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SOME OBSTACLES IN THE PATH TOWARDS AN OPTIMUM DIET[1]

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WAR, by interference with agriculture and commerce, as well as by direct destruction of foods, brings on starvation and the hosts of human ailments that sprout on malnutrition. Hence, in a world-wide violence, like our present war, the ancient problems of individual and national diets requisite for health and efficiency become both a national and an international concern of nutrition experts, physicians, statesmen and captains of industry. These imperative problems compel the biologist to re-examine the known and the unknown in the field of food and fitness, food and life, food and victory, so that the obstacles in the path towards an optimum diet for optimum health may not trip us in the dark. Such re-examination of the nutritional history of man (and other mammals), past and present, reveal as of to-day much new and reliable information, much innocent ignorance, many faulty food habits and unwise individual and commercial food practices of to-day, unwise practices in the light of present knowledge and past experience. There appear to be even questionable building stones in our scientific edifice. Such dilemmas as the recent assertion by Surgeon General Dr. Thomas Parran, of the U. S. Public Health Service, that, in our own country with its abundance of excellent foods, and in times of peace, "one third of our people is getting food inadequate to maintain good health, and less than one fourth of the American people are getting a good diet." This is perplexing, especially in view of the more recent assertion (November, 1942) of Sir John

[1] Lecture before the Physiological Society of Detroit, Michigan, November 19, 1942.

Boyd Orr, director of Great Britain's Imperial Bureau of Nutrition: "There is no sign of malnutrition (in England and Scotland)." In fact, Sir Orr states that the people in England and Scotland are fed better in war than in peace, the people in the higher income brackets now eating one third less than before the war, and those with lower incomes are now provided with better foods. Whether or not the alarming assertion of Dr. Parran as to the American people and the optimistic statement of Sir Orr as to Great Britain will stand scientific scrutiny may be partly a matter of definitions. But, unfortunately these are not the only questionable stones in our edifice. We, the actual workers in the field of human health and nutrition, have, in most cases unwittingly, contributed many more.

The obstacles in the path towards an optimum diet are numerous. A good or an adequate diet may be defined as the kind and quantity of food which sustains the health and general efficiency of otherwise normal people at different ages. This is of course a rough overall estimate since we have no accurate quantitative measure either of health or of physical and mental efficiency. An inadequate diet obviously is the kind and quantity of food that induces physical or mental impairments measurable by our present methods. An optimum diet implies much more than this. It might be defined as that kind and quantity of food which permits and promotes optimum growth, optimum performance of all biologic functions, optimum resistance to disease, optimum conservation of the factors of safety and powers of repair and optimum length of life with optimum efficiency within the framework of the hereditary potentialities of the individual and the species. In enumerating and discussing some of the obstacles still in the way of securing or using such a diet for man, I wish to make it perfectly clear that the order of their listing does not in any way imply their relative importance. This we do not know. Colleagues working in the different fields will obviously rate these obstacles in very different order of importance, but this is of little significance since many of them overlap, and provided that we recognize them all as actual or possible factors.

(A) If the above definition of an optimum diet is accepted, it will be clear to most informed people that the sciences of physiology, nutrition and medicine do not to-day have sufficient knowledge to outline the components of an optimum diet. We do not know the optimum hereditary potentials of any one individual. We do not know the tissue reserves that any one starts out with at birth, nor do we have accurate measures of the depletion of these reserves until well advanced in the form of demonstrable or recognizable disease. We do not even know all about the optimum soil fertility for the production of grains, vegetables and fruit of optimum nutrition value. In experimental nutrition in animal husbandry the rate of growth, body size and body weight are usually taken as a measure of superiority of the diet within the framework of hereditary potentials and in the absence of recognizable disease. But one may question whether the height and other dimensions of man are adequate measures of an optimum diet so far as these elements are determined by the diet. I know of no evidence that the five foot ten inches individual is biologically, mentally and economically or even socially inferior to a six-footer. In some biological factors man is inferior to the gorilla, the tiger, the elephant and the horse. Yet he has survived and may some day conquer the jungle. The measure of biologic fitness of the man of to-morrow would seem to be the capacity to produce, serve and survive in the kind of environment worthwhile for man to live in. It seems probable that in this task the size and plasticity of the brain is of more significance than the length of the legs or the width of the shoulders. At any rate the dinosaur and the mastodon are extinct, but the ant carries on. We do not even know whether the eating of proteins considerably above the minimum requirement for growth, tissue repair and nitrogen equilibrium, is biologically indifferent, whether it improves or inspires mental and physical performance, whether it shortens or lengthens the life span. It seems clear at least to me that there is a large territory of unknown factors yet to be scientifically explored before we can talk with any degree of certainty about an optimum diet for man. Therefore those who know the most in this field ought to confine themselves for the present to such terms as a good or an adequate diet, on the positive side. If a good diet or even an optimum diet alone was omnipotent and could push back the hereditary limitations of the individual, we should not so often see differences in physical and mental capacities of children in the same family, at least not in the absence of accidents and non-dietary diseases. If a diet of "red meat" alone was the determining factor on the football field there would be no scores on either side, outside of accidents and luck. Genius, like mortals made of common clay, can neither develop their best nor for long balance on the top rung of the ladder on seriously inadequate diets. It seems equally certain that even optimum diets will not build genius out of all clays. The persistence of hereditary factors and the unknowns of mutation appear to say that much.

Drs. Park and Follis, Jr., of the Johns Hopkins Medical School, have kindly put at my disposal their results to date of their significant and long study on the prevalence of rickets in the bones of 230 children

between the ages of two and thirteen years dying of sundry acute and chronic diseases of non-dietary origin. They find signs of rickets in 46½ per cent. of these children. The acute diseases ending some of these children's lives appear to be of too short duration for the diseases themselves to have been the primary factor in the initiation of rickets although the disease might have aggravated the rickets. It is doubtful that the conditions of rickets in these children could have been diagnosed without this type of examination after death or by biopsis of the bones during life. In my judgment this is a significant approach towards the study of incipient dietary deficiencies and a commentary on society of to-day in failing to apply the known, for we have known for many years the dietary requirements for the prevention of rickets, in the absence of disease.

Our knowledge of the composition of foods, the role of foods in the living body and the specific requirements for the main groups of foods in the living organism—the proteins, fats, starches, inorganic salts and vitamins—has increased enormously in the last fifty years. This detailed knowledge has, however, not gotten down very effectively to the man in the street, the woman in the average home or the people in the factory and on the farm. More recently, the startling character of these biologic and chemical discoveries in human nutrition has, to my way of thinking, led to much unfounded anxiety, fear, wishful thinking and questionable commercial exploitation.

Whether or not we can maintain good health on 40 grams or on 100 grams of protein per day depends largely on the kind of proteins we eat, as the biologic or nutritional value of proteins differs greatly. Some ten so-called essential amino acids are now known. These protein "building stones" are so called because the human body can not make them from the other nitrogenous elements in the diet. However, these essential building stones are present in varying amounts in nearly all proteins of animal and vegetable origin. Man's past history teaches us that if we eat a sufficient variety of natural foods we will get all the essential amino acids needed for good health. Meats, milk, eggs and grains provide good food proteins. The first principle in adequate dietary proteins is accordingly: variety, natural foods, omnivorousness.

Up until yesterday even experts in nutrition thought that the nutritive significance of the animal and vegetable fats in our dietary, besides providing flavor, was: (1) energy or calories and (2) carriers of such dietary essentials as vitamins A, D and possibly others. It now seems highly probable that two or three of the numerous fatty acids in the animal and vegetable fats are as necessary in our diet as are the essential amino acids of the proteins. But, as in the case of the proteins, nutritional welfare of man lies in variety and omnivorousness, since these essential fatty acids occur widely in plant and animal fats.

(B) It is almost superfluous to point out that many diseases, acute and chronic, not primarily of dietary origin, may and do prevent, in part at least, the good effects of good diets. The infant with summer diarrhea no matter what food is given does not get the full benefit of that food. This applies to many diseases of adults. In the presence of hookworm infestation good food alone does not seem to engender maximum physical and mental efficiency. Chronic lead poisoning in the child appears to so interfere with the use of the calcium and the phosphorus in the diet as to induce or aggravate the disease of rickets. We are not now concerned with the important problem, the role of a good diet in the prevention or limitation of infectious disease. Diet alone does not seem to promise the conquest of infections. But when we speak of good or optimum diets for the entire population of the land we must keep in mind the non-dietary disease factors that nullify in whole or in part the good results expected from such diets in individuals having these diseases.

(C) *Food habits.* The food habits of man tend to become as fixed and in many cases as unreasonable as many of his religious, political and social habits. The name of foods, the visual appearance of foods as well as the taste of foods are frequently determining factors. The types of foods consumed by people or races less sophisticated, more ignorant or poorer financially than we are are frequently looked upon by us as degrading, as not good for us. Many people refuse the meat of eels because this fish looks like a snake. Many people think that food good for dogs, cats and hogs are by that token not good for man. A central factor here is obviously social habits as well as the fact that we can train our palate to like or prefer even foods markedly deficient in some of the dietary essentials. For example, the liking for sugar, sweet drinks, candy. Now sugar is a good energy food and such preference for sweets is not serious provided we eat enough of more complete foods. But when foods like pure sugar or pure starch become a larger percentage of our daily diet trouble will follow.

Wherever we turn in the dietary field, past and present, there appears an important factor of safety in omnivorousness. Very few of the natural foods contained chemical or organic poisons for man. Civilized man could be even more omnivorous than he is at present, but we do add serious chemical poisons (lead, arsenic, fluorine) to some of our very important if not necessary food categories, fruits and vegetables. To be sure these insecticides are sprayed on important human foods, not with the intention of in-

juring man but for the purpose of rescuing good human food from insects. However, one of the dietary unknowns to-day is how much of these protoplasmic poisons we can take with our fruits and vegetables during a lifetime without impairing our reserves, impairing our health. The consumer demands a perfect apple. He can see the "worm" or the track of the "worm" in the apple. The lead, arsenic and fluorine on the perfect apple he either can not see or, when he does see them, he thinks it is mere dust from the good earth. We should like to know whether the dietary health of our forbears was worse off with a worm in the apple than is ours with protoplasmic poisons on the apple.

Modifying human food habits in the direction of better health and efficiency may come through necessity or dictation. It will probably not stay put except through understanding via the long and strenuous road of education. In the matter of education in health to the extent that our health depends on food I think there is much yet to be done in our grade schools, high schools and colleges. In a not too distant past the teaching of health in our schools did not significantly transcend the tooth brush, alcoholism, sex and social diseases. Even to-day in many of our schools we find inadequate teaching of the fundamentals of health and nutrition. As if the matter of foods was a concern for women students alone and the matter of general health a concern only of the physicians. We have scarcely begun to realize that the modern sciences of chemistry and physics are so rapidly changing our environment and mode of life that proceeding to-day by the ignorance of our forbears we may travel into tragedy. Urbanization and industrialization renders it well-nigh impossible for modern man to have access to the natural unprocessed foods available to our forebears of a thousand years ago.

(D) *Food advertising.* In connection with this discussion of education of the public in health and foods one necessarily thinks of the positive and valuable role that modern commercial food advertising could play in this program. Unfortunately, such commercial food advertising in the past has frequently been misleading and occasionally undiluted artistic lying. People are urged to eat more of everything. If they did they certainly would develop dangerous obesity. The 1942 advertising of a vitamin alleged to prevent or recolor gray hair on the human scalp is as yet without foundation in science. There are cheerful signs that the more responsible food producers and food processors are now aware of their public responsibility in this field, their responsibility of contributing to factual adult education as to food and nutrition in advertising their special ware. But it is discouraging, to say the least, to have our federal government leaders urge us (in posters, advertisements and circulars): "Eat Nutritional Foods." This is silly, and, if certain foods are listed to the exclusion of others, misleading. For an article which is not nutritional is not a food.

(E) *Food refining and food processing impairing the value of foods.* The polishing of rice, the milling of the germ and much of the protein, vitamins and inorganic salts out of such foods as wheat and other grains, corn, etc., are food practices of the gravest concern to health. Purification and hydrogenation of animal and vegetable fats may take considerable if not all of the fat-soluble vitamins out of these fats. Modern preservation of food such as canning, freezing or dehydration is necessary in modern urbanization. Some food values are diminished, unavoidably, by these processes. Cooking, freezing and packing undoubtedly saves man from infectious disease, but some food values are lost. It is a question of balance of benefits. Fortunately we do still eat raw fruits and some raw vegetables. The latter could and should be greatly extended.

Digestible carbohydrates occur usually in abundance in most of our natural foods. Except by heat to point of carbonization, these food factors are not denatured or destroyed by food processing, baking or cooking, except that the sugars and water-soluble starches may be lost into the cooking and canning liquids. Dextrose, the sugar of the blood, is a necessary constituent for our internal environment. A large part of our heat and energy requirement can and should come from the starches. The starches are our most easily digested and on the whole the least expensive energy foods. So necessary is our blood sugar (dextrose) that, as in prolonged fasting, the body appears to manufacture it from body proteins, and possibly from the body fats. It now seems clear that our body can do the same with the proteins and the fats of our common foods. Hence no specific or distinct dietary deficiency disease of man is known as due to too little starch in the diet. A form of malnutrition, obesity, may be caused by eating too much starch, or sugars, as the carbohydrate in excess of our energy needs is readily converted to and stored as body fat. However, some of the important dietary deficiency diseases have come about, not by eating too much starch, but eating too little of the other important elements in the natural grains. I refer to the polishing of rice and the modern milling of wheat and other cereals for white or patent flour. The germ and the outer coats of the grain hold valuable proteins, vitamins and minerals. Human dietary safety on this front would seem to be: Go back to first principles—putting the whole grain into the flour and the bread. This can be

done. We can learn to like it. If Great Britain (at war) can take an important step in that direction, why can't we?

I believe we could learn to prevent the oxidative rancidity of whole grain flour. If we insist on milling the grain and storing the flour, instead of storing the grain, and milling as needed, there are now known relatively non-toxic antioxidants that might prevent the rancidity of whole grain flour that takes place on long storage. And until we have that problem licked, what is the matter with storing the wheat and milling the flour as we need it? I do not see any essential economic principle in storing the flour in place of storing the wheat. In my judgment, the recent addition of a little of the vitamins and minerals now milled out of the grain, and singing paeans of dietary salvation over this "enriched" flour and bread is not a sound policy either for to-day or to-morrow. Let us go back to first dietary principles on this front. The whole wheat, rye, corn or rice grain is one of our most valuable and our least expensive protective foods. Fortunately, we still eat oatmeal, a whole grain food, having, among other important nutrients, proteins of a high biologic value. On the whole we can trust nature further than the chemist and his synthetic vitamins. Recently Professor J. C. Drummond, the scientific adviser to the British Ministry of Food, voiced his reluctance to put the dietary safety of a nation on synthetic vitamins, as a long-range policy. He thinks we must, and should, provide the natural vitamins in the natural foods. I stand on that platform, until we know a great deal more than we do to-day about foods and human nutrition.

It appears true that for our forbears, except for the element iodine in restricted areas of the earth, the dietary need of minerals was efficiently met by the common non-purified, non-processed natural foods. So far as I know, this would still hold true, except for the cooking of such foods as meats, fruits and vegetables, and the habit of discarding the cooking water. To be sure the otherwise excellent natural food, milk, is so deficient in iron that an exclusive diet of milk for weeks or months brings on an anemia due to the iron deficiency in the diet. How does the American dietary stand as to some of the essential mineral needs such as calcium, phosphorus, iron and iodine? The iodine deficiency in the states whose soil and water were depleted of iodine by the waters from ancient glaciers is now taken care of by putting the iodine back into our table salt. The iodine was there before our ingenious chemists learned to take it out. Professor C. H. Sherman, of Columbia University, has long held the view that the American diet is probably too low in calcium, and possibly in phosphorus, for optimum nutrition. This problem is complicated by the fact that a modicum of vitamin D is involved in the adequate absorption and utilization of calcium and phosphorus, particularly in the growth and maintenance of our bones. I wonder if the possibility of a dietary danger in this field could not be met, universally and without cost, by adding a little calcium, phosphorus and iron to our table salt. This should offer no insurmountable difficulties, and there is no evidence that a slight excess above actual needs of these minerals works any injury to our health.

We are urged to eat milk especially for its calcium. Yes, milk is a good source for lime. But milk is a relatively expensive food, and even in our country, with a plethora of foods, there is not enough milk to go around, at least as long as we insist on butter and cream for our table, and turn so much (50 billion pounds a year) of the valuable skim milk into channels other than human food.

How much of vitamins do we need for optimum health? That the disease scurvy, induced by long subsistence on dried, cured and cooked foods, can be cured or prevented by eating some fresh or raw fruits, vegetables, potatoes, leaves or grasses has been known for more than a hundred years, but the specific chemical substance involved (ascorbic acid or vitamin C) is of very recent acquaintance, and the precise role of this vitamin in our cellular health is still partly unknown. Pellagra, beriberi and rickets are old human ailments, but their precise etiology and partial conquest belong to the last fifty years.

The recent advances in our knowledge of the chemical nature and the biologic role of the vitamins have been so rapid and so startling that, as usual, man's wishful thinking hopes to find in them the cure for nearly all the physical and mental ills to which the flesh is heir. In fact, the miracles now claimed by some misguided people for vitamin pills, natural and synthetic, rival the miracles of Lourdes. The giving a mixture of table salt, vitamin C and vitamin B_1 to workers in very hot environments, observing reduction in fatigue and heat prostrations, and concluding that the vitamins contribute to this desirable result is not a scientific experiment. For we know that under such conditions NaCl alone produces these results, and it is difficult to measure fatigue with accuracy. Vitamin concentrates are useful aids in the hands of a physician. The tragedy and waste in the 1942 vitamin pill business is this: Most of the people who can afford to buy them probably do not need them; most of the people who may need them probably can not afford to buy them. But a competent chemist asserts that "intelligence and morality go together. . . . Since an ample supply of vitamins can foster a high intelligence, it has also the capability of fostering morality!" If this be true, and if we further admit that

lying and injustice are phases of immorality, the vitamin deficiency in the human race of our generation is indeed appalling! When we have the vitamins that prevent dishonesty and injustice, the millennium will have come. But as I read and listen to the 1942 propaganda for vitamin pills, I am led to suspect that at least some vitamin vendors do not take their own medicines. They just sell them. And the selling noise is so loud that our attention is distracted from the more important role of adequate proteins in preventing one of the fundamentals in the overall malnutrition created by such catastrophes as crop failure and war.

(F) *Waste of food.* Waste of food in the family increases the cost of food to the family. It also contributes to food scarcity. Food waste in our country is partly avoidable such as the waste in the home, waste or neglect of fruit and vegetable on the farm; partly perhaps unavoidable such as that produced by oxidative rancidity of fats in the foods. I have already referred to the huge waste of skimmed milk, so far as this is turned into channels other than human food. The waste of food in the home tends to increase with the economic prosperity of the family. It is not "refined" to clean the plate. It is a measure of prosperity and caste to waste food. When we are told that under conditions of war and food rationing in England and Scotland the economically more fortunate eat one third less food than they did in times of peace, this probably means that they eat just as much food in war as in peace, if they can get it, but in war they waste one third less food at the table. When nations are facing universal food shortage, the wastage of food in the home or on the road from the farm to the home may seriously contribute to national malnutrition. Much of this food waste is even to-day preventable, but we are up against individual and social habits and agricultural practices that will yield only to education or dire necessity. Some food wastage in the home as well as in the food-processing industry appears to be based in part on the erroneous assumption that the least roughage in the food we eat the better for our health. So we peel and prune fruits and carrots, cabbage and potatoes and with such peelings and prunings we decrease or eliminate valuable food elements. The facts are the normal human alimentary tract must have some indigestible roughage to work at its optimum, and it will probably take millions of years before man has evolved, like that of the honey-bee, an alimentary tract which can function on nectar and pollen alone. It is difficult to assess the blame for some of the waste of our food, particularly the fats of animal origin. We seem to have developed the idea that the fattest hog and the fattest steer is the best hog and the best steer. These animals may be best in the sense of providing greater income to the farmer, but a great deal of the fat of the steer and even some of the fat of the hog does not reach the human stomach. From the kitchen or the dining table it passes into the garbage can or down the drain pipe.

(To be concluded)

RESEARCH IN WARTIME

By Professor J. H. SIMONS

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AT a time when the nation is engaged in a gigantic war that will determine the very survival of civilization, it is appropriate to examine all our activities in the light of values in the war effort. The only purpose of any real significance for any one's actions is the defeat and destruction of the ememy. All personal or political motives represent various forms of treason. Every activity not contributing to the war effort should be either stopped or redirected. Scientific research should be examined with this point of view.

Modern war requires modern weapons, and these are directly the product of scientific research. It is true that it is a long way from the birth of ideas in the brains of the scientists, their demonstration, verification and study in the research laboratories to the final perfection of powerful weapons for the destruction of the enemy or of materials and tools for the aid and comfort of ourselves and friends. This way, however, follows a direct path that is fully recognized. From the source of the original ideas it progresses through development, engineering, trial and production. All the weapons, tools and materials of vital importance in the war, to a very considerable extent, have had their beginnings in the scientific research laboratories. The research of the past produced our present practices and materials. New things for the future will have their beginnings in the research being done at present. The only sure way of not having new weapons or major improvements of old ones is to stop scientific research.

Research is a word that is used for different meanings by different people. In some industrial firms it is made to include the development of industrial processes after the original ideas are all well founded. In other places it is used to include data collecting or the