn, (J. D. Capps), Alabama Polytechnic Institute
34. Conservation of nutritive values in dehydrated vegetables 6,790.00
D. K. Tressler, (L. A. Maynard and E. H. Stotz), Cornell University
52. Factors affecting vitamin A stability and utilization 2,700.00
W. C. Sherman, (E. L. Hove), Alabama Polytechnic Institute
59. Vitamin content of dehydrated and stored meats 2,700.00
C. A. Elvehjem, University of Wisconsin
60. Changes in nutritive value of processed meat products during storage 4,000.00
E. A. Evans, Jr., University of Chicago

64. Effect of processing and storage upon nutritive factors in dehydrated vegetables 5,250.00
L. A. Maynard and W. A. Gortner, Cornell University
66. Oxidizing enzymes and other factors related to nutritive value of dehydrated foods 5,250.00
J. M. Nelson, C. R. Dawson, Columbia University

FATIGUE

16. Nutrition and resistance to fatigue in normal man 15,000.00
A. Keys, University of Minnesota
61. Nutritional requirements of normal men doing hard work 5,600.00
W. H. Forbes, Harvard University

FATS

21. *Availability of fatty acids in hydrogenated fats
H. E. Longenecker, University of Pittsburgh

FOOD COMPOSITION

14. The amino acid content of vegetables 2,000.00
L. E. Holt, Jr., Johns Hopkins University
18. Copper-containing proteins and their relation to the destruction of specific nutrients 7,000.00
C. G. King, Columbia University
25. A natural butter suitable for use under tropical conditions 4,350.00
L. S. Palmer, et al, University of Minnesota
28. The carotene and vitamin A content of market butters and cheese 3,400.00
W. H. Peterson, University of Wisconsin
35. Survey of vitamin content of fruits and vegetables 13,500.00
J. H. L. Truscott, Ontario Agricultural College
49. The vitamin content of low cost vegetables 1,600.00
N. L. Noecker, University of Notre Dame

INFECTION

39. *The relation of vitamin deficiency to susceptibility of monkeys to infection
P. L. Day, University of Arkansas

* Duplicate listing.

LIVER FUNCTION

67. Vitamin A, carotene and fat in cirrhosis and fatty infiltration of the liver
Elaine P. Ralli and C. L. Hoagland, New York University

NUTRITION (GENERAL)

10. Support of the work of the Board in developing and applying the science of nutrition 20,000.00
R. G. Harrison, Food and Nutrition Board, National Research Council
31. Utilization of soy bean proteins and minerals . . 7,200.00
A. H. Smith, Wayne University
101. *Newer members of the vitamin B complex with special reference to anti-anemia activity
L. C. Norris, Cornell University

SHOCK

41. The relation of vitamin C to the vascular system 4,500.00
A. W. Duryee, New York Post Graduate Hospital

STARVATION

46. *Metabolism of proteins during partial starvation
A. T. Milhorat, Cornell University Medical College

TOLERANCE TO ARSENICAL DRUGS

37. *Improvement of the nutritional status of patients to increase their tolerance to chemotherapeutic agents
H. C. S. Aron, Northwestern University

TOXIC EMERGENCY FOOD

78. A new form of food poisoning where vetch and related products were consumed as emergency foods 2,400.00
H. B. Lewis, University of Michigan

* Duplicate listing.

*INSTITUTIONS IN THE UNITED STATES AND CANADA
RECEIVING GRANTS-IN-AID*

ALABAMA POLYTECHNIC INSTITUTE, Auburn, Alabama	NEW YORK UNIVERSITY, New York, New York
CHILDREN'S FUND OF MICHIGAN, Detroit, Michigan	NORTHWESTERN UNIVERSITY, Chicago, Illinois
COLUMBIA UNIVERSITY, New York, New York	OKLAHOMA EXPERIMENT STATION, Stillwater, Oklahoma
CORNELL UNIVERSITY, Ithaca, New York	ONTARIO AGRICULTURAL COLLEGE, Guclph, Ontario
DUKE UNIVERSITY, Durham, North Carolina	OREGON STATE COLLEGE, Corvallis, Oregon
EMORY UNIVERSITY, Atlanta, Georgia	PUBLIC HEALTH RESEARCH INSTITUTE, New York, New York
FOOD & NUTRITION BOARD, N.R.C. Washington, D. C.	PURDUE UNIVERSITY, Lafayette, Indiana
FORDHAM UNIVERSITY, New York, New York	ROCKEFELLER INSTITUTE, New York, New York
HARVARD UNIVERSITY, Cambridge, Massachusetts	STANFORD UNIVERSITY, Stanford University, Calif.
JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland	UNIVERSITY OF ARKANSAS, Little Rock, Arkansas
MCGILL UNIVERSITY, Montreal, Canada	UNIVERSITY OF CALIFORNIA, Berkeley, California
MASS. INSTITUTE OF TECHNOLOGY, Cambridge, Massachusetts	UNIVERSITY OF CHICAGO, Chicago, Illinois
MASS. STATE COLLEGE, Amherst, Massachusetts	UNIVERSITY OF CINCINNATI, Cincinnati, Ohio
MEHARRY MEDICAL COLLEGE, Nashville, Tennessee	UNIVERSITY OF ILLINOIS, Urbana, Illinois
MOUNT SINAI HOSPITAL, New York, New York	UNIVERSITY OF MICHIGAN, Ann Arbor, Michigan
NEW YORK MEMORIAL HOSPITAL, New York, New York	UNIVERSITY OF MINNESOTA, Minneapolis, Minnesota
NEW YORK POST-GRADUATE HOSPITAL, New York, New York	UNIVERSITY OF NOTRE DAME, South Bend, Indiana

UNIVERSITY OF PITTSBURGH,
Pittsburgh, Pennsylvania

UNIVERSITY OF ROCHESTER,
Rochester, New York

UNIVERSITY OF SOUTHERN CALIFORNIA,
Los Angeles, California

UNIVERSITY OF TORONTO,
Toronto, Ontario

UNIVERSITY OF VIRGINIA,
Charlottesville, Virginia

UNIVERSITY OF WISCONSIN,
Madison, Wisconsin

VANDERBILT UNIVERSITY,
Nashville, Tennessee

WASHINGTON UNIVERSITY,
St. Louis, Missouri

WAYNE UNIVERSITY,
Detroit, Michigan

YALE UNIVERSITY,
New Haven, Connecticut

RESEARCH PAPERS PUBLISHED IN SCIENTIFIC
JOURNALS ARISING FROM GRANTS OF
THE NUTRITION FOUNDATION

Area I: Human Requirements of Individual Nutrients

PROTEINS AND AMINO ACIDS

The Role of the Amino Acids in Human Nutrition.

Rose, Haines & Johnson (University of Illinois).
Journal of Biological Chemistry, Vol. 146, p. 683, December, 1942.

Further Experiments on the Role of the Amino Acids in Human Nutrition.

Rose, Haines, Johnson & Warner (University of Illinois).
Journal of Biological Chemistry, Vol. 148, p. 457, May, 1943.

Observations on the Biological Value of a Mixture of Essential Amino Acids.

Albanese & Irby (Johns Hopkins School of Medicine).
Science, Vol. 98, p. 286, September 24, 1943.

A Biochemical Lesion of Lysine Deficiency in Man.

Albanese, Holt, Frankston, Kajdi, Brumback & Wangerin (Johns Hopkins School of Medicine).
Proceedings of the Society for Experimental Biology and Medicine, No. 52, 1943, p. 209.

Observations on a Histidine Deficient Diet in Man.

Albanese, Holt, Frankston & Irby (Johns Hopkins School of Medicine).
Bulletin of Johns Hopkins Hospital, Vol. LXXIV, p. 251, April, 1944.

Observations on a Diet Deficient in Both Methionine and Cystine in Man.

Albanese, Holt, Brumback, Frankston & Irby (Johns Hopkins School of Medicine).
Bulletin of Johns Hopkins Hospital, Vol. LXXIV, p. 251, April, 1944.

A Difference in the Metabolism of *l*- and *dl*-Tryptophane in the Human.

Albanese & Frankston (Johns Hopkins University).
Journal of Biological Chemistry, Vol. 155, p. 101, September, 1944.

Colorimetric Estimation of Phenylalanine in Some Biological Products.

Albanese (Johns Hopkins Hospital).
Journal of Biological Chemistry, Vol. 155, p. 291, September, 1944.

- The Utilization of *d*-Amino Acids by Man.
 Albanese (Johns Hopkins School of Medicine).
Bulletin of Johns Hopkins Hospital, Vol. LXXV, p. 175, September, 1944.
- Amino Acid Analysis of Some Common Vegetables. Method for Carbohydrate-Free Extraction of Nitrogen from Fresh Vegetables.
 Albanese, Wagner, Frankston & Irby (Johns Hopkins School of Medicine).
Industrial & Engineering Chemistry, Vol. 16, p. 609, October, 1944.
- The Estimation of Methionine in Protein Hydrolysates and Human Urine.
 Albanese, Frankston & Irby (Johns Hopkins School of Medicine).
Journal of Biological Chemistry, Vol. 156, p. 293, November, 1944.
- The Tryptophane Requirement of Man as Determined by Nitrogen Balance and by Excretion of Tryptophane in Urine.
 Holt, Albanese, Frankston & Irby (Johns Hopkins School of Medicine).
Bulletin of the Johns Hopkins Hospital, Vol. LXV, p. 353, December, 1944.
- The Estimation of Tryptophane in Human Urine.
 Albanese and Frankston (Johns Hopkins School of Medicine).
Journal of Biological Chemistry, Vol. 157, p. 59, January, 1945.
- Studies on Human Blood Proteins, Part I.
 Albanese & Barnes (Johns Hopkins University).
Journal of Biological Chemistry, Vol. 157, p. 613, February, 1945.
- The Utilization of *d*-Amino Acids by Man, Part II.
 Albanese, Irby, Wagner & Frankston (Johns Hopkins School of Medicine).
Journal of Biological Chemistry, Vol. 158, p. 101, March, 1945.
- Corneal Vascularization in Rats on a Tryptophane Deficient Diet.
 Albanese (Johns Hopkins University).
Science, Vol. 101, p. 619, June 15, 1945.
- The Colorimetric Determination of Arginine in Protein Hydrolysates and Human Urine.
 Albanese & Frankston (Johns Hopkins University).
The Journal of Biological Chemistry, Vol. 159, No. 1, p. 185, June, 1945.

VITAMINS

- Biotin, Pantothenic Acid, and Riboflavin Balances of Young Women on a Milk Diet.
 Gardner, Neal, Peterson & Parsons (University of Wisconsin).
Journal of American Dietetic Assn., Vol. 19, p. 683, October, 1943.

The Minimum Ascorbic Acid Need of Adults.

Kyhos, Gordon, Kimble & Sevringhaus (University of Wisconsin).
Journal of Nutrition, Vol. 27, p. 271, March, 1944.

Observations on Riboflavin Excretion by the Adult Male.

Hagedorn, Kyhos, Germek & Sevringhaus (University of Wisconsin).
Journal of Nutrition, Vol. 29, p. 179, March 10, 1945.

Area II: Origins and Functions of Individual Nutrients
(Including identification and measurement)

PROTEINS AND AMINO ACIDS

Transmethylation as a Metabolic Process in Man.

Du Vigneaud & Simmonds (Cornell University).
Journal of Biological Chemistry, Vol. 146, p. 685, December, 1942.

The Utilization of the Methyl Groups of Choline in the Biological Synthesis of Methionine.

Simmonds, Cohn, Chandler & Du Vigneaud (Cornell University).
Journal of Biological Chemistry, Vol. 149, p. 519, August, 1943.

Glycine Oxidase.

Ratner, Nocito & Green (Columbia University).
Journal of Biological Chemistry, Vol. 152, p. 119, January, 1944.

Interrelation of Methionine, Choline, Betaine, and Arsenocholine in the Chick.

Almquist & Grau (University of California).
Journal of Nutrition, Vol. 27, p. 263, March, 1944.

Amino Acid Absorption and Utilization in the Chick.

Kratzer (University of California).
Journal of Biological Chemistry, Vol. 153, p. 237, April, 1944.

The Ornithine Cycle in *Neurospora* and Its Genetic Control.

Srb & Horowitz (Stanford University).
Journal of Biological Chemistry, Vol. 154, p. 129, June, 1944.

A Leucineless Mutant Strain of *Neurospora Crassa*.

Regnery (Stanford University).
Journal of Biological Chemistry, Vol. 154, p. 151, June, 1944.

Some Aspects of the Metabolism of Leucine and Valine.

Bloch (Columbia University).
Journal of Biological Chemistry, Vol. 155, p. 255, September, 1944.

Requirement of Tryptophane by the Chick.

Grau & Almquist (University of California).
Journal of Nutrition, Vol. 28, p. 263, October, 1944.

The Amino Acid Requirements of the Chick.

Almquist & Grau (University of California).

Journal of Nutrition, Vol. 28, p. 325, November, 1944.

A Lysineless Mutant of Neurospora and Its Inhibition by Arginine.

Doermann (Stanford University).

Archives of Biochemistry, Vol. 5, p. 373, December, 1944.

Investigations of Amino Acids, Peptides and Proteins, Part XVIII.

Dunn, Shankman, Camien, Frankl & Rockland (University of California).

Journal of Biological Chemistry, Vol. 156, p. 703, December, 1944.

Investigations of Amino Acids, Peptides and Proteins, Part XIX.

Dunn, Shankman, Camien, Frankl & Rockland (University of California).

Journal of Biological Chemistry, Vol. 156, p. 715, December, 1944.

Investigations of Amino Acids, Peptides and Proteins, Part XX.

Dunn, Schott, Frankl & Rockland (University of California).

Journal of Biological Chemistry, Vol. 157, p. 387, January, 1945.

Further Studies on Cystine, Methionine and Choline in Chick Diets.

Almquist & Grau (University of California).

Journal of Nutrition, Vol. 29, p. 210, March 10, 1945.

A Further Study of the Lability of the Methyl Group of Creatine.

Simmonds & Du Vigneaud (Cornell University).

Proceedings of the Society for Experimental Biology and Medicine, Vol. 59, p. 293, June, 1945.

Deformity of the Tongue Associated with Amino Acid Deficiencies in the Chick.

Grau (University of California).

Proceedings of the Society for Experimental Biology and Medicine, Vol. 59, p. 177, June, 1945.

CARBOHYDRATES

Sources of Acetic Acid in the Animal Body.

Bloch & Rittenberg (Columbia University).

Journal of Biological Chemistry, Vol. 155, p. 243, September, 1944.

Studies in Carbohydrate Metabolism, Part I.

Stetten & Boxer (Columbia University).

Journal of Biological Chemistry, Vol. 155, p. 231, September, 1944.

Studies in Carbohydrate Metabolism, Part II.

Stetten & Boxer (Columbia University).

Journal of Biological Chemistry, Vol. 155, p. 237, September, 1944.

Studies in Carbohydrate Metabolism, Part III.

Stetten & Boxer (Columbia University).

Journal of Biological Chemistry, Vol. 156, p. 271, November, 1944.

Studies in Carbohydrate Metabolism, Part IV.

Stetten (Columbia University).

Journal of Biological Chemistry, Vol. 159, p. 123, June, 1945.

An Estimation of Acetic Acid Formation in the Rat.

Bloch & Rittenberg (Columbia University).

Journal of Biological Chemistry, Vol. 159, p. 45, June, 1945.

FATS

Unsaturated Synthetic Glycerides, VII.

Daubert & Baldwin (University of Pittsburgh).

Journal of American Chemical Society, 66, 997 (1944).

Unsaturated Synthetic Glycerides, VIII.

Daubert & Baldwin (University of Pittsburgh).

Journal of American Chemical Society, 66, 1507 (1944).

The Biological Conversion of Cholesterol to Pregnanediol.

Bloch (Columbia University).

Journal of Biological Chemistry, Vol. 157, p. 661, February, 1945.

Fatty Acid Analyses of Known Mixtures of Purified Methyl Esters.

Baldwin & Longenecker (University of Pittsburgh).

Oil & Soap, Vol. XXII, p. 151, June, 1945.

MINERALS

Conversion of Inorganic and Hemoglobin Iron into Ferritin Iron in the Animal Body. Storage Function of Ferritin Iron as Shown By Radioactive and Magnetic Measurements.

Hahn, Granick, Bale & Michaelis (University of Rochester).

Journal of Biological Chemistry, Vol. 150, p. 407, October, 1943.

The Physiological Bilaterality of the Portal Circulation.

Hahn, Donald & Grier (Vanderbilt University).

American Journal of Physiology, Vol. 143, p. 105, January, 1945.

VITAMINS

The Increase of B Vitamins in Germinating Seeds.

Burkholder & McVeigh (Yale University).

Proceedings of National Academy of Sciences, Vol. 28, p. 440, October, 1942.

- The Fluorescence of Vitamin A.
Sobotka, Kann & Loewenstein (Mount Sinai Hospital).
Journal of American Chemical Society, 65, 1959, 1943.
- The Probable Identity of Najjar and Holt's Fluorescent Substance, F₂.
Huff & Perlzweig (Duke University).
Science, Vol. 97, p. 538, June 11, 1943.
- Vitamins in Edible Soybeans.
Burkholder (Yale University).
Science, Vol. 98, p. 188, August 27, 1943.
- Provitamin A and Vitamin C in the Genus *Lycopersicon*.
Lincoln, Zscheile, Porter, Kohler & Caldwell (Purdue University).
The Botanical Gazette, Vol. 105, p. 113, September, 1943.
- A Rapid Method of Estimating N¹-Methylnicotinamide in Urine.
Huff & Perlzweig (Duke University).
Journal of Biological Chemistry, Vol. 150, p. 483, October, 1943.
- N¹-Methylnicotinamide, A Metabolite of Nicotinic Acid in the Urine.
Huff & Perlzweig (Duke University).
Journal of Biological Chemistry, Vol. 150, p. 395, October, 1943.
- The Methylation of Nicotinamide by Rat Liver in Vitro.
Perlzweig, Bernheim & Bernheim (Duke University).
Journal of Biological Chemistry, Vol. 150, p. 401, October, 1943.
- The Excretion of Thiamin, Riboflavin, and Nicotinic Acid by Fasting Men.
Perlzweig, Huff & Gue (Duke University).
Federation Proceedings, Vol. 3, No. 1, March, 1944.
- Pyrimidine Nucleosides and Nucleotides as Growth Factors for Mutant Strains of *Neurospora*.
Loring & Pierce (Stanford University).
Journal of Biological Chemistry, Vol. 153, p. 61, April, 1944.
- Metabolism of Phosphoryl Choline, Part I.
Riley (University of Rochester).
Journal of American Chemical Society, 66, 512, 1944.
- Metabolism of Phosphoryl Choline, Part II.
Riley (University of Rochester).
Journal of Biological Chemistry, Vol. 153, p. 535, May, 1944.
- A Convenient Method for the Preparation of Synthetic Xanthopterin.
Totter (University of Arkansas).
Journal of Biological Chemistry, Vol. 154, p. 105, June, 1944.

Fluorescence of Vitamin A, Part II.

Sobotka, Kann, Winternitz & Brand (Mount Sinai Hospital).
Journal of American Chemical Society, 66, 1162, 1944.

Niacin in Maize.

Burkholder, McVeigh & Moyer (Yale University).
Yale Journal of Biology & Medicine, Vol. 16, p. 659, June, 1944.

An Oxidative Metabolite of Pyridoxine in Human Urine.

Huff & Perlzweig (Duke University).
Science, Vol. 100, p. 15, July 7, 1944.

F₂ and N¹-Methylnicotinamide.

Huff & Perlzweig (Duke University).
Science, Vol. 100, p. 28, July 14, 1944.

Further Studies on the Relationship Between Xanthopterin, Folic Acid and Vitamin M.

Totter, Mims & Day (University of Arkansas).
Science, Vol. 100, p. 223, September 8, 1944.

A Product of Oxidative Metabolism of Pyridoxine, 2-Methyl-3-Hydroxy-4-Carboxy-5-Hydroxy-Methylpyridine (4 Pyridoxic Acid).

Huff & Perlzweig (Duke University).
Journal of Biological Chemistry, Vol. 155, p. 345, September, 1944.

The Use of *Lactobacillus Fermentum* 36 for Thiamine Assay.

Sarett & Cheldelin (Oregon State College).
Journal of Biological Chemistry, Vol. 155, p. 153, September, 1944.

Acute Toxicity of Choline Hydrochloride Administered Intraperitoneally to Rats.

Hodge (University of Rochester).
Proceedings of the Society for Experimental Biology and Medicine, Vol. 57, p. 26, October, 1944.

A Method for the Determination of Substances Enzymatically Convertible to the Factor Stimulating *Streptococcus Lactis* R.

Mims, Totter & Day (University of Arkansas).
Journal of Biological Chemistry, Vol. 155, p. 401, October, 1944.

Inhibition of Utilization of Thiamine and Diphosphothiamine for Growth of Microorganisms.

Sarett & Cheldelin (Oregon State College).
Journal of Biological Chemistry, Vol. 156, p. 91, November, 1944.

An Inositolles Mutant Strain of *Neurospora* and Its Use in Bioassays.

Beadle (Stanford University).
Journal of Biological Chemistry, Vol. 156, p. 683, December, 1944.

- A Modification of the Thiochrome Method for the Rapid Determination of Thiamine in Urine.
Perlzweig, Kamin, Gue & Blalock (Duke University).
Archives of Biochemistry, Vol. 6, p. 97, January, 1945.
- The Pantothenic Acid Requirements of Lactic Acid Bacteria.
Cheldelin, Hoag & Sarrett (Oregon State College).
Journal of Bacteriology, Vol. 49, p. 41, January, 1945.
- The Utilization of Beta-Alanine and Pantothenic Acid by Yeasts.
Sarrett & Cheldelin (Oregon State College).
Journal of Bacteriology, Vol. 49, p. 31, January, 1945.
- Effect of Wheat Germ on Creatinuria in Dermatomyositic and Progressive Muscular Dystrophy.
Milhorat, Toscani & Bartels (Cornell University).
Proceedings of the Society for Experimental Biology and Medicine, Vol. 58, p. 40, January, 1945.
- The Defect in Utilization of Tocopherol in Progressive Muscular Dystrophy.
Milhorat & Bartels (Cornell University).
Science, Vol. 101, p. 93, January 26, 1945.
- Acute Toxicity of Choline Chloride Administered Orally to Rats.
Neuman & Hodge (University of Rochester).
Proceedings of the Society for Experimental Biology and Medicine, Vol. 58, p. 87, January, 1945.
- The Nature of Some New Dietary Factors Required by Guinea Pigs.
Woolley & Sprince (Rockefeller Institute).
Journal of Biological Chemistry, Vol. 157, p. 447, February, 1945.
- Studies on the Enzyme Which Produces the Streptococcus Lactis R-Stimulating Factor from Inactive Precursor Substance in Yeast.
Laskowski, Mims & Day (University of Arkansas).
Journal of Biological Chemistry, Vol. 157, p. 731, February, 1945.
- Microbiological Assay Methods for Nicotinic Acid.
Sarrett, Pederson & Cheldelin (Oregon State College).
Archives of Biochemistry, Vol. 7, p. 77, June, 1945.

Area III: Maternal and Infant Nutrition

HUMAN MILK AND RELATED STUDIES

- Component Fatty Acids of Early and Mature Human Milk Fat.
Baldwin & Longenecker (University of Pittsburgh).
Journal of Biological Chemistry, Vol. 154, p. 255, June, 1944.

Component Fatty Acids from the Fat of Cow Colostrum.
Baldwin & Longenecker (University of Pittsburgh).
Journal of Biological Chemistry, Vol. 155, p. 407, October, 1944.

Studies on Carotenoid Metabolism, Part V. The Effect of a High Vitamin A Intake on the Composition of Human Milk.
Hrubetz, Deuel & Hanley (University of Southern California Medical School).
Journal of Nutrition, Vol. 29, p. 245, April 10, 1945.

CONGENITAL MALFORMATIONS

Congenital Malformations Induced in Rats by Maternal Nutritional Deficiency.

Warkany & Schraffenberger (University of Cincinnati).
Journal of Nutrition, Vol. 27, p. 477, June, 1944.

Congenital Malformations of the Eyes Induced in Rats by Maternal Vitamin A Deficiency.

Warkany & Schraffenberger (Children's Hospital Research Foundation, Cincinnati).
Proceedings of the Society for Experimental Biology and Medicine, Vol. 57, p. 49, October, 1944.

Area IV: Public Health Problems in Nutrition

ANEMIA

Radioactive Iron Procedures.

Hahn (Vanderbilt University).
Industrial & Engineering Chemistry, Vol. 17, p. 45, January 15, 1945.

CANCER

Effect of Dietary Protein on Liver Riboflavin Levels and on Inactivation of Estradiol by Liver.

Unna, Singher, Kensler, Taylor, Jr., & Rhoads (Memorial Hospital).
Proceedings of the Society for Experimental Biology and Medicine, 55, 254, 1944.

The Effect of Vitamin Deficiency on Estradiol Inactivation by the Liver.

Singher, Kensler, Taylor, Rhoads & Unna (Memorial Hospital).
Journal of Biological Chemistry, Vol. 154, p. 79, June, 1944.

Interrelationship Between Thiamine and Riboflavin in the Liver.

Singher, Kensler, Levy, Poore, Rhoads & Unna (Memorial Hospital).
Journal of Biological Chemistry, Vol. 154, p. 69, June, 1944.

DENTAL CARIES

Dental Caries in the Cotton Rat, Part I.

Shaw, Schweigert, McIntire, Elvehjem & Phillips (University of Wisconsin).
Journal of Nutrition, Vol. 28, p. 333, November, 1944.

Dental Caries in the Cotton Rat, Part III.

Schweigert, Shaw, Phillips & Elvehjem (University of Wisconsin).
Journal of Nutrition, Vol. 29, p. 405, June 11, 1945.

Dental Caries in the Cotton Rat, Part IV.

Shaw, Schweigert, Phillips & Elvehjem (University of Wisconsin).
Proceedings of the Society for Experimental Biology and Medicine,
Vol. 59, p. 89, May, 1945.

Dental Caries in the Cotton Rat, Part V.

Schweigert, Shaw, Elvehjem & Phillips (University of Wisconsin).
Proceedings of the Society for Experimental Biology and Medicine,
Vol. 59, p. 44, May, 1945.

DETECTION OF NUTRITIONAL DEFICIENCIES

The Natural Occurrence of Riboflavin Deficiency in the Eyes of Dogs.

Spies (University of Cincinnati).
Science, Vol. 98, p. 369, October 22, 1943.

Detection and Treatment of Severe Atypical Deficiency Disease.

Spies, Cogswell & Vilter (University of Cincinnati).
Journal of American Medical Association, Vol. 126, p. 752, November 18, 1944.

Studies on the Urinary Excretion of Riboflavin.

Feder, Lewis & Alden (Emory University).
Journal of Nutrition, Vol. 27, p. 347, April, 1944.

INFECTION

Effect of a Concentrate of Potential Streptococcus Lactic R-Stimulating Factor on Growth and White Blood Cell Counts of Succinylsulfathiazole-Fed Rats.

Mallory, Mims, Totter & Day (University of Arkansas).
Journal of Biological Chemistry, Vol. 156, p. 317, November, 1944.

The Successful Treatment of Vitamin M Deficiency in the Monkey with Highly Purified Lactobacillus Casei Factor.

Day, Mims, Totter, Stokstad, Hutchings & Sloane (University of Arkansas).
Journal of Biological Chemistry, Vol. 157, p. 423, January, 1945.

NUTRITION AND WELL-BEING

Vitamin A in relation to aging and to length of life.

Sherman, Campbell, Udiljak and Yarmolinsky (Columbia University).
Proceedings of the National Academy of Sciences, Vol. 31, p. 107,
April, 1945.

RHEUMATIC FEVER

The Anti-Bacterial Action of the Xanthine Oxidase System.

Green & Pauli (Columbia University).
Proceedings of the Society for Experimental Biology and Medicine,
No. 54, p. 148, 1943.

The Antibacterial Action of Derivatives and Analogues of
p-Aminobenzoic Acid.

Johnson, Green & Pauli (Columbia University).
Journal of Biological Chemistry, Vol. 153, p. 37, April, 1944.

VITAMIN DEFICIENCY

Acute and Chronic Ascorbic Acid Deficiencies in the Rhesus
Monkey.

Shaw, Phillips & Elvehjem (University of Wisconsin).
Journal of Nutrition, Vol. 29, p. 365, June 11, 1945.

Area VI: Directly Related to the War Emergency

AVIATION AND NUTRITION

Aviation Nutrition Studies, Part I. Effects of Pre-flight and In-
flight Meals of Varying Composition with Respect to Carbo-
hydrate, Protein and Fat.

King, Bickerman, Bouvet, Harrer, Oyler & Seitz (Columbia
University).
Journal of Aviation Medicine, Vol. 6, p. 69, April, 1945.

BONE HEALING

Effect of Lowered Blood Supply and of Glucose-1-Phosphate on
Healing of Bone Fractures.

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