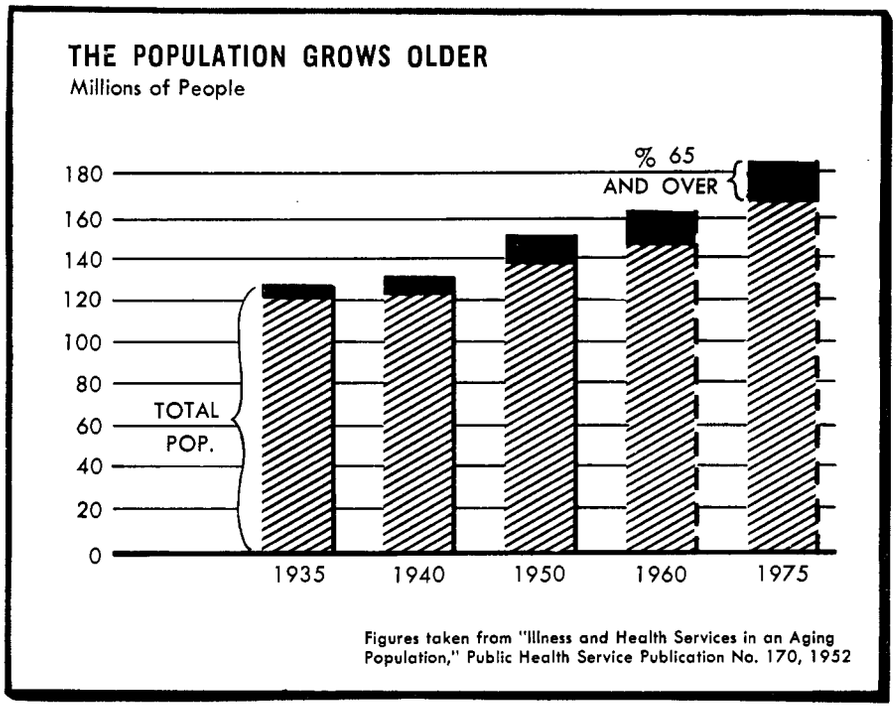

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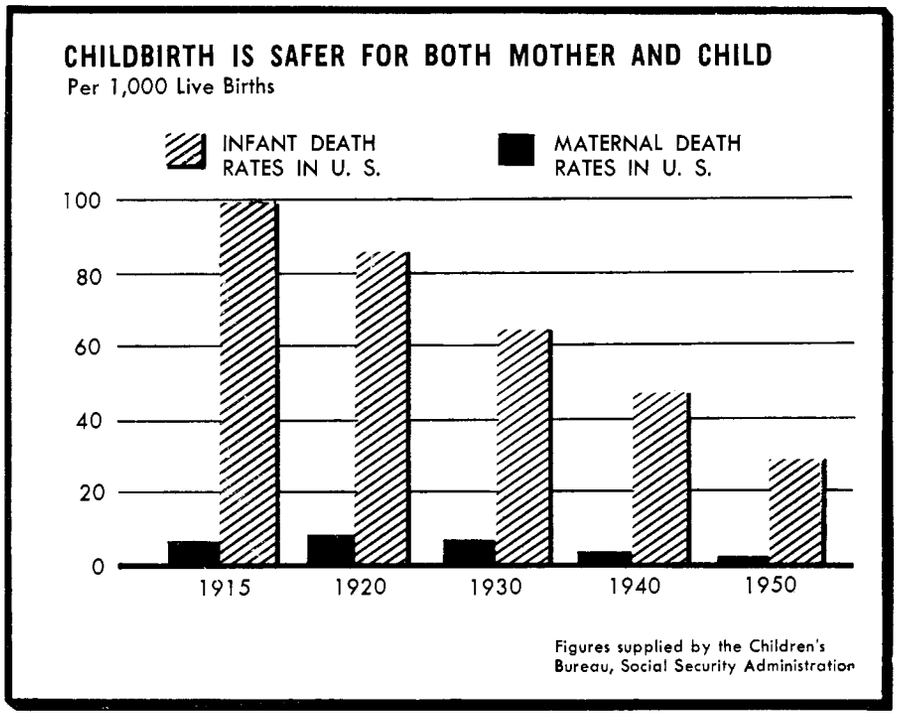

As we learn more about nutrition we see a broader extension of its effects. Chronic diseases and diseases of the aged may be pushed back by better nutrition. There is convincing evidence that leading killers among our diseases can be influenced by nutrition. What we eat and how much are playing a far greater part in our lives than satisfying our appetites and providing energy—and we see that we have only begun to learn.

Public Health *through better* Nutrition

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ANYONE who has reviewed the substantial public health gains of recent years in the field of nutrition must be impressed by the impact of new knowledge on health. The nature of these advances—particularly the conquest of the dietary deficiency diseases—is familiar. This progress is mentioned only as background to an appraisal of the potentialities of nutrition research.

Can we assume that the opportunities of the future will measure up to the tremendous challenges of the past? Or has research in nutrition reached the point of diminishing returns?

There are many indications that the medical profession is becoming aware of health potentialities in nutrition which were undreamed of even in very recent years. Only a few weeks ago (April 1953), for example, Edward L. Bortz, a former president of the American Medical Association, said that the most important underlying factors in premature breakdowns of health are ill-balanced nutrition and prolonged stress. Other examples might be cited, all reflecting the increased significance of nutrition in safeguarding health.

The science of nutrition occupies today a position roughly analogous to that of microbiology. The specific dietary deficiency diseases have yielded to research much as the major infectious diseases have been effectively controlled. In both cases, this has freed our scientists to work on other problems in their respective fields—problems on which research has long been lagging or neglected because of the urgent need to concentrate on those diseases which presented the greatest current threat to public health.

Far from reaching the point of diminishing returns, nutrition research today is confronted by a whole galaxy of highly complex, interrelated problems, the full significance of which is not yet adequately understood and appreciated. Clearly, they will require much fundamental research and long-term support by public, private, and industrial organizations.

Before examining the nature of these problems, I should like to mention briefly the importance of safeguarding the broad nutrition advances made in the last decade or so. These gains are tenuous and must not be taken for granted. We need to continue our efforts to improve both foods and food habits. For, despite the improved nutritional status achieved in recent years, many of our people may still be in a borderline category with respect to nutrition. Their intake of certain nutrients, while sufficient to prevent overt deficiencies, may provide only a scant margin of safety in their tissue stores to resist stress stemming from disease or temporary imbalance in their diets. Any important deterioration in the average American diet might cancel out many of our gains.

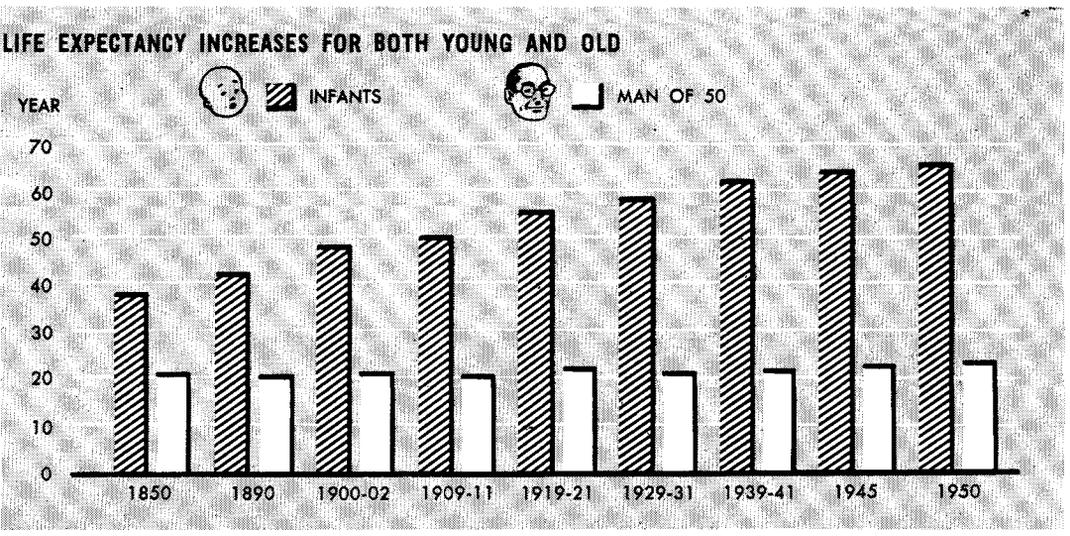
I have said that nutrition research faces tremendous challenges today. Perhaps no factor is more significant here than the aging of our population. During the past century, for example, a full generation has been added to the average span of life in this country and other highly developed nations. This increase in life expectancy amounted to about 2 years in each decade between 1850 and 1900. In the last 50 years, this increase was stepped up to approximately 3.5 to 4 years per decade. (*7*).

It is interesting to note the extent to which the lengthening of the average life span is changing the composition of our population. In 1935 the United States had slightly less than 8 million people 65 years of age and over. By 1950 this age group had increased to more than 12 million. By 1960 the figure is expected to exceed 14.5 million, and by 1975 the 65-and-over group will total almost 20 million (*8*).

When we compare these increases with those of the total population, we find that the old-age group will show an increase of 156% between 1935 and 1975, compared with a 45% increase in the total population (*8*). I think you will agree that this is a rather striking trend of great significance.

A comparison of the life expectancy of the middle-aged American today with that of a century ago further emphasizes the need for attention to the health problems of the aged. As I have indicated, the past century has seen an increase of about 30 years in the average total life span. A 50-year-old man today, however, may except to live only 23 years–a year and a half more than in 1850.

Equally striking comparisons can be made between life expectancies of the middle-aged in this and other countries. In the United States today, the average man of 50 cannot expect to live quite as long as a man of the same age in Norway, the Netherlands, or Denmark. These comparisons all point to the fact that our health gains, for the most part, have been against diseases of the young, and that



we should augment our attack against those prevalent among older people.

Beyond all doubt, nutrition problems concerning our old-age groups will grow in importance in the years ahead. These problems are of special interest in view of the age-associated changes affecting food intake and metabolism. I have in mind here limitations of digestion and circulation, dental problems, emotional factors, poor eating habits, and so forth. In addition, defective absorption or utilization may increase the need for such nutrients as calcium, iron, and protein. These problems, I think, suggest the need for more research into the nutritional requirements of the aged, with attention to upper as well as lower limits. We need also to study means for preventing metabolic derangements, some of which are undoubtedly related to the extensive hormone changes which occur with advancing age.

I should like to mention briefly another problem in nutrition, one which is urgently in need of more research. This is obesity. Our concern here is obvious, in view of the close association of overweight to increased incidence of various chronic diseases. Unfortunately, we know very little about how to attack this problem on a public health scale. Our methods for preventing or curing obesity are inadequate, and the same is true of our standards for evaluating the degree of obesity in any given individual.

It would seem that we could profit greatly in this country, where obesity is so common, from further studies which explore the benefits in health accruing to obese people who have successfully reduced their weight and maintained the reduction. Likewise, we need more precise knowledge of the complex factors which lead to overeating, including psychological complications such as boredom, anxiety, and tension. These are problems which concern not only adults but children as well. For we know that obesity not infrequently originates in childhood.

In the normal person, there is apparently some sort of mechanism for maintaining constant weight by balancing appetite against exertion. This mechanism, which Jolliffe has called the "appestat," fails to function properly in the obese (*3*). Why, we do not know. Until more is learned about the factors that influence and alter appetite, the operation of this mechanism will remain obscure.

Another area which requires further exploration is nutrition under conditions of stress. We know that following surgery, the body tends toward a catabolic economy resembling that of starvation. Ascorbic acid virtually disappears from the circulation, and a negative nitrogen balance occurs. Similar changes may persist into convalescence. To some extent, these unfavorable conditions can be avoided by a buildup of nutritional status. But before we can develop a rational therapy, we need to acquire more knowledge of metabolic processes and how they adjust to stress and more precise information on the benefits which will accrue to patients if these catabolic phenomena are prevented.

This brings us to the major problem area in public health today—the chronic diseases. We are all aware that these disorders present grave problems of long-range importance to public health. Some idea of their cost to society is indicated by the findings of the National Health Survey of 1935–36 and the Baltimore study of 1938–43.

These surveys showed that the chronic diseases—mainly cardiovascular-renal disorders—accounted for almost one third of the annual disability rates in the old-age group, compared with less than 10% of the total illness rate in the general population. Among those aged 65 and over, heart disease headed the list of the 10 leading causes of disabling illness and of days lost from disability (*8*).

When we project these figures to the future, we find that the number of disabling illnesses in the United States lasting seven consecutive days or longer will be 25 to 30% higher by 1960 and 40 to 50% higher by 1975 (*8*). As you know, these expected increases in disability will result not only from the over-all increase in our population, but will also reflect the future rise in the proportion of older people—those in age groups that show the highest rates of chronic illness.

What conclusions can we draw here? First of all, it seems evident that more of our medical, hospital, and nursing services will have to be devoted to the chronic diseases. This will cost the nation many millions of dollars, and I think it points up clearly the need and importance of continued long-range support of research, if we are to make any headway in reducing time lost from disability and the patient load on hospitals, physicians, and nurses.

Now, what do these conditions have to do with nutrition? It is my conviction that in the field of nutrition research the opportunities are great for contributing to the control of the chronic diseases, particularly by increasing our understanding of metabolism. Much of this research in the future will be fundamental in nature, for we know that the science of nutrition has become increasingly concerned with deeper exploration of the function of nutrients. This, as we all recognize, is a study of the phenomena of life itself.

William H. Sebrell, Jr.

Since receiving an M.D. at Virginia in 1925 has held many a key post in the nation's public health affairs, chiefly in the field of nutrition. Among these were member of the technical committee on nutrition, League of Nations, 1935–37; deputy assistant director of the nutrition division in the defense health and welfare services, 1941–43; associate chief, nutrition and food conservation branch, Food Distribution Administration, 1943–46; and member of nutrition expeditions to Newfoundland and Germany. He has been director of the National Institutes of Health at Bethesda, Md., since 1950.

In attacking problems through a biochemical approach, nutritionists must now work closely with scientists in other disciplines such as endocrinology, biophysics, enzymology, bacteriology, and immunology. Only in this way can we begin to learn the mechanisms of nutrition—the kind of knowledge which is vital to continued progress against many of the chronic disorders.

Nutrition and Cancer

In this connection, I should like to mention some of the nutrition studies which have been done on cancer. These investigations have demonstrated that dietary manipulations exert pronounced effects on the development of cancer in animals. Caloric or amino acid restriction prevents or delays the appearance of a variety of tumors (*16*). On the other hand, a choline-deficient diet has been reported to induce liver cancer in the rat (*2*). These observations are of no practical value at present. Nevertheless, they represent promising leads in cancer research and suggest other possibilities for investigation. One encouraging line of study concerns chemical carcinogens which are administered to animals in conjunction with dietary manipulations. The azo dyes are especially useful here, since riboflavin gives partial protection against their carcinogenic action (*5*). Another study with interesting implications concerns certain pyrimidine compounds in connection with leukemia. When administered to animals, these drugs, in combination with a folic acid antagonist, appear to be more effective in inhibiting cell growth than an antifolic alone. For nutritionists, studies of this nature on the effect of various antimetabolites upon cell growth offer significant opportunities for extending our knowledge of dietary factors and their possible relation to cancer.

I think it is worth emphasizing here that science may eventually be able to demonstrate that diet plays an important role in the prevention and treatment of chronic diseases not known to result from dietary deficiencies. But whatever the outcome, these diseases deserve the attention of the nutritionist inasmuch as they frequently influence the nutrition of the patient. Moreover, nutrients are often involved fundamentally in the disease process. This is illustrated by the work of King and his associates, who recently demonstrated a relationship between vitamin C and cholesterol metabolism. In experiments with guinea pigs, they showed that cholesterol forms with abnormal rapidity when a diet is deficient in vitamin C. This was particularly evident in the formation of cholesterol in the adrenal glands, and to a lesser extent in the liver, lungs, heart, and arteries (*4*).

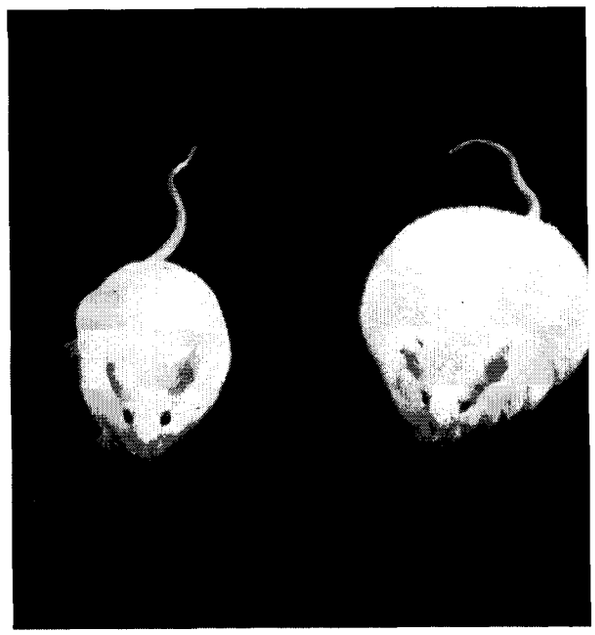
Like the chronic diseases, the problem of borderline deficiencies is also in need of further research. Inadequate nutrition may be responsible for many common manifestations of suboptimal health, such as retarded growth, abnormal births, loss of vigor, low resistance to infection, and other forms of debility and illness.

The difficulty here is that we do not have the diagnostic methods for estimating the prevalence of borderline deficiencies. Nor are we able to determine whether such deficiencies are due to diet or metabolic dysfunction. Clearly, one need is the development of better means for assessing the nutritional status of individuals and population groups.

In the search for new factors in food and exploration of their role in health, new approaches have been devised. One such technique uses vegetable tissues as indicators in the assay of possible growth factors, another involves the possibility of utilizing animal tissue cultures to determine the requirements of different types of cells.

The investigations of coconut milk offer a good example of vegetable tissue assays. Growth factors in coconut milk were first noted by van Overbeek in 1941 (*12*). Last year deRopp and others at the Lederle Laboratories reported growth-promoting properties, employing carrot on a medium of sucrose, minerals, and agar. This medium and coconut milk, through more than 100 transfers, supported the growth of carrot tissue in darkness for more than a year (*1*). Shantz and Stewart succeeded last year in isolating three apparently new crystalline compounds. In combination with other substances, these compounds comprise "CMF," the coconut milk factor (*10*). Further investigations will be necessary before we can say whether these substances have economic or clinical possibilities. However, if we can identify all the factors controlling the growth of vegetable tissues, interesting possibilities will be evident in the fertilizer field, and it may be that the malnourished carrot or potato will be in for a course of scientific nutritional therapy.

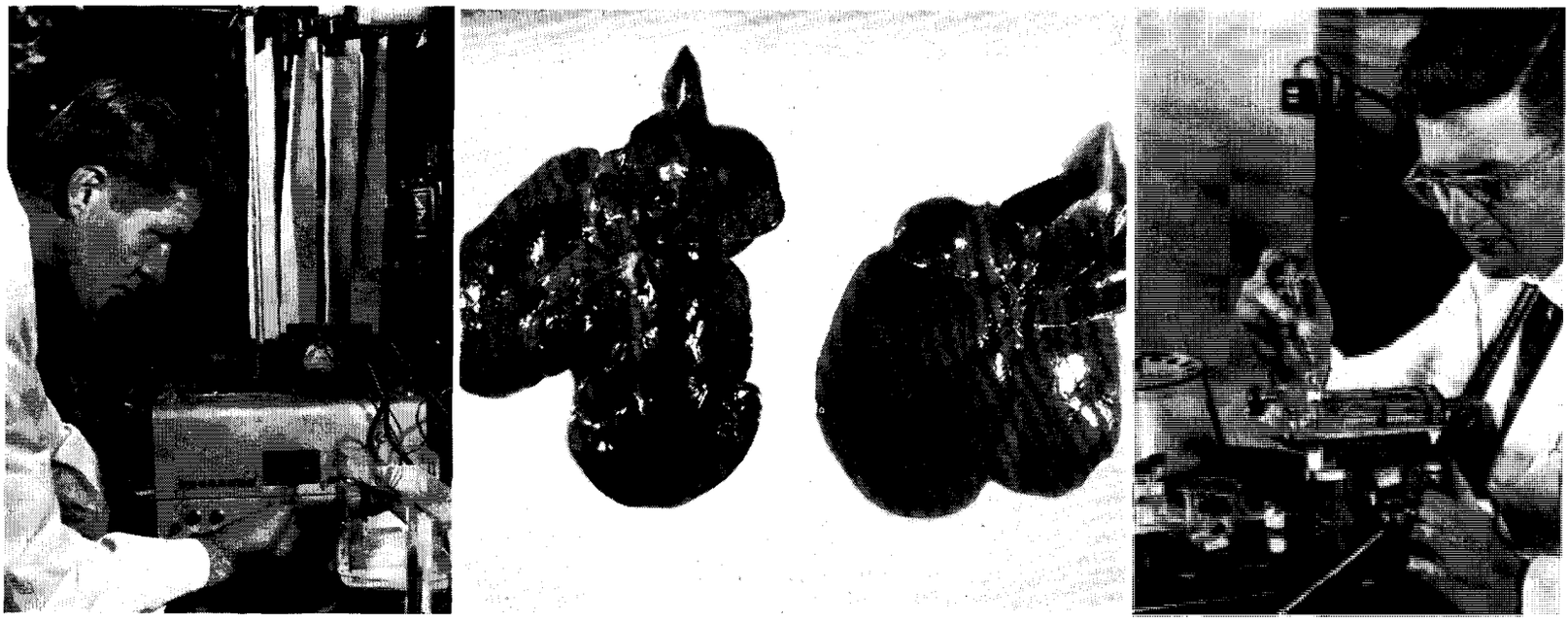
In other studies involving hitherto unknown substances needed for the growth of microorganisms, there are new findings which may have clinical possibilities. One such investigation concerns *Lactobacillus bifidus*, an organism present in large numbers in the gastrointestinal tract of breast-fed infants. Infants harbor different types of intestinal organisms depending upon the source of the milk they receive. The presence of the bifidus organism in breast-fed infant. suggested a factor in human milk which this organism required for growths In this connection, Gyorgy and associates in 1949 reported detecting a substance in human milk which is required by one strain of the organism (*11*). Whether the bifidus factor is related to supposed differences in infant health remains to be seen.



The mouse on the right, shown beside a control from the same litter, grew obese following a single dose of gold thioglucose given by scientists at the National Institutes of Health

Already many are familiar with some of the research developments in connection with vitamin B_{12} since its isolation five years ago. A recent observation of considerable interest is that of Lang and associates who have found that in diabetic retinitis there is an unusually high excretion of vitamin B_{12} which is reduced by the administration of testosterone (*6*). Of special interest also are the findings of Wetzel and associates, who have observed a beneficial effect of vitamin B_{12} in correcting retarded growth in children (*13*, *14*, *15*). There is need, however, for more research to prove the role of B_{12} in the growth of children.

One may legitimately ask whether periods of slow growth can definitely be assessed as unfavorable. I do not, of course, mean retarded growth resulting from malnutrition. The studies of McCay and associates, for example, revealed that in animals there is a direct relation between longevity and a slower rate of growth induced by caloric restriction. In view of this evidence, it is altogether possible that certain health advantages may accrue to children who normally grow slowly at certain age periods. I raise these questions merely to indicate that a great deal of research is needed before we can delineate all the factors of growth and draw any final conclusions.



Left. C. B. Anfinsen of the National Institutes of Health separates enzymes of interest in studies on atherosclerosis by means of filter paper electrophoresis. Center. Dietary protection against liver necrosis, showing (left) necrotic liver of rat on a deficient diet and (right) a normal liver protected by Factor 3. Right. Edwin Boyle, National Institutes of Health, removes the fat-containing protein of human plasma following high-speed centrifugation in studies on atherosclerosis

Nutrition experiments designed to produce liver necrosis in rats, a disease apparently related to certain fatal liver diseases in humans, recently have yielded results which merit mention here. In these studies, Schwarz at the National Institutes of Health discovered a new substance which, like vitamin E and cystine, protects animals against necrotic liver degeneration. This substance, which he named "factor 3," was obtained in high concentration from casein and brewer's yeast. Whether the new vitamin-like substance will prove effective against liver diseases in humans remains to be determined (*9*).

The foregoing studies emphasize, I think, the complex pattern of metabolism and the need for developing means of determining how well the endocrine, enzyme, and other systems function in the individual. They also indicate that the search for new vitamins and other food factors is continuing to yield a great body of basic data which has yet to be applied and evaluated in relation to health problems in humans.

I say in conclusion that I hope I have made clear my conviction that the science of nutrition offers tremendous opportunities for future advances in public health. Much has been accomplished in recent years, largely through our efforts to control specific deficiency diseases. There have been other gains, too—gains for which nutrition can claim a measure of credit. Maternal and infant deaths have declined to unprecedented levels, and there is reason to hope that this trend will continue. The mortality from infections, particularly tuberculosis, has likewise dropped, paralleling the rising trend in the nutritional status of our people.

All of these benefits have greatly exceeded our expectations. They are, it seems to me, part of a general advance in human betterment which, in our time, has been so swift and so sweeping that it is difficult to discern its real dimensions. Thus, it may be true, as Toynbee suggests, that our age will be remembered not for its great scientific discoveries and inventions, but "because it is the first age since the dawn of history in which mankind dared to believe it practicable to make the benefits of civilization available to the whole human race" (*7*).

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