THE RESTRICTED SUPPLY OF FOOD: ITS RELATION TO HEALTH AND EFFICIENCY.*

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THE relation of an inadequate supply of food to health and efficiency is not a new problem, for in the past it has constantly claimed the attention of the medical profession and social reformers. In this country the conditions have been supplied by the poverty of a limited class and the inefficiency of many mothers of all classes in the most important function of motherhood. Our slums and hospitals supply ample material for observation, and numerous small graves in every churchyard throughout the country are at the same time eloquent evidence of the results of inadequate food and woman's failure in her first duty to the race.

The question is now more urgent because the public generally is involved and its attention is arrested, whether it will or not, by varying and often conflicting orders and advice. In the complex conditions of modern life we have been taught to neglect and distrust the dictates of instinct, and need guidance upon the fundamental principles of nutrition.

Food in the strict sense relates to any substance which is taken into the digestive system and serves for the growth, maintenance, and repair of the body. The best types of perfect foods are represented by milk and eggs, for an infant flourishes and doubles its living substance if fed entirely on its mother's milk for six or seven months; an egg serves for the development and growth of the chick during the twenty-one days of incubation, and even for the subsequent day or two. A study of the composition of these foods shows that the essentials are proteins, carbohydrates, fats, salts, water, and substances of unknown composition known as "vitamines." Proteins contain nitrogen, and are represented by meat, the casein of milk and cheese, and the gluten of corn; the carbohydrates in common use are starch and sugar; the so-called "vitamines" are found in most fresh and natural foods, such as milk, eggs, corn, and vegetables.

The food required by an individual varies according to so many factors that it is impossible to give any dogmatic statement. Even in the case of a simple steam engine rough estimates only can be given of the probable amounts of fuel necessary for its efficient working at different speeds; trials and experience of its personal equation must be obtained. In the living body the problem is far more complex, and the important factors, age, sex, occupation, and environment will need consideration.

In a discussion upon this subject it is convenient to start from some definite point, for instance, the condition of an adult man doing no work and taking either no food or just sufficient to maintain his life. A man can fast for thirty to forty days without any fatal or very serious results, as the observations upon the professional fasting men have proved. Water they must have, and food they will obtain by living upon their own living substance. The material consumed by a fasting man corresponds to food-stuffs which would yield 1,500 to 2,000 calories per day. Combustion, therefore, is a characteristic of life and in man only ceases with life itself. A man at rest in bed requires food with a fuel value of about 1,800 calories per day to make good the daily loss, which is due to the "physiological work" of living. Even during the deepest sleep the body is always at work, the heart must continue to pump the blood, the muscles of the chest and abdomen contract in the process of breathing, and the glands elaborate their products.

The voluntary ration, 4 lb. bread, $\frac{3}{4}$ lb. sugar, and 2½ lb. meat a head a week, yields about 1,200 calories a day, and when allowance is made for women and children is calculated to supply 2,000 calories per man. It may therefore be considered a maintenance diet, and with the addition of other food will form an adequate diet for a man doing light work.

It is now possible to consider briefly the quality and quantity of food required in relation to age, sex, occupation, and environment.

Age.

The infant is a physiological unit and has its own special requirements; it would be a fatal error to estimate its needs at one-tenth of that of a man because its body weight is only one-tenth. It thrives best when it is treated like any other young animal, and receives as much of its mother's milk as it cares to take. The value of this food expressed in calories per day is about 400 for a young baby at the breast; in infants of 1 to 2 years of age it is about 1,050 calories. The young child needs in proportion to its weight a far larger amount of food than does the adult, for it is rapidly growing; and owing to the large surface of its body in relation to its mass it must produce more heat in order to maintain the temperature of its body. As the healthy child grows older he becomes relatively more active than an adult, and makes a further demand for food. The boy of 10 to 16 years of age often requires as much food as his father.

Sex.

Women require less food than men, for they perform less muscular work; but during pregnancy and suckling the development of the offspring makes an extra demand upon the supply of food. The employment of women in hard manual labour cannot fail to increase their consumption of food as long as they are efficient.

Occupation.

The laws of nutrition hold good for all classes, from the highest to the lowest; the various occupations, however, owing to the different outputs of energy involved, make very different demands upon the food. The dietary which would be generous for a man or a horse doing no work would be slow starvation if he were forced to work hard each day. A system of rations, therefore, which pays no attention to occupation is absurd. In the following table of standards, due to Atwater, it will be seen that a man doing very hard work requires twice as much food as the man who does none.

Condition as regards muscular work.	Calories required per day.
None	2,700
Light	3,000
Moderate	3,500
Hard	4,500
Very hard	5,500

Environment.

In cold weather more food is required for the maintenance of the heat of the body and the greater muscular activity which is a response to the stimulating action of cold. Animals and men inadequately fed quickly perish when they are exposed to severe cold.

Individual Differences.

Apart from the foregoing factors attention must be given to the personal equation of the individual. Some men work economically, others extravagantly; one man's food is another man's poison. Free choice of food makes for efficiency.

Standard Diets.

Reference has been made already to Atwater's standards for the food required by men, and it will be interesting to see what are the daily rations allowed for the navy, army, and institutions for the young and old in this and other countries. (See Table I.)

These figures, collected from various sources, supply data which will serve as a basis for discussion; it is true that allowance cannot be made in all cases for waste, but against this must be set the increase due to the food which is bought. The figures for Japan and China show how erroneous is the popular idea that the inhabitants of those countries can live upon a handful of rice. There is no physiological reason for believing that different races have any fundamental differences in nutrition when every allowance is made for external factors.

A system of rations may be necessary under certain conditions, but it is an uneconomical one, and on physiological grounds is unsound. It allows little or no free choice of food, and is not readily adjusted to the various factors which determine the need of different qualities or quantities of food. Likes and dislikes are expressions of physiological needs. Healthy men are animals, and when

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TABLE I.—Standard Diets.

	Protein.	Fat.	Carbo- hydrate.	Total Calories.
	Grams.	Grams.	Grams.	Grams.
*Food supplied, free, seamen, Royal Navy	91	48	406	2585
*Food supplied, free, boys, Royal Navy	107	69	406	2745
†Food consumed by seamen, Royal Navy	176			4080
Food supplied free to four British regiments	133	115	424	3369
British army (South Africa minimum)	138	105	528	3903
Russian army (Manchuria) ...	187	27	775	4891
Japanese army (Manchuria) ...	158	27	840	4343
United States of America army (peace ration)	157	140	603	4179
Ordinary prisoners, Scotland, light work, mostly sedentary	135	35	536	3115†
Convicts, Scotland, "hard labour" so called = moderate work	173	57	602	3707‡
Convicts, England, "hard labour"	177			4161‡
United States of America, members of two college football teams	225	334	633	6812§
United States of America, labourers at hard muscular work	177			6485
United States of America, very poor working people	69			2275
Japan, labourers	118			4415¶
China, labourers	91			3400¶
Egypt, labourers	112			2825¶
Duke of York's Royal Military School (young men)	157	206	472	4514
Boys 9-14 years of age at English public school	123	97	430	3400
Children over 8 years of age in London County Council school	88	66	377	2515

* Allowed also 4d. a day to buy extra food.

† Alcohol not included; no allowance for waste.

‡ Food supplied.

§ Food eaten.

¶ Energy utilized.

they work steadily and well do not overfeed, even if they have free choice of abundant food. This is well shown by the fact that the average weight of the body remains very constant over long periods—it may be years—in the healthy and active adult; and likewise, as would be expected, the average consumption of food and the output of work.

The limitation of the system of rations is shown by the presence of dry canteens in the services; the numerous eating-houses in garrison towns and ports; the parcels from home, and the "tuck" shops for school children. Rigid rations, if they are adequate for a large number of men, must lead to waste, for in no other way can allowance be made for various physiological needs.

Restricted Supply of Food.

The supply of food may be inadequate in quality, quantity, or in both. The foodstuffs which at the present time must be considered are wheat, meat, milk, sugar, and potatoes. A deficiency in one form of food may be covered by another article which is available. Substitution can be by physiological processes be carried further than is possible by the chemist. In the living body sugar and fat can be formed from starch in the food, and the reverse processes are also possible. As a general law it may be stated that as sources of energy the foodstuffs can replace each other according to their values as producers of heat. Thus the following are isodynamic quantities: 100 grams fat, 232 starch, 234 cane sugar, and 243 dried meat.

Unconsciously this has long been recognized, and experimentally it has been proved by the farmer and physiologist. When the cost of fat and meat is high the working man with a small wage must buy more starchy foods; given an increase in wages but no extra work he will buy more meat and fat. One thing he must have is protein; he can substitute vegetable for animal protein, but he cannot form proteins from starch and fat, for they contain no nitrogen.

Nutrition.

For a condition of health and efficiency the food should be more than enough to cover the outgoings in the form of

heat and work; a balance upon the right side is useful for times of extra- or special demand. This is especially the case in the young, for, if this balance is not available, healthy growth is impossible. Unsuitable food, inadequate in quality or quantity, or both, is recognized as one of the chief causes of the terrible mortality of children. During the years 1911-14 the deaths of children under 5 years of age in England and Wales were 575,078. Not only may death be caused directly by digestive troubles, but the resistance to infectious diseases is lowered by defective nutrition. The difference in the prospects of life in infants fed at the mother's breast and of those given artificial food is notorious. It is the duty of healthy mothers at all times to suckle their offspring, but never was the duty more imperative than now, when there is a danger of a shortage of the best substitute, cow's milk, at a time when the infant mortality is high and the birth-rate exceedingly low. The mother can form the ideal food for the infant, not only without detriment, but with positive advantage to herself; moreover, she can form the milk from food which contains no milk, but she must be fed well. For children after weaning a supply of cow's milk is necessary, for no longer is it the custom to suckle children of one or even two years of age, as was done in times past. How far the supply of milk is safeguarded will be considered later.

For school children and young adults there is no doubt whatever that safety lies in a generous diet. Underfeeding in animals and man is a greater danger than overfeeding. The vaunted benefits of a sparse diet are apparent only, not real. Most of the cases of obesity are due to insufficient muscular work, an inactive life; the man is no longer a free healthy animal, but resembles the stall-fed ox, which fattens more readily because he does no work and is emaculated. Muscular work will strengthen the heart, lungs, and the whole system, and will prevent the deposition of fat; a sparse diet will lessen the burden of fat, it is true, and will diminish the work of the heart, but it does not raise the efficiency above the average.

The effects of a restricted supply of food are increased directly an imperative demand is made for a great output of muscular work. There are points of resemblance and also of difference between man and a machine. No one expects to obtain work from a steam or petrol engine without a proportionate supply of fuel; the more work, the more fuel. There is always waste, and in respect of efficiency the engine is far behind the living body. The points of difference are enormous. The body is not only a transformer of energy, but effects its own repairs, becomes stronger with use, and even reproduces itself. The widely spread ignorance upon the question of the consumption of food appears to be due to the fact that many of the men and women who write or talk to the public are dwellers in cities, who have never done continuous and hard muscular work. They do not recognize that the law of the conservation of energy applies to man. For national efficiency the man who does essential muscular work must have a greater amount of food than the sedentary worker, and it matters not what may be their respective wage. It is true that for a time man can work without an adequate supply of food, but it is inefficient work at the expense of his living substance; the result is always the same—discontent, less strength, less work, less resistance to disease, and ill health. All records of the effects of forced labour upon men and horses have proved this conclusively.

Regulation for the Supply of Food.

The ideal is a liberal supply of food with free choice. This may be impossible, and the question arises, How is the supply to be regulated in the interests of the nation? The Government have wisely avoided thus far a compulsory ration, but have made attempts at control by fixed prices and other methods. The laws of nutrition will still be in force whatever this or any other Government may do, and wisdom would lie in the recognition of the supreme power of natural law. If one foodstuff is deficient a substitute can be found in others, owing to the powers of adaptation of the body and its capacity of converting some forms of food into others. Moreover, the body as an engine can use different kinds of fuel. If coal fails, steam may be generated in the engines of a ship by oil, wood, or in emergencies even by burning parts of the ship itself. From this point of view the scarcity of wheat must be considered. Other corn can take the place of wheat and

should be used for this purpose. There is barley and malt used for the production of alcohol, an inefficient form of food at the best and a deadly poison in excess. According to the Food Controller there are one million quarters of brewer's malt in this country at the present time; it is not to be used for food, but for the production of beer. The convictions for drunkenness in the Metropolitan Police District and the City for the first quarter of this year were 6,176. The Food Controller says that the food value of beer is not disputed, and the Government does not consider that it is necessary to save the millions of quarters of barley, malt, and other foodstuffs which are to be used in the manufacture of alcohol. There may be reasons of policy for allowing alcohol to men in the services or employed in some essential occupations, but there is none for its widespread consumption.

Oats can be used as a substitute for wheat, but there is difficulty in obtaining a ready and cheap supply; the oats are being kept for the horses. A horse may consume 40 to 80 lb. of oats per week, and hunters and racehorses receive the best. Hunting and racing have been and are allowed; only now is the Government taking steps to consider whether savings in this respect should be effected in the interests of the food supply of the people. There are thousands of hunters, racehorses, riding horses, and carriage-horses, used only for pleasure in this country; the consumption of oats, maize, beans, hay, straw, and carrots by these animals must be enormous. With the exception of the hay and straw, which would be useful for cows, all these tons of food could be used by man himself; the objection that the horses are needed as a reserve for breeding and for the army has no force, for all these animals could be kept at grass, and under these conditions would liberate many men for essential work.

TABLE II.—Percentage Composition of Certain Cereals.

	Protein.	Fat.	Carbo- hydrate.	Fuel Value per lb.
Wheat, flour ...	8.3	1.0	73.5	Calories. 1615
Barley, pearled ...	6.6	1.0	76.1	1630
Maize, flour ...	5.8	1.2	76.3	1625
Oat, meal ...	13.4	6.6	65.2	1795

All of these substances have been used even in times of peace as substitutes for wheat. In some respects oats are a better food than wheat and the fuel value of 1 lb. is greater than the total for one day of the voluntary ration suggested by the Food Controller. A horse eating daily 10 lb. of oats consumes an amount of cereal food which would be sufficient for ten to twenty men.

Sugar and potatoes are foods which were introduced into this country in times relatively recent, and it is obvious that they are not so essential as some people imagine. The children should have the first claim on sugar, and they could also obtain milk sugar in milk and malt sugar in malt, besides those essential substances known as "vitamines."

The supply of milk is another difficulty, and it has received the attention of the Government. A maximum price has been fixed for the retailer and the producer; the farmers have been selling their cows and giving up the production of milk, notwithstanding the fact that it was a very lucrative business according to many writers to the daily press. For young children, invalids, and our sick and wounded soldiers milk is a food for which no efficient substitute can be found. In the case of infants the practice of wet nurses should be revived if the mother cannot or will not suckle her child.

During the spring and summer months there may be no serious shortage, for those are the best months; when the cows are at grass the supply is large and feeding is cheap. There is a shortage at the present time, and the autumn and winter will show the effects of the reduction of the milking herds. Action, however, must be taken now. Heifers cannot be made into milch cows under ten months. The Government have revised their "milk orders"; the farmers ask for the recall of these orders. In any case a reserve of cows could be provided by the end of next winter if the Government purchased at once numerous heifers and turned them out to graze with

young bulls on land owned or taken over by the Government. Even if money were an object, the transaction would be probably a very profitable one. A supply of milk should be safeguarded, and its cost should be low for the sake of the children, even if it be necessary for the State to give a subsidy.

If the scarcity of food is general, the true remedy lies in an extension of the supply. Action has been taken at last, pasture has been ploughed up, but the highly fertile ground of the hop gardens will apparently in many cases still grow hops for beer, instead of corn or potatoes for bread. The hop growers should have compensation, if necessary, but food they should grow, for it is food which is needed.

Another source of food which is undeveloped is the salt-water and the fresh-water fish, but this, owing to the supply of cattle, is not so urgent as the question of cereals.

If the cost of food continues to rise, difficulties of a serious kind must occur, for a strong man is liable to become dangerous when he is hungry. A corresponding rise in wages does not meet every difficulty. The wage is not adjusted to the size of the breadwinner's family. A great relief and a true safeguard for the present and the future would be the free supply of dinner and tea to school-children; the necessary machinery is simple, if the expense is a general one borne by the State. The health of the future generation could be secured, a great burden would be taken from many hard-working and deserving parents. Foodstuffs which the labouring classes cannot obtain readily or cook properly could be used in these free meals and bread would be saved. There would be no danger that the children would be overfed, for even with active and growing children the law of averages as regards food would hold good. Many children, as well as men and women, are doing more work than they ever did before; this means an increase in the consumption of food, especially cheap food, such as the cereals.

Petty orders, such as the prohibition of Sunday-school treats and cakes, show no appreciation of the laws of nutrition, and cause an amount of irritation out of all proportion to the result obtained. The owner of poultry is not allowed corn for his fowl; the hen does not return in eggs and flesh the food value of the grain consumed; no animal ever did or ever will, for it must have some for its life. When allowance, however, is made for the consumption of refuse the hen is economical. The owner of racehorses, hunters, and other horses used for pleasure, is allowed in unlimited quantities the very best oats, maize, and beans that he can buy. He takes the food from the mouths of the poor by outbidding them in the purchase of some of the best articles of food which are scarce at the present time.

ON THE THREE COMMON INTESTINAL ENTAMOEBAE OF MAN, AND THEIR DIFFERENTIAL DIAGNOSIS.

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At the present day the belief is widely held that there are only two amoebic parasites of the human intestine—the harmless *Entamoeba coli*, and the dysentery amoeba, *E. histolytica*. Although it is certain that nearly all the amoebae hitherto described from human faeces actually belong to one or other of these species, whatever names may have been bestowed upon them, nevertheless it is now possible to say with equal certainty, we believe, that there are not two, but in reality three different *Entamoebae* commonly inhabiting the human bowel. Our own observations have convinced us personally of this fact, and in conjunction with those of others recently published have, we believe, placed the matter beyond all doubt. As many people are now engaged in the diagnosis of amoebic infections, and as they are still in many cases—as we have good reason to believe—confining their attention to certain forms of the two well-known species only, we think no excuse is needed.