FOOD AND DIET.

BY

W. O. ATWATER, PH. D.,

Professor of Chemistry in Wesleyan University, Director of Storr's (Conn.) Experiment Station, and Special Agent of the U. S. Department of Agriculture in Charge of Investigations of Food and Nutrition.

[Reprinted from the Yearbook of the U. S. Department of Agriculture for 1894.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

CONTENTS.

ILLUSTRATIONS.

FOOD AND DIET.

By W. O. ATWATER, Ph. D.,

Professor of Chemistry in Wesleyan University, Director of Storrs (Conn.) Experiment Station, and Special Agent of the U. S. Department of Agriculture in charge of Investigations of Food and Nutrition.

"Half the struggle of life is a struggle for food."—*Edward Atkinson.*

"The labor question, concretely stated, means the struggle for a higher standard of living."—*Commissioner Carroll D. Wright.*

"I have come to the conclusion that more than half the disease which embitters the middle and latter part of life is due to avoidable errors in diet, * * * and that more mischief in the form of actual disease, of impaired vigor, and of shortened life accrues to civilized man * * * in England and throughout central Europe from erroneous habits of eating than from the habitual use of alcoholic drink, considerable as I know that evil to be."—*Sir Henry Thompson.*

"If we care for men's souls most effectively, we must care for their bodies also."—*Bishop R. S. Foster.*

What proportion of the cost of living might be saved by better economy of food; how far such economy would help the wage worker to the higher plane of living toward which he justly strives; how dietary errors compare in harmfulness with the use of alcohol; and to what extent the spread of the gospel and the perfection of its fruit are dependent upon the food supply—are questions hardly possible of exact solution in the light of our present knowledge. The foregoing statements are quoted, however, because they come with authority, and because, starting from the widely different standpoints of the economist, the statistician, the physician, and the divine, the conclusions tally perfectly with those to which the study of the chemistry and economy of food seems to lead.

With the progress of human knowledge and human experience we are at last coming to see that the human body needs the closest care. We are coming to realize that not merely our health, our strength, and our incomes, but our higher intellectual life, and even our morals, depend upon the care which we take of our bodies, and that among the things essential to health and wealth, to right thinking and right living, one, and that not the least important, is our diet.

The power of a man to do work depends upon his nutrition. A well-fed horse can draw a heavy load. With less food he does less work. A well-fed man has strength of muscle and of brain, while a poorly nourished man has not. A man's nourishment is not the only factor of his producing power, but it is an important one.

This subject concerns the laboring classes in many ways. Statistics as well as common observation bear emphatic testimony to the better condition of the American as compared with the European working-

man in respect to his supply of the necessaries and comforts of life. Nowhere is this superiority more striking than in the quality and quantity of his food. And the difference in the dietaries of the two is especially marked in the larger amount of potential energy, of capability to yield muscular strength for work and to fulfill other uses in nutrition, which characterizes the food of the American. That the American workman, in many cases at least, turns out more work per day or per year than his European competitor is a familiar fact. That this superiority is due to more nutritious food as well as to better use of machinery and to greater intelligence is hardly to be questioned. But the better nourishment of the American wage worker is largely due to our virgin soil. With the growth of population and the increasing closeness of home and international competition his own diet can not be kept up to its present nutritive standard, nor can that of his poorer neighbor and his foreign brother be brought up nearer to that standard, without better knowledge and application of the laws of food economy.

To the farmer also the subject is important. Materials for the food of man make up the larger part of our agricultural production and the largest item of our export abroad. Our food production is one-sided. It includes a relative excess of the fat of meat, of starch, and of sugar, the substances that serve the body for fuel to yield heat and muscular power, while the nitrogenous substances, those which make blood and muscle, bone and brain, are relatively deficient. This is unfortunate for the consumer, because it leads him to buy material which he does not need and makes his diet one-sided, and hence injurious to health and strength. It is unfortunate for the farmer also, because it decreases the value of his product; and the very things which are needed to make his food product more valuable are the ones which will make it cheaper to produce. What is needed is more nitrogen in the soil for plant food, more nitrogen in plants to make better food for animals and man, and more nitrogen in the food of man. Better culture of the soil and better manuring will bring not only larger crops, but crops richer in nitrogen. The cultivation of more clover, alfalfa, vetch, cowpeas, peas, beans, and other leguminous crops which obtain nitrogen from the air will help in the same direction. With more nitrogenous material in his crops the farmer can make more meat, and meat with less excess of fat, and at less cost; he can produce milk, butter, and cheese more profitably, and at the same time he can be improving his land. The food for man which he thus produces will be better adapted to the actual needs of the community, much of the prevalent waste of material will be avoided, and both producer and consumer will receive the benefit.

Most people pay very little attention to these matters. The result is great waste in the purchase and use of food, loss of money, and injury to health. The chief reason why people act as they do is found in a lack of information about food and nutrition, and in the widespread and

unfortunate prejudice against economy in diet. The remedy for the evil will come only with the spread of knowledge of the subject.

DEFINITION OF FOOD AND ECONOMY.

The following statements will help to make clear the fundamental principles of the subject:

(1) Food is that which, when taken into the body, builds up its tissues and keeps them in repair, or which is consumed in the body to yield energy in the form of heat to keep it warm and create strength for its work.

(2) The most healthful food is that which is best fitted to the wants of the user. To be adapted to his wants, the food must supply the different nutritive ingredients, or nutrients, in the kinds and amounts needed by the body to build up its several parts, to repair them as they are consumed by constant use, and to yield energy in the form of heat and muscular power. The ingredients should also be supplied in forms which the person can easily digest and which will "agree" with him. If the nutrients are not supplied in the right proportions, or if they are not in easily digestible forms, or if they yield material which does not agree with the user, injury to health and strength will result.

(3) The cheapest food is that which furnishes the most nutriment at the least cost.

(4) The most economical food is that which is both most healthful and cheapest.

THE ACTUAL NUTRIMENT OF FOOD AND ITS COST.

A picture in a magazine has just struck my eye. It is a family scene in a humble home. The four children are sitting at the table with bowls of milk before them, while the mother holds in her hand a loaf of bread which she is cutting into slices for their dinner. The room is neat, but plain; the furniture is of the simplest kind, and the children's clothes are of ordinary material, with here and there a well-sewed patch. The mother's air is that of a busy housewife, her thought one of tender care for her family, but there is a trace of anxiety in the lines of her face which is in contrast with the careless eagerness of her little ones. Doubtless the father has taken his dinner with him to his daily work, by which, if he be an average bread winner, with health and industry, he may earn $500 per year. If he is not addicted to drink, the whole of this sum will go for the support of his family. It must pay for food, clothing, fuel, rent, and doctor's bills, leaving not a very large remainder for the extra comforts of the home, an occasional new carpet or piece of furniture, books, or a short excursion in summer, with perhaps a little for a life insurance or the savings bank or a timely help for a less fortunate neighbor.

When the mother goes to the market to make her purchases, she is thinking of meat and flour and potatoes, what they cost, and how the folks at home will relish them. But in fact, though she does not realize

it, she is buying certain nutritive substances in the food—flesh formers and fuel ingredients, which she and her husband need to repair the wastes of their bodies and to give them strength for their daily toil, and which their children must have for healthy growth and work and play. Her real problem, though she does not understand it, is to get the most and the best nutriment for her money. She is accustomed to buy certain materials, but if, by wiser selection, she could get abundant nutriment at less cost, and thus save a little money for extra comforts for the family or to put by in the savings bank, it would be fortunate.

The members of the family need, as essential for the day's diet, certain amounts of protein to make blood and muscle, bone and brain, and corresponding quantities of fat, starch, sugar, and the like, to be consumed in their bodies, and thus to serve as fuel to keep them warm and to give them strength for work—a larger amount for the father, with his active muscular labor; somewhat less for the mother, with her smaller body and lighter work; and quantities for the children according to age, growth, and occupation. Of course they need other substances, like mineral salts, which are contained in the food, and the water of both food and drink, and they want and will have things like salt and spice and tea and coffee, which gratify the palate and are more or less useful for nourishment.

If this family live in a village or city in Massachusetts, about $300 of their annual $500 will be expended for food.[1] Will it be expended wisely?

Due regard for health, strength, and purse requires that food shall supply enough protein to build tissue and enough fats and carbohydrates for fuel, and that it shall not be needlessly expensive. The protein can be had in the lean of meat and fish, in eggs, in the casein (curd) of milk, in the gluten of flour, and in substances more or less like gluten in various forms of meal, potatoes, beans, peas, and the like.

[1] The smaller the income, the larger is the proportion used for food, as is illustrated by the following figures, summarized from those of Hon. Carroll D. Wright in the report of the Massachusetts bureau of statistics for 1884:

Percentage of family income of workingmen in Massachusetts expended for subsistence.

Annual income.	Amount expended for food.	Per cent expended for food.
$350 to $400	$224 to $256	64
450 to 600	284 to 378	63
600 to 750	360 to 450	60
750 to 1,200	420 to 672	56
Above 1,200	612	51

In parts of the West and South, where food is very cheap, its cost in proportion to other expenses is less, and sometimes falls a little below half the income. In Europe, where incomes are smaller and food dearer, the cost of food makes a larger part of the whole expenditure.

These statements apply less accurately to farmers than to the inhabitants of the larger towns; but, although the farmer produces much of his food, yet, taking everything into account, the expense for nutriment is large even for him.

Fats are supplied in the fat of meat and fish, in lard, in the fat of milk, or in the butter made from it; it is also furnished, though in small amounts, in the oil of wheat, corn, potatoes, and other vegetable foods. Carbohydrates occur in great abundance in vegetable materials, as in the starch of grains and potatoes, and in sugar. The fats, sugars, and starches all serve for fuel, and we may measure their quantity by their fuel value, expressing this in heat units, or calories,[1] as they are commonly called. In the food this woman buys, then, she has to deal with protein, or tissue formers, and with fuel values.

If her husband is engaged at moderately hard muscular work, like that of a carpenter or mason or active day laborer, he should have in his day's food say 0.28 pound of protein and enough carbohydrates and fats so that the fuel value of the whole will be about 3,500 calories. The wife, if busy at work with her hands about the house or otherwise, will need perhaps eight-tenths as much. If the children are two boys of 13 and 8 and two girls of 10 and 5 years of age, they will need enough to make the wants of the whole family equivalent, let us say, to four men at moderately hard work. This would require 1.12 pounds of protein, and a fuel value of 14,000 calories. It could be supplied by various food mixtures—some dearer and some cheaper. If the costlier meats, oysters, or eggs at high prices are used, the diet will be an expensive one, but if the animal food is used in the forms of the less costly meats, in milk and cheese in not too large quantities, and if the bulk of the diet consists of such wholesome vegetable foods as wheat flour, corn meal, oatmeal, peas, beans, and potatoes when the last are not too dear, the cost will be very much less. Some specimens of food mixtures, with amounts of ingredients and costs, are given in the Appendix (Human Foods, Table D).

NUTRITIVE INGREDIENTS OF FOOD.

The real problem before this woman when she goes to market is to obtain, at the least cost, protein, fats, and carbohydrates needed to meet the wants of her family. Flavor and appearance are things to look out for, of course. She may buy them in the food if she has the money and is willing to spend it, but they are costly. She may supply them by good cooking and tasteful serving, but this will take skill and care, and too many women in her circumstances lack the one and are averse to the other. Or she may ignore both flavor and appearance, and if her husband does not like the food she sets before him, and other things about the home are not attractive, he will very likely go to the "poor man's club," otherwise known as the saloon.

The training of a well-ordered home or the cooking school will tell how to make savory dishes from inexpensive materials. A little of the chemistry of the subject will show how to select them.

Table A (Human Foods, Appendix) gives the composition of speci-

[1] A calorie is the amount of heat required to raise a pound of water 4° F.

mens of common food materials. The composition of a smaller number is shown in figure 80 herewith.

Thus a pound of sirloin of beef of medium fatness will furnish, say, 0.15 pound of protein in the "lean" and 0.16 pound of fat. The fuel value of the protein added to that of the fat makes 970 calories in the pound of sirloin. A pound of wheat flour of average quality will contain about 0.11 pound of protein, in the form of gluten; 0.01 pound of fat, which, if extracted from the flour, would be an oily substance; and 0.75 pound of carbohydrates, of which nearly all would be starch. The fuel value of these nutrients in the pound of flour would be, according to Table A, 1,645 calories.[1]

Food materials rich in protein are the most valuable for building the tissues of the body. A pound of cheese may have 0.28 pound of protein, as much as a man at ordinary work needs for a day's sustenance, while a pound of milk would have only 0.04 and a pound of potatoes only 0.02 pound of protein. The materials which have the most of fats and carbohydrates have the highest fuel value. The fuel value of a pound of fat pork may reach 2,995 calories, while that of a pound of salt codfish would be only 315 calories. On the other hand, the nutritive material of the codfish will consist almost entirely of protein, of which the salt pork has very little.

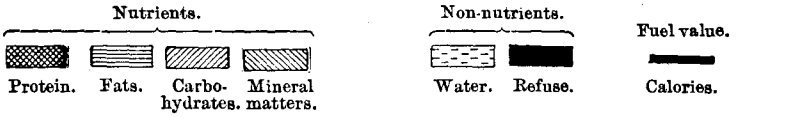
In general, the animal foods have the most of protein and fats, while the vegetable foods are rich in the carbohydrates, starch, and sugar. The lean meats and fish abound in protein. Cheese has so large a quantity of protein because it contains the casein of the milk. Among the vegetable foods, beans and peas have a high proportion of protein. The proportion in oatmeal is also large. In wheat it is moderate, and in corn meal it is rather small. The materials with the highest fuel value are those with the most fat, because the fuel value of the fat is, weight for weight, two and one-fourth times as great as that of either sugar, starch, or protein. Hence fat pork and butter lead the other materials in fuel value. The fat meats in general stand high in this respect. So also do the grains, flour, and meal, as they have large quantities of carbohydrates. Potatoes are quite low in the list in respect to fuel value as well as protein, principally because they are three fourths water. For the same reason, milk, which is seven-eighths water, ranks low in respect to both protein and fuel value.

It is important to remember that all these estimates apply to the food materials in the form in which we buy them, including both refuse, like the bones of meat, skins of potatoes, etc., and water. If we were to remove the bones and other refuse from the meats, fish, and other foods which contain them, and then remove the water from all the materials, and compare the actually nutritive substances of nutrients, their rank would, of course, be very different. Salt codfish, for instance,

[1] Detailed explanations of the composition of food materials, the ways they are used in the body, and their nutritive values as compared with their cost, are given in Farmers' Bulletin No. 23 of the United States Department of Agriculture.

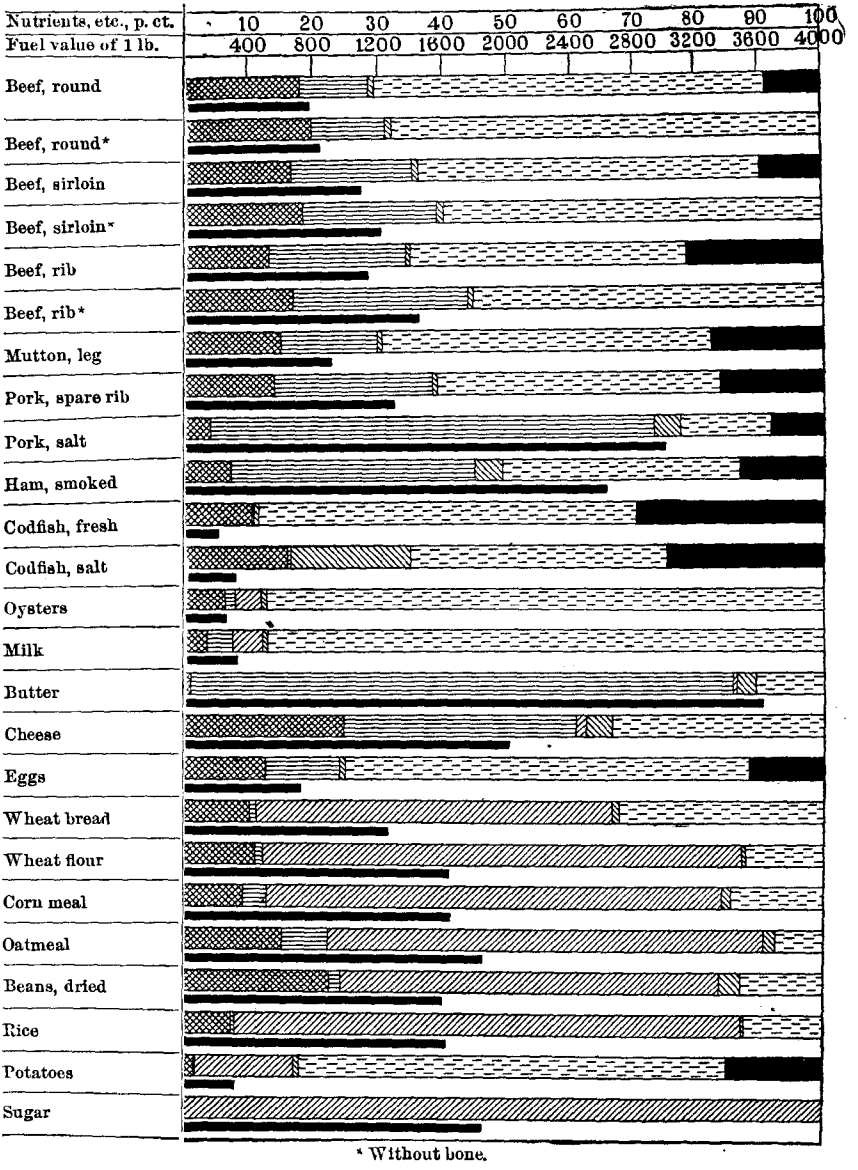
FIG. 80.—COMPOSITION OF FOOD MATERIALS.

Nutritive ingredients, refuse, and fuel value.



Protein compounds, e. g., lean of meat, white of egg, casein (curd) of milk, and gluten of wheat, make muscle, blood, bone, etc.

Fats, e. g., fat of meat, butter, and oil, } serve as fuel to yield heat and muscular power.
Carbohydrates, e. g., starch and sugar, }



* Without bone.

is a very economical food, because it furnishes protein in an easily digestible form, although, as we buy it, a pound will contain over eight-tenths of a pound of water and refuse. A pound of rice consists of about seven-eighths of a pound, and a pound of potatoes only one-fourth of a pound of nutritive materials, but in cooking the rice we mix water with it and thus make it not very different in composition from potatoes. By drying the potatoes we could get a material very similar in food value to rice.

In Table 1 a number of the most common articles of food are grouped according to their quantities of protein and their fuel values.

TABLE 1.—*Classification of food materials by composition.*

GRADATION BY AMOUNTS OF PROTEIN IN 1 POUND.	GRADATION BY FUEL VALUES IN 1 POUND.
VERY LARGE.	
.32 to .21 pound protein.	*4,220 to 1,700 calories.*
Canned corned beef; cheese. Beans, dry.	Butter; salt pork; cheese; smoked ham. Milk crackers; sugar; oatmeal.
LARGE.	
.20 to .16 pound protein.	*1,700 to 1,200 calories.*
Canned salmon; beef, round; beef, sirloin; salt codfish; beef, chuck.	Pork, spare rib. Corn (maize) meal; wheat flour; rice; beans, dry; wheat bread.
MEDIUM.	
.15 to .11 pound protein.	*1,200 to 700 calories.*
Mutton, leg; pork, spare rib; beef, rib; eggs; fresh codfish. Oatmeal; wheat flour.	Canned corned beef; beef, rib; beef, sirloin; canned salmon; beef, chuck; mutton, leg; beef, round; eggs.
SMALL.	
.10 to .06 pound protein.	*700 to 300 calories.*
Smoked ham. Wheat bread; milk crackers; corn (maize) meal; rice.	Milk; salt codfish. Potatoes.
VERY SMALL.	
.05 pound and less protein.	*300 calories and less.*
Oysters; salt pork; milk; butter. Potatoes; sugar.	Oysters; fresh codfish.

Before leaving the subject of the composition of food materials, a word of caution is in order. The figures in Table A in the Appendix represent the averages of the analyses now available. But different specimens of the same kind of food materials may vary widely in composition. This is especially true of meats, because of the variations in the proportions of bone and of fat.

CHEAP AND DEAR FOODS.

To get at the actual cheapness or dearness of different food materials we must take into account both the composition and the price. Suppose, for instance, our would-be thrifty housewife, in buying food at the

FIG. 81.—PECUNIARY ECONOMY OF FOOD.

Amounts of actually nutritive ingredients obtained in different food materials for 10 cents.

Protein compounds, e. g., lean of meat, white of egg, casein (curd) of milk, and gluten of wheat, make muscle, blood, bone, etc.
Fats, e. g., fat of meat, butter, and oil, } serve as fuel to yield heat and muscular power.
Carbohydrates, e. g., starch and sugar, }

	Price per pound.	Ten cents will buy—	Pounds of nutrients and calories of fuel value in 10 cents' worth.
	Cents.	*Lbs.*	1 Lb. 2000 Cal. / 2 Lbs. 4000 Cal. / 3 Lbs. 6000 Cal. / 4 Lbs. 8000 Cal.
Beef, round	12	.83	
Beef, sirloin	18	.55	
Beef, rib	16	.63	
Mutton, leg	12	.83	
Pork, spare rib	12	.83	
Pork, salt, fat	14	.71	
Ham, smoked	16	.63	
Codfish, fresh	8	1.25	
Codfish, salt	6	1.67	
Oysters, 40 cents quart	20	.50	
Milk, 6 cents quart	3	3.33	
Butter	24	.42	
Cheese	16	.63	
Eggs, 25 cents dozen	16⅔	.60	
Wheat bread	4	2.50	
Wheat flour	2½	4.00	
Corn meal	2	5.00	
Oat meal	4	2.50	
Beans, white, dried	4	2.50	
Rice	5	2.00	
Potatoes, 60 cents bushel	1	10.00	
Sugar	5	2.00	

market for her family, wishes to obtain the largest amount of nutriment for her money. What kind shall she select? To put it in another way, How much of tissue formers and fuel value can she obtain for a given sum—10 cents, for instance—in beefsteak, flour, or potatoes, as she ordinarily buys them?

If she spends her dime for beefsteak at 20 cents a pound, she gets half a pound, which supplies 0.08 pound of protein and 550 calories of energy; but if she invests the same money in flour at 2½ cents a pound, she has 4 pounds, with 0.44 pound of protein and 5,680 calories of energy. Table B (Human Foods, Appendix) shows the quantities of nutrients and energy in 10 cents' worth of each of a number of food materials at ordinary prices. Figure 81 illustrates the differences, and Table 2 herewith shows the gradation of a small number:

TABLE 2.—*Classification of food materials by cost of actual nutriment; i. e., by amounts of protein and energy in the quantities bought for 10 cents at ordinary prices per pound.*

GRADATION BY AMOUNTS OF PROTEIN IN 10 CENTS' WORTH AT PRICES STATED PER POUND.	GRADATION BY FUEL VALUES OF 10 CENTS' WORTH AT PRICES STATED PER POUND.
VERY CHEAP.	
.75 to .26 pound protein.	*9,000 to 3,000 calories.*
Salt codfish, 6 cents. Beans, dry, 4 cents; wheat flour, 2½ cents; oatmeal, 4 cents; corn meal, 2 cents; wheat bread, 4 cents.	Wheat flour, 2½ cents; corn meal, 2 cents; oat meal, 4 cents; beans, dry, 4 cents; sugar, 5 cents; rice, 5 cents; potatoes (60 cents bushel), 1 cent; wheat bread, 4 cents.
CHEAP.	
.25 to .18 pound protein.	*3,000 to 1,800 calories.*
Canned corned beef, 12 cents; milk (4 cents quart), 2 cents; skim milk (3 cents quart), 1½ cents. Potatoes (60 cents bushel), 1 cent.	Salt pork, 12 cents. Milk crackers, 9 cents; wheat bread, 6 cents.
MEDIUM.	
.17 to .13 pound protein.	*1,800 to 1,000 calories.*
Cheese, 16 cents; beef, chuck, 12 cents; beef, round, 12 cents; fresh codfish, 8 cents. Wheat bread, 6 cents; rice, 5 cents.	Butter, 24 cents; cheese, 16 cents; smoked ham, 16 cents; pork, spare rib, 12 cents; skim milk (3 cents quart), 1½ cents; milk (4 or 6 cents quart), 2 or 3 cents.
EXPENSIVE.	
.12 to .08 pound protein.	*1,000 to 500 calories.*
Mutton, leg, 12 cents; pork, spare rib, 12 cents; milk (6 cents quart), 3 cents. Milk crackers, 9 cents.	Canned corned beef, 12 cents; beef, chuck, 12 cents; mutton, leg, 12 cents; beef, rib, 16 cents; beef, round, 12 cents; beef, sirloin, 18 cents; salt codfish, 6 cents.
VERY EXPENSIVE.	
.07 pound and less protein.	*500 calories and less.*
Smoked ham, 16 cents; salt pork, 12 cents; oysters, 30 cents quart.	Fresh codfish, 8 cents; oysters, 30 cents quart.

The most striking fact brought out by all these calculations is the difference between the animal and vegetable foods in the actual cost of nutriment. Meats, fish, poultry, and the like are expensive, while flour and potatoes are cheap food. The reason of this is simple. The animal foods are made from vegetable products. Making meat from grass or grain is costly. An acre of land will produce a given number of bushels of wheat, but when the grass or grain which the same land would produce is converted into meat it makes much less food than the wheat.

DIGESTIBILITY OF FOOD.

These calculations do not take into account the digestibility of the food. In general, the animal foods are somewhat more digestible than the vegetable foods. The protein of ordinary meats, for instance, is practically all digested when it is eaten in moderate quantities by healthy persons, but the same persons might digest only nine-tenths of the protein of wheat flour made into bread, and not more than three-fourths of that of potatoes. The fat of meats is less completely digested. The sugar and starch of vegetable foods, properly cooked, is very easily and completely digested.[1]

THE FITTING OF FOODS TO THE NEEDS OF THE BODY.

Different people have different needs for nutriment. All are alike in that they must have protein for the building and repair of the bodily machine, and fuel ingredients for warmth and work. But they differ widely in the amounts and proportions they require, and even among those in good health there are many who are obliged to avoid certain kinds of food, while invalids and people with weak digestion must often have special diet.

For people in good health and with good digestion there are two important rules to be observed in the regulation of the diet. The first is to choose the things which "agree" with them, and to avoid those which they can not digest and assimilate without harm. The second is to use such kinds and amounts of food as will supply all the nutrients the body needs and at the same time avoid burdening it with superfluous material to be disposed of at the cost of health and strength.

For guidance in this selection, nature provides us with instinct, taste, and experience. Physiological chemistry adds to these the knowledge—still new and far from adequate—of the composition of food and the

[1] Detailed statements of the results of experiments upon the digestibility of food by man and the effects of cooking upon digestibility may be found in Bulletin No. 21 of the Office of Experiment Stations of this Department on the Chemistry and Economy of Food. Brief explanations regarding the digestibility of food are given in Farmers' Bulletin No. 23 of the same Department.

laws of nutrition. In our actual practice of eating we are apt to be influenced too much by taste, that is, by the dictates of the palate; we are prone to let natural instinct be overruled by acquired appetite; and we neglect the teachings of experience. We need to observe our diet and its effects more carefully, and regulate appetite by reason. In doing this we may be greatly aided by the knowledge of what our food contains and how it serves its purpose in nutrition.

What kinds of food best agree with any individual is a matter to be found out by experience. Milk is for most people a very wholesome, digestible, and nutritious food, but there are persons who are made ill by drinking it; they should avoid milk. The author knows a boy who is made seriously ill by eating eggs. A small piece of sweet cake in which eggs have been used will cause him serious trouble. The sickness is nature's evidence that eggs are, for him, an unfit article of food. Some people have to avoid strawberries. Indeed, cases in which the most wholesome kinds of food are hurtful to individual persons are, unfortunately, numerous.

How it is that food which contains nothing unwholesome can be so harmful has always been a mystery until, within a few years past, chemistry has begun to explain the changes that food undergoes in the body. It appears that in their course through the body the constituents of the food are subject to a great variety of chemical changes, and that some of the compounds formed may be at times harmful in one way or another. Some of the compounds produced from the food in the body may be actually poisonous. Different persons are differently constituted with respect to the chemical changes which their food undergoes and the effects produced, so that it may be literally true that "One man's meat is another man's poison." Every man must learn from his own experience what food agrees with him and what does not.

On the other hand, some foods have at times a great value outside of their use for nourishment. Fruits and garden vegetables often benefit people greatly, not as nutriment merely, for they may have very little of actual nutrients, but because of the vegetable acids or other substances which they contain, and which sometimes serve a most useful purpose.

Food does more than to build tissue and yield energy. What it does in other ways—its value as medicine rather than nutriment—this is not the place to discuss. Let us return, then, to our subject, which is food economy.

For the great majority of people in good health the ordinary food materials—meats, fish, eggs, milk, butter, cheese, sugar, flour, meal, potatoes, and vegetables—make a fitting diet, and the main question is to use them in the kinds and proportions fitted to the actual needs of the body. This will be best answered by considering the subjects of dietaries and dietary standards.

STANDARDS FOR DAILY DIETARIES.

Various attempts have been made by physiologists and chemists to devise standards to represent the amounts of nutrients needed by people of different age, sex, and occupation for their daily sustenance. There are two great difficulties in the way of setting up such standards. The first is that we have not yet enough definite knowledge to say exactly how much nutriment the average man or woman who does a given kind and amount of work actually needs to keep his or her body in good condition, to make blood and muscle and other tissues as they are constantly used up, and to serve as fuel to keep the body warm and supply it with strength for work. Nor can we yet say just how much an average child of a given age and period of growth requires to build up its growing body, repair the wastes, and give it warmth and strength for its work or play.

The other difficulty in the way of laying down hard and fast rules to regulate the diet is that different individuals of the same class differ so widely in their demands for food and in the use they make of it. Two men of like age, size, build, and occupation may live and work side by side. One will eat more and the other less, while both do the same amount of work; or both may eat the same food and do the same work, and one will be fat and the other lean; or both may have the same diet, and yet one will be strong and vigorous and able to do a great deal of work, while the other will be weak and able to accomplish but little. Just why individuals differ in their ways of utilizing their food, and how to measure the differences and make dietary rules to fit them exactly, are problems which the physiological chemist of to-day is far from solving. The fact is that the whole subject is new, and the accurate investigation thus far made, though quite considerable when we get it all together, is far too small for satisfactory conclusions. The best we can do with our present knowledge, or rather lack of knowledge, of the subject is to make general estimates, with the clear understanding that they are only rough estimates, and that they apply to average rather than individual cases. For that matter, we can never expect to reduce this matter of diet to an exact science. The nutrition of man is not a mere matter of pounds of protein and units of energy. Even when the complex laws of our physical being are learned, if science shall reveal them to us in all their fullness, as we can hardly expect that it ever will, there will still remain factors outside the domain of chemistry and physiology, factors for which no physical measure is now or ever can be possible.

The ordinarily accepted standards for dietaries are estimated in terms of "protein," "fats," and "carbohydrates." The amounts of these appropriate for daily food for different classes of people under different conditions have been estimated in two ways:

(1) By observing the amounts actually consumed by individuals, and by groups of people differing in age, sex, occupation, and other conditions of life.

(2) By experiments in which the income and outgo of the body are directly compared. Experiments of this sort are made by supplying individuals with food of known amount and composition, and determining the quantity and composition of the products given off from the body. The most valuable researches thus far have been made with the so-called respiration apparatus. In these, the food, drink, and inhaled air, which make up the income and outgo of the body, are measured, weighed, and analyzed. The balance of income and expenditure is thus made, and the gain or loss of material of the body, with different kinds and amounts of food, and under different conditions of muscular exercise and rest, is determined.

The experiments involve a large amount of labor, but bring correspondingly complete and reliable results. They are of fundamental importance in learning the ways in which food is used in the body, and it is for this purpose that most of the respiration experiments have been made. The larger part of this kind of experimenting has been with domestic animals; only few trials have been made with men.

An improvement upon this method is now being attempted by several investigators. It consists in taking into account the income and outgo of energy along with the income and outgo of matter. The income of energy is measured by the potential energy of the food; the outgo is measured by the heat given off from the body and the muscular work done. The apparatus used may be called the respiration calorimeter. Experimenting with it is even more complex, laborious, and costly than with the respiration apparatus, so that while investigators have come to see its necessity, extremely few have attempted it,[1] and the research attempted by them is still in its beginning. Enough has been accomplished to show that the work is feasible and the time is ripe for extended and thorough experiments with men of different ages, bodily conditions, and callings.

Our best information regarding dietary standards comes from Germany, where studies have been made by numerous investigators, such as Liebig, and especially Voit and his followers of the Munich school of physiologists. The names of Payen in France, Playfair in England, and Moleschott in Italy deserve especial mention as contributors to our knowledge on the subject. It is a noteworthy fact, however, that very

[1] Research of this especial kind has been undertaken by Professors Rubner and Rosenthal in Germany, Chauveau in France, and Burdon-Sanderson and associates in England, and in the writer's laboratory in Middletown, Conn. The only results thus far published, in which the income and outgo of energy have been measured, are those of a limited number of experiments by Rubner with dogs.

A more detailed, though not complete, discussion of the whole subject, including dietaries and dietary standards, is given in the bulletin on the Chemistry and Economy of Food, mentioned above.

little attention appears to have been paid in either the United States or England to the results of the latest and best research in this direction. Even the text-books in chemistry and physiology in the English language, which are looked upon as most authoritative, are too apt to pass the subject over most superficially or ignore it.

DIETARY STANDARDS FOR MEN AT MUSCULAR WORK.

Let us take, for instance, the case of an average "working" man—say a carpenter, blacksmith, or day laborer—who is doing a moderate amount of muscular work. To make up for the constant wear and tear of muscle, tendon, and other nitrogenous tissue, he must have protein. To use his muscles, strength or muscular energy is required. Furthermore, his body must be kept warm. The most of the energy is supplied by the fats and carbohydrates, but some come from protein. Our workingman, then, needs in his daily food (1) enough of protein to make up for the protein of muscle and other nitrogenous tissue consumed in his body; (2) enough energy to supply the demand for heat and muscular work.

The problem, then, is this: How much protein, fats, and carbohydrates does the average man, with a moderate amount of manual work to do, require in a day's food?

A number of noted European investigators have made diligent comparisons of the results of their own and other inquiries, and have set up certain standards, which are given in Table E, Human Foods, Appendix. In Table F are some standards proposed by the author after consideration not only of the data which were at the disposal of the authorities named above, but also of later ones, especially those obtained from the studies of American dietaries. For Americans at moderately active or at hard muscular work a more liberal allowance of nutrients has been provided than is given by any of the European authorities, for the reason, explained in more detail beyond, that people in this country work harder and need ampler nourishment than is common among wage workers in Europe.

Standards for daily diet of laboring man at moderate muscular work.

Author.	Nutrients in daily food.			
	Protein.	Fats.	Carbohydrates.	Fuel value.
	Pound.	*Pound.*	*Pounds.*	*Calories.*
Playfair, England	0.26	0.11	1.17	3,140
Moleschott, Italy	.29	.09	1.21	3,160
Wolff, Germany	.28	.08	1.19	3,030
Voit, Germany	.26	.12	1.10	3,055
Atwater, United States	.28	.17—.33	.88—1.21	3,500

No. 4 of the table, by Professor Voit, of the University of Munich, is the one most commonly quoted. It is intended to represent the needs of ordinary mechanics and laboring men at their usual work.

It was estimated from the food consumed by such men in Germany, and especially in the region of Munich, Bavaria. Voit would have somewhat over half of the 0.26 pound of protein of the food of the average laboring man at moderate work supplied by meat and other animal foods.

It will be borne in mind that these quantities, like those in the other tables of this article, generally refer to the total rather than the digestible nutrients of the food. Such dietaries as those proposed by Voit and the author would contain approximately the following amounts of digestible nutrients:

	Protein.	Fats.	Carbohydrates.
	Pound.	*Pound.*	*Pound.*
For laboring man at moderate work, Voit	0.25	0.11	1.00
For laboring man at moderate work, Atwater	.30	.21	.88

Of course, such standards as these represent only general averages. Thus Voit, Playfair, and the other physiologists named assume that for an ordinary laboring man, doing an ordinary amount of work, the amounts of nutrients stated in the table will suffice; that with them he will hold his own, and that any considerable excess above these quantities will be superfluous.

No one expects any given man to adjust his diet exactly to either of these standards. He may need more, and may perhaps get on with less. He may eat more fats and less carbohydrates, or he may consume more protein, if he is willing to pay for it. If he has much less protein and keeps up his muscular exertion, he will be apt, sooner or later, to suffer. But he may increase the fats and diminish the carbohydrates, or vice versa, within reasonable limits, without harm, because they both do the same work in the body and one may take the place of the other.

Different individuals, under like conditions, will both require and consume different quantities of nutrients. In general, the larger the person—that is to say, the bulkier the machinery in his organism—the more of protein and other nutrients will be consumed. Hence, men need, on the average, more than women.

The requirements vary with the muscular activity. A man at hard work requires more nutrients to make up for the wear and tear of the bodily machine and supply it with fuel than one at lighter work or at rest. Aged people, who are generally less active than those in the prime of life, require less food.

THE FOOD OF PEOPLE IN BUSINESS AND PROFESSIONAL LIFE.

Just what ingredients of the food serve for nourishment of the brain and nerves, and how they do that service, are mysteries which the physiological chemist has not yet solved. Brain and nerve contain the elements nitrogen and phosphorus, which occur in the protein com-

pounds, but are not found in the true fats or in the sugars and starches, which contain only carbon, hydrogen, and oxygen. A natural inference is that the protein compounds of the food and certain other substances in food, like lecithin, which also contain nitrogen and phosphorus, must be especially concerned in building up brain and nerve and keeping them in repair. This is practically as far as our present knowledge goes.

Just how much food the brain worker needs is a question for which the answer to-day is no more definite. In general, it appears that the man or woman whose occupation is what we call sedentary, who is without vigorous physical exercise and does but little of hard muscular work, needs much less than the man at hard manual labor, and that especially the brain worker needs comparatively little of carbohydrates and fats.

Many physicians, physiologists, and students of hygiene have the very firm conviction that well-to-do people, whose work is mental rather than physical, eat too much; that the diet of people of this class as a whole is one-sided as well as excessive, and that the principal evil is in the use of too much fat, starch, and sugar.

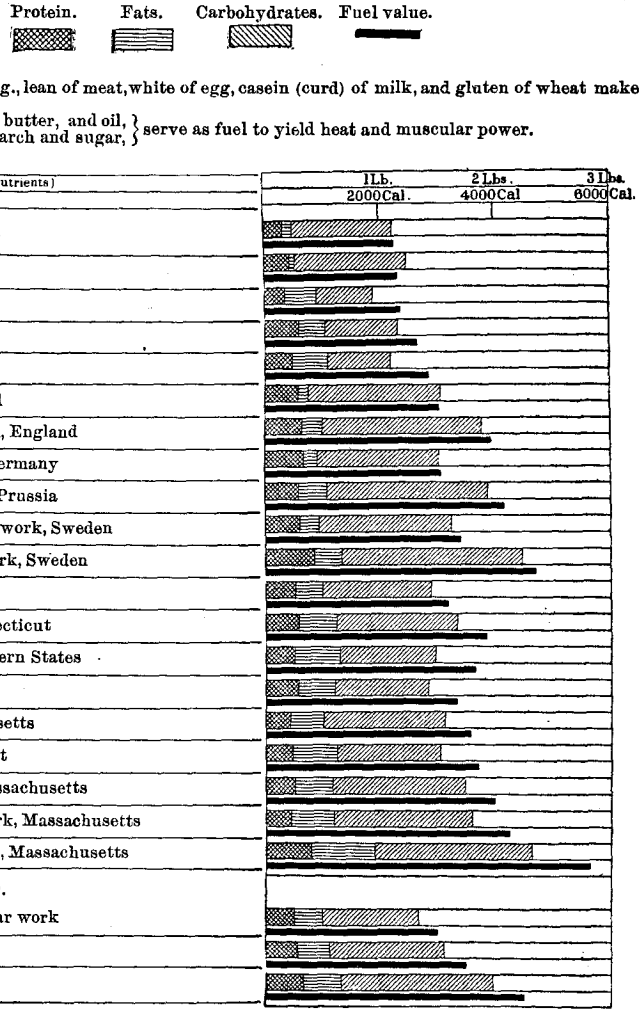
The facts of accurate experiment and observation upon this point are meager, but, such as they are, they tend to confirm this view very emphatically. Let us briefly consider some facts drawn from a review of all the reliable studies of the food of men in professional life which have been reported in the literature of the subject to which the author has had access. They include dietaries of 2 university professors, 3 lawyers, 3 physicians, and 5 medical students in Hesse-Nassau, Bavaria, Denmark, and Sweden—in all, 8 dietaries of 14 persons in Europe—and those of 1 retired merchant, 3 chemists, 2 college professors, and 4 boarding clubs of students in a college and in a theological school—in all, 10 dietaries of nearly 130 persons in Connecticut. The college students were mostly from a considerable number of Northern and Eastern States. Figure 82 shows the quantities of nutrients and energy in a number of these dietaries as compared with the dietary standards.

We may notice first some of the details of the European dietaries. Those of the two professors, one in the University of Marburg and the other in that of Munich, were studied by the gentlemen themselves with especial care. There was no restriction upon their diet; the attempt was to find how much food sufficed for the actual demand. Both were men of good health, vigorous, and in the prime of life. They had in their daily food, respectively, 0.20 pound and 0.22 pound of protein and 2,565 and 2,325 calories of energy. The three lawyers and two of the physicians lived in Munich, and were selected by Professor Forster, who made the studies, as individuals typical of their class. They were young, vigorous, well-to-do, and well nourished. The lawyers averaged 0.18 pound of protein and 2,400 calories; the physicians, who very

likely had more exercise, 0.28 pound of protein and 2,765 calories. The third physician, who lived in Copenhagen, had 0.30 pound of protein and 2,800 calories per day. The students were in Stockholm. They worked several hours per day in the laboratory, so that their occupation partook somewhat of the character of that of mechanics with

FIG. 82.—DIETARIES AND DIETARY STANDARDS.

Quantities of nutrients and energy in food per man per day.



light muscular work. They averaged 0.28 pound of protein and 3,035 calories of energy.

The order of the dietaries in respect to amounts eaten is interesting. Of the men engaged in professional duties, the professors and the lawyers, who would be presumed to have the least muscular exercise, con-

sumed the least food. The physicians, who, in the daily practice of their profession, would be expected to have more exercise, consumed more food. The people in Munich consumed the least, and those in the more northerly and colder latitudes of Denmark and Sweden the most. With the less muscular exercise and the warmer climate was the smaller, and with the more muscular activity and the colder climate was the larger, food consumption. This coincidence may be accidental, but it is worth noticing.

The important fact for our present purpose is this: Here are a considerable number of men in comfortable circumstances, able to provide themselves with ample food, and living in circumstances which would seem to favor proper nutrition. Their labor is mainly intellectual and their muscular work light. Their food contains from 0.18 to 0.30 pound of protein, and from 2,325 to 3,035 calories of energy per day. The average is 0.23 pound of protein and 2,670 calories of energy. For the active study or professional practice in which they are engaged, their nutriment is ample.

Let us now compare with these the dietaries of the professional men and students in Connecticut. As the waste may have been larger here than in the European dietaries, and we do not wish to exaggerate the difference between the two, we will compare the food actually eaten by the people in Connecticut with the total food supplied to the Europeans. In the 5 dietaries of as many families in Connecticut, 1 of a retired merchant, 3 of college professors, and 1 of a chemist, the protein ranged from 0.20 to 0.26 pound and averaged 0.24 pound, while the energy ranged from 3,205 to 4,080, and averaged 3,560 calories. Compared with the dietaries of the professional men in Germany and Denmark, those in Connecticut had a very little more protein and nearly one-half more fuel value.

The majority of the students in the Connecticut college were from the New England and Middle States. The same was true of those in the theological school, who were nearly all college graduates, a little older and somewhat less given to athletic sports and other kinds of physical exercise. Each of the clubs in which they boarded was managed by one of the number, who selected the food to suit their taste. It seems fair to assume that their eating habits were such as they had acquired at home; that, in other words, they represented the class of people in New England and the Middle States whose sons go to college. In the dietaries of these 115 young men the protein ranged from 0.20 to 0.31 pound and the energy from 3,085 to 4,825 calories. The average for protein was 0.26 pound, and that for fuel value, 3,720 calories. Of the Swedish students, there were only 5 dietaries of 5 individuals. These averaged 0.28 pound of protein and 3,035 calories. The number of persons for the comparison with the American students is small. The difference is less, but in general character it is the same as in the cases of the men in professional practice.

Did the professor and chemists in Connecticut require so much nutriment, when professors and physicians in Germany and Denmark are well nourished with so much less? Did the American students need food with so much more fuel value than the Swedish students? It seems to me very decidedly not.

The lower nutritive standard of the European as compared with the American wage worker coincides with his smaller income, which forbids generous diet, and his smaller capacity for work. But these European professional men and students were able to eat all they needed, and it might be difficult to prove that the intellectual activity of the American men of like calling was so much greater as to call for so great an excess of protein and fuel value in their food.

Doubtless, we live and work more intensely than people do in Europe. We also take more outdoor exercise. Students with us are, fortunately, much more given to athletic exercise than are German students. Possibly the medical students in Stockholm may have been so much more active physically than the young physicians in Munich and the other professional men in Germany as to need the ampler diet which they enjoyed. And it may very well be that the gentlemen in Connecticut used their muscles more and lived at higher tension than those on the other side of the Atlantic, and on these accounts needed more nutriment. But it is hard to see how they could have required food with a 50 per cent higher fuel value.

DIETARIES OF LABORING PEOPLE—FOOD, WORK, AND WAGES IN THE UNITED STATES AND IN EUROPE.

In 21 dietaries of mechanics, carpenters, cabinetmakers, coopers, locksmiths, shoemakers, farm laborers, and other wage workers in Germany, mostly in Bavaria, all of whom were counted as well-to-do for people of their class and were engaged in moderately hard work, the smallest quantity of food per man per day had a fuel value of 1,405 calories, and the largest 5,285, the average being 3,135. In 20 dietaries of factory and mill operatives, mechanics, and other laboring people in Massachusetts and Connecticut, who were also engaged in ordinary work, the smallest dietary furnished 3,055, the largest 5,340, and the average just about 4,000 calories. The people in New England whose food consumption is thus summarized included a very large percentage of factory operatives, whose standard of living was low as compared with that of the wage workers of the region generally, and yet their food was nearly one-third more nutritious than that of the better class of wage workers at ordinarily hard work in Germany.

In 11 dietaries of iron and steel workers, miners, brickmakers, and other wage workers in Prussia and Bavaria, who were counted as doing "hard" and "severe" work, the smallest furnished 3,365, the largest 5,690, and the average 4,390 calories per man per day. In 6 dietaries of machinists, blacksmiths, brickmakers, and others in Massachusetts

and Connecticut, also counted as doing "hard" and "severe" muscular work, the smallest furnished 4,250, the largest 7,805, and the average 5,710 calories. Here, again, the wage workers in Massachusetts and Connecticut were better nourished by one-third than those in Bavaria and Prussia.

In 40 dietaries of the people of the poorer classes in Prussia and Saxony the fuel value averaged 2,566 calories. The food of 25 families in the poorest part of Philadelphia averaged 3,235, and that of 36 families in the poorest part of Chicago, 3,425 calories. The poor people in the two American cities were better nourished by half than those referred to in Leipsic, Munich, and elsewhere in Germany.

The inhabitants of Saxony and Bavaria rank well among the population of Europe in respect to industry and thrift. Those whose food consumption is here reported were selected by investigators there as typical for their respective classes. Among the people whose dietaries were studied in Massachusetts and Connecticut were many (those in Philadelphia and Chicago were chiefly, foreigners whose standard of living and food consumption we should hardly expect to be up to the level of those of the native population. The statistics are not sufficient for a just comparison between the wage workers of the two countries, but, in so far as they go, they imply very distinctly that people here are very much better fed than there.

During the last dozen years the author has conversed with many observers, including a considerable number of statisticians of the best repute in the United States and in Europe, and has found among them a practical unanimity of opinion to the effect that the workingman in this country is much the more efficient. The statistics regarding this subject are very meager. Accurate details are much to be desired. An investigation which should bring them is certainly called for. Meanwhile it would seem reasonably safe to assume that the consensus of observers is right as to the general principle that, on the whole, people in the United States do more work than do people in Europe.

Regarding wages on the two sides of the Atlantic, the statistics are very extensive, and the advantage in favor of the American workingman is a familiar fact.

Discussions of this sort are entirely outside of the province of the chemist, but to a layman in political economy the parallelism between food, work, and wages in the United States and in Europe is very striking.

THE NUTRITION OF THE WORKINGMAN AND HIS ELEVATION.

Among the standard illustrations of the relation between the food consumed and the work done is that of the experience with English and French workingmen in the building of a railroad many years ago in the north of France. The contractor, the well known Englishman, Mr. Brassey, found that the English navvies were much more efficient than

the French laborers with the pick and shovel. But, on looking into the matter, it appeared that the Englishmen were much the better fed, and when more food was given to the Frenchmen there was a corresponding increase in the work which they performed.

Among the persons engaged in the railroad enterprise thus referred to was a young Englishman who afterwards came to this country and became very prominent as an employer of labor and manager of large manufacturing enterprises. Among his observations are some of great interest. He says that he has had occasion to observe large numbers of English laborers who have come to this country and entered his employ, and that the change which comes over many of them is very noticeable. Under the stimulus of the larger experience, the more favorable surroundings, and better opportunities, their ambition is excited, they try to see what they can make of themselves, and the result is a noteworthy development in their personal character as well as in their working capacity.

This last observation is very suggestive. The merely physical factors—food, clothing, and shelter—are not enough to elevate a man. There must be the conditions about him and the spirit within him to enable him to utilize them. The material conditions, environment, and spirit must all be present if he is to rise to the level where a man ought to live.

The facts and observations above cited have a profound significance. The dietary statistics, taken with the collateral facts, lead to the inference that ordinary people have with us what only the exceptionally well fed have on the other side of the Atlantic—the food they need to make the most of themselves and their work. Indeed, is it not safe to say that, so far as the facts at hand go, they imply very distinctly that to the American workingman is vouchsafed the priceless gift which is denied to most people of the world, namely, the material conditions, including especially the liberal nourishment, which are essential to large production, high wages, and the highest physical existence, and that, as a corollary, he has a like peculiar opportunity for intellectual and moral development and progress? The saddest part of the picture that one sees among the industrious and worthy members of the poorly paid and poorly fed classes in Europe is not the physical want, but the spiritual poverty, the lack of buoyancy, the mute, hopeless endurance of their lives. And, by contrast, the happiest feature in the condition of wage workers with us is not simply that they have better food, better clothing, better houses, and a better material existence in general, but that they have what is more important—and these things help to bring them—the vigor, the ambition, the hope for higher things, and that their effort leads them to the realization of their hope.

The general principle here urged is that liberal food, large production, and higher wages go together. If this be true, the connection between the American's generous diet and his high wages is very clear. The question naturally follows, What is to be done for the future mainte-

nance of the position of our laboring people at home and in their competition with others in the markets of the world? Part of the answer, at any rate, must be sought in a reform in the purchase and use of food. Instead of our present wastefulness, there must be future saving. With increase of population and closer competition with the rest of the world, the abundance which tempts us to our lavishness must grow gradually less, and closer economy will be needed for living on our present plane of nutrition.

FOOD OF PEOPLE WITH SCANTY NOURISHMENT.

The statistics of the food consumption of people of the poorer classes deserve more notice than can be given to them here. Studies of families in Philadelphia and Chicago were made at the College Settlements in the former, and at the Hull House in the latter city, by Miss Amelia B. Shapleigh, as holder of the Dutton fellowship of the College Settlements Association. They represent a line of inquiry for which the College Settlements are in peculiarly favorable situation to carry out by virtue of their intimate and sympathetic relation with the people in the poorer quarters of the cities, where they are located. The variations in the quantities of nutriment, as ascertained in these investigations, are very wide. Here are the figures for pounds of protein and fuel value of the food per man per day:

	Protein.	Calories.
Twenty-five families in the poorest part of Philadelphia:	*Pound.*	
Largest dietary, German family	0.45	5,235
Smallest dietary, negro family	.15	1,630
Average of 25 dietaries	.24	3,235
Twenty-six families in the poorest part of Chicago:		
Largest dietary	.31	4,950
Smallest dietary	.21	2,195
Average of 26 dietaries	.26	3,425

The standard above proposed for a man at moderate work calls for 0.28 pound of protein and a fuel value of 3,500 calories. Voit's German standard calls for 0.26 pound of protein and 3,050 calories of energy. It would appear that these people have on the average about enough for normal nourishment. Assuming them to be engaged in moderately hard muscular labor, the figures give them more than the accepted European standards provide, and very nearly as much as is called for in the more liberal American standard. The food of the German family, with 0.45 pound of protein and 5,235 calories of fuel value, was excessive unless the members were doing very hard muscular work. But while some had so much—and here is the sad story the figures tell—others were underfed. Men with only 1,600 calories of energy in their daily food live on a very low nutritive level.

This low level of nutrition appears in the dietaries of poor people in Europe. The condition of many of these people, as depicted in the

detailed accounts of their ways of living and their nutrition, is most pathetic. These accounts describe factory girls with wages of $1.20 and less per week and 1,600 calories of energy in their daily food; families of mechanics and laborers that are no better nourished; and whole communities whose incomes, nutrition, and standards of living are on a plane far below anything of which most people in the United States have any conception.

Neither the European nor the American figures for food consumption thus cited are absolutely correct. Very few of them represent accurate measurements, weighings, and analyses of the food; the majority are more or less crude estimates. Furthermore, they represent, in most cases, the food purchased, and make no allowance for amounts wasted, which doubtless averaged much larger in the American than in the European dietaries. A considerable deduction for such waste, perhaps 5 and possibly as much as 10 per cent, would have to be made from the quantities given for the American dietaries to put them on the same basis with the European.

The American figures are nearly all from Massachusetts and Connecticut. The European come very largely from Germany, and especially from Saxony and Bavaria. It would be going too far to assume that the figures, if they were entirely accurate for the cases studied, would be exact measures of the food consumption in the localities where the studies were made. It would be still less justifiable to claim that the New England dietaries here given represent accurately the average food consumption for working people in the whole United States, or that the German dietaries cited are typical for wage workers throughout Europe. It is difficult to avoid the impression that, in so far as the figures fail to represent the average facts on the two sides of the Atlantic, the American data come fully as near, if not nearer, to the average conditions in the United States than the German ones do to the conditions in central and western Europe, for we have not in the United States the large numbers of the underfed poor who are so numerous among the working classes there. In other words, while there seems to be no reason to think that the people in New England, whose dietaries have been studied are better fed than the average people of their occupations elsewhere in the United States, there does seem to be good reason to doubt whether factory operatives, mechanics, and other wage workers in general on the continent of Europe have as abundant and nutritious food as the tabulated results of the dietary studies thus far made imply and the dietary standards of Voit and others call for.

NUTRITION AND WORKING POWER—THE BODY AS A MACHINE.

The thesis defended in this article is that, to make the most out of a man, to bring him up to the desirable level of productive capacity, to enable him to live as a man ought to live, he must be well fed. This

is only part of the story, but it is an essential part. The principle is one that reaches very deep into the philosophy of human living.

Part of the principle is found in the fact that the human body is a machine. Its efficiency for muscular work depends upon how strongly it is built, and how much fuel is used to give it power. If a machine is strong, well built, and in good order, the work it does will, within certain limits, vary with the fuel. The bodily machine, however, differs from those made of iron and steel in that its building material and fuel are from the same source, namely, the food. A well-nourished body is a machine with abundance of good material for building and repair, and well supplied with the most effective fuel.

So long as a man's labor is the labor of his hands, so long as his power to work depends upon his use of his body as a machine, so long will the amount of work he can do be more or less as he has more or less ample nourishment.

Of course, a workingman is more than a machine. His capacity for work depends upon more than brute force. There is no wish to underrate the other factors of the wage worker's efficiency—environment, intelligence, skill (especially in the management of machinery), ambition, and will power. The point is that, among the factors, food is one, and a more important one than is commonly realized.

ERRORS IN OUR FOOD ECONOMY.

Scientific research, interpreting the observations of practical life, indicates that we make a fourfold mistake in our food economy. First, we purchase needlessly expensive kinds of food. We use the costlier kinds of meat, fish, vegetables, and the like, when the less expensive ones are just as nutritious, and, when rightly cooked, are just as palatable. Many do this under the impression that there is some peculiar virtue in the dear food materials, and that economy in their diet is somehow detrimental to their dignity or their welfare. And, unfortunately, those who are most extravagant in this respect are often the ones who can least afford it. Secondly, our diet is apt to be one-sided. It often does not contain the different nutritive ingredients in the proper proportions. We consume relatively too much of the fuel ingredients of food—those which are burned in the body and yield heat and muscular power. Such are the fats of meat and butter, the starch which makes up the larger part of the nutritive material of flour, potatoes, and sugar, of which such enormous quantities are eaten in the United States. Conversely, we have relatively too little of the protein or flesh-forming substances, like the lean of meat and fish and the gluten of wheat, which make muscle and sinew, and which are the basis of blood, bone, and brain. Thirdly, we use excessive quantities of food. This is true not only of the well-to-do but of many people in moderate circumstances also. Part of the excess which is bought is thrown away in the wastes of the kitchen and the table, so that the injury to health

from overeating, great as it may be, is doubtless much less than if all of the food we buy were actually eaten. Probably the worst sufferers from this evil are the well-to-do people of sedentary occupations—brain workers as distinguished from hand workers. Not everybody eats too much; indeed, there are some who do not eat enough for healthful nourishment. But there are those, and their name is legion, with whom the eating habit is as vicious in its effect on health as the drinking habit, which is universally deplored. Fourthly and finally, we are guilty of serious errors in our cooking. We waste a great deal of fuel in the preparation of our food, and even then a great deal of the food is very badly cooked. A reform in the methods of cooking is one of the economic demands of our time.

PURCHASE OF NEEDLESSLY EXPENSIVE KINDS OF FOOD.

One of the ways in which the worst economy is practiced is in the buying of high-priced foods. For this error, prejudice, the palate, and poor cooking are mainly responsible. There is a prevalent but unfounded idea that costly foods, such as the tenderest meats, the finest fish, the highest-priced butter, the choicest flour, and the most delicate vegetables possess some peculiar virtue which is lacking in the less expensive materials. Many people who have small incomes and really wish to economize think it beneath them to use the cheaper meats and inexpensive but substantial groceries. Many, too, labor under the false impression that the costly food materials are somehow essential and economical. The maxim that "the best is the cheapest" does not apply to food. The "best" food, in the sense of that which is the finest in appearance and flavor and is sold at the highest price, is rarely the most economical for people in good health. The food that is best fitted to the real wants of the user may be of the very kind which supplies the most nutriment at the lowest cost.

Illustrations of the relative cheapness and dearness of food materials were given in the previous pages. What is here urged is that the facts are not understood, and that the ignorance results in great waste of hard-earned money. If a man has an income of $5,000 a year, he can afford tenderloin steak, oysters at 50 cents a quart, and young chicken and early strawberries at the high prices that prevail when they first come into the market. He can likewise, if he wishes, pay $100 for an overcoat, and his wife may indulge in twenty-dollar bonnets. But if his yearly income is only $1,000, these luxuries will be beyond his means, and if he has but $500 a year for the support of his family, such extravagance would be unpardonable. So far as the overcoat and bonnet are concerned, everyone would agree to this statement, but wher it comes to a matter of food economy a great many people of small incomes would object to the principle most decidedly.

The larger part of the price of the costlier foods is paid for appearance, flavor, or rarity. The sirloin of beef is no more digestible or

nutritious than round or rib, although it is more tender, and to cook it so as to get the finest flavor is an easier matter. Saddle Rock oysters, fresh from the shell, at 50 cents a quart, are worth no more for nutriment than the ones that are sold in the same market at half the price, and a quart of milk contains as much nutriment and in fully as digestible form as either. Salmon has no higher food value in the first of the season at $1 than later at 25 cents a pound, and at either time it ranks as food just about on a level with mackerel, which is often sold at 10 cents per pound or less. The expensive food materials are like the expensive articles of adornment. They are very nice if one can afford them, but they are not economical. The plain, substantial, standard food materials, like the cheaper meats and fish, milk, flour, corn meal, oatmeal, beans, and potatoes, are as digestible and nutritious and as well fitted for the nourishment of people in good health as any of the costliest materials the markets afford.

In the traditional diet of the Scotchman, oatmeal and herring are very prominent. Both contain large quantities of protein and thus supplement potatoes and flour and make a well-balanced diet. These materials are of the cheapest kinds, but they are none the less nutritious on that account, and the strongest possible evidence of their fitness for nourishment is found in the physical and mental vigor of the people nourished by them.

The case is similar with the famous New England dishes of codfish and potatoes, pork and beans, and bread and milk. These are all comparatively inexpensive. Potatoes furnish a great deal of fuel material in the form of starch, but they lack protein. The nutritive material of codfish consists of protein and little else. A little fat in the form of butter added to the protein of the codfish and the starch of the potatoes makes a well-balanced, digestible, and nutritious food. Beans are likewise rich in protein, and have large quantities of carbohydrates also, but they are lacking in fat. When they are heated in water and then baked with a little fat pork, they make a dish which is chemically rational, gratifying to the palate, highly nutritious, and very inexpensive. Milk is one of the most nutritious of foods. Bread is the very "staff of life." It is not well to live on bread alone, but meat and milk go well with it, and experience anticipated chemistry by centuries in certifying to the value of such combinations. The inhabitants of the country districts of New England have not lacked in sturdiness of mind or body with such things as these for nourishment. Doubtless, one reason why this diet, at once so rational and so well chosen, came into vogue was that it was so economical. But the low cost alone could hardly explain the use of codfish and beans to furnish protein to supplement the carbohydrates of wheat flour, corn meal, and potatoes, and the fat of pork, and thus make fit nourishment for such people as the early New Englanders and their descendants have proved themselves to be. Their dietary practice is instinctive, but is it not one of those

cases where the experience of communities and generations has been, unconsciously, but none the less accurately and surely, formulated into unerring instinct? It was "plain living, with high thinking." If there had been luxury to tempt, instead of necessity to restrain, doubtless the earlier generations of people in this region might long since have acquired the evil habits of food selection which are so prevalent to-day.

The writer has spoken of the dietary usages in New England because he is personally more familiar with them and because most of the dietary studies thus far made are of people in that part of the country. All that he has observed implies that the conditions are much the same in other parts of the country. The investigations now beginning in the West and South will doubtless throw much light upon the dietary practices there.

WASTE OF FOOD.

The studies of food consumption above cited give a number of illustrations of the waste of food. Among the dietaries examined by the Massachusetts labor bureau was that of a machinist in Boston who earned $3.25 per day. The following figures show what the dietary furnished, its cost, and how it might have been altered:

	Protein.	Energy.	Cost.
	Pound.	*Calories.*	*Cents.*
In food purchased	0.40	5,640	47
If one-half the meats, fish, lard, milk, butter, cheese, eggs, sugar, and molasses had been subtracted	.12	1,650	19
There would have remained	.28	3,990	28

The standard proposed by the author for a laboring man at moderately hard work provides 0.28 gram of protein and a fuel value of 3,500 calories. This man was engaged in rather hard work and may have needed more. His family, however, consisted only of himself and wife. The calculations allowed his wife eight-tenths as much as himself. If she had the muscular work of an ordinary housekeeper, even the reduced dietary would have been excessive for her, and a share of that thus allotted to her would have been available for her husband. In other words, by the above calculation, the family might have dispensed with one-half of all their meats, fish, eggs, dairy products, and sugar, thus saving 40 per cent of the whole cost of their food, and still have had all of the protein and much more fuel value than is called for by a standard supposed to be liberal.

In this instance no attempt was made to learn how much of the food purchased was actually consumed and how much was rejected, but, for the sake of the health of this man and his wife, it is to be hoped that a large part of the food went into the garbage barrel.

In the case of a college students' boarding club, of which three successive dietaries were studied, estimates were made of the waste. In the first dietary the quantity of food purchased was so large as to supply 5,345 calories per man per day. The matron who attended to the cooking of the food and the care of the table was a very intelligent, capable woman who had been selected because of her especial fitness for the care of such an establishment. The steward, who purchased the food, had been chosen as a man of business capacity. Both thought that but little of the food was left unconsumed. "All the meat and other available food that was not actually delivered to the men at the table," said the steward, "was carefully saved and made over into croquettes. Men who work their way through college can not afford to throw away their food." But actual examination showed that about one-tenth of the food was thrown away with the table and kitchen refuse, so that the amount actually eaten was 4,825 calories. The next term the food was reduced so as to furnish 3,875 calories in that purchased; but over one-tenth was rejected, so that the amount actually eaten was 3,415 calories. In the third dietary the fuel value of the food purchased was 3,680 calories, but in this case the waste amounted to about one-seventh, so that the amount eaten was 3,110 calories. Even this was certainly a very liberal allowance physiologically and it was entirely satisfactory to the club.

Another form of waste is that which comes with the trimming out of the bone and fat of meat at the butchers' shops. People often do not care to utilize the bone for soup, valuable as it is for the purpose; and many object to the large lumps of fat, which is entirely natural in view of the excess of fat in our ordinary diet. The butcher, in his haste, is apt to cut out more or less of the lean with the bone and fat, and his customers are generally so little inclined to economize as to make no objections.

The waste of food of which we are speaking is really worse from the pecuniary standpoint than it seems, because so much of the material rejected at the table, as well as at the butcher's, consists of meat, in which the nutritive ingredients are in their costliest forms. The protein of beef, for instance, is several times as expensive as that of flour.

Just where and among what classes of people this waste of food is worst it is not possible to say, but there is certainly a great deal more of it in the United States than in Europe. There may be more in boarding houses than in private families, and still more in hotels and restaurants. The worst sufferers from it are, doubtless, the poor, but the large body of people of moderate means, the intelligent and fairly well-to-do wage workers, are guilty of similar errors in this regard.

THE FOOD OF THE POOR.

That the rich man becomes richer by saving, and the poor man poorer by wasting his money, is one of the commonest facts of experience. The most wasteful people in their food economy are the poor. Not

only do they waste in the same ways as the well-to-do, but often, if not generally, they are less inclined to economize, and the sad side of the story is that their wastefulness deprives them of the comforts and even necessities of life which otherwise they might enjoy.

Sometimes this bad economy is due only to ignorance. The School of Sociology in Hartford, Conn., is undertaking some inquiries into the food supply in that city. The first family visited was that of an Irish coal laborer, who earns $8 a week when he has full work. The week the inquiry was begun he earned a little over $6; the week before he had only work enough to bring $2.50. The family consists of himself, wife, and five children. The day on which the inquiry began they spent 35 cents for bread. Service as a cook in a well-to-do family before she was married had shown the mother how to make good bread. She had plenty of spare time to make it at home, and 13 cents would have paid for the flour, yeast, and other materials, including the extra coal, needed to make the day's supply, which she had bought of the baker. She had not thought so far as to see that she might thus have easily saved 23 cents a day in that item alone. She was, however, wise enough not to get the highest-priced meats, and she did try in various ways to economize as best she knew how. But, nevertheless, she bought eggs at 25 cents a dozen, not realizing that they were for her a very dear food. The result of the examination of the dietary showed it to supply just about four-fifths as much nutriment as the American standard above quoted would require for people at moderate muscular work. By wiser management the family might have had the full amount at considerably less cost.

One fruitful source of this bad economy is the prejudice against the cheaper kinds of food, and the impression that the finer and costlier kinds have some special virtue. With this is a false pride which considers economy in food a thing unworthy of the buyer's dignity. A series of investigations lately begun in New York City have brought out some striking illustrations of this unfortunate fact. Among the families visited is one of seven persons, so poor that the mother has not a dress in which she is willing to be seen on the street of even the poor quarter where she lives. She therefore stays in the house day after day, giving herself up to constant drudgery. The cost of food for the family is $14 per week, or $2 per person. The markets of New York, including those of this district, afford excellent food at extremely low prices, so that the family might be well nourished at half the expense. But these people, some of whom really wish to economize, are the victims of a theory. They think they must have "the best." They buy the nicest and costliest cuts of beef, the tenderest chicken, the earliest spring vegetables, and other things in like manner, and pay high prices for them. They will doubtless continue to do so until they learn that their policy is an unwise one, and why it is unwise.

The especial attention of economists, teachers, physicians, and clergymen is invited to this subject. To the statistician, the economist, and the sociologist, it is certainly inviting. The fundamental facts that the cost of food absorbs half the wage worker's earnings, and that his capacity for work is so intimately dependent upon his diet, justify this assertion. To the investigator there is the special attraction that the subject is comparatively new and that the field of inquiry is one which is only beginning to be explored. It is due largely to the farsighted appreciation of this principle by Dr. Carroll D. Wright that a considerable share of the data cited in the previous pages have been gathered, since his cooperation as chief of the Massachusetts Bureau of Labor, and later of the United States Department of Labor, made the investigations possible.

In his last annual report the Secretary of Agriculture has called attention to the desirability of instruction regarding food economy in the common schools of the country. A communication lately received from Dr. W. T. Harris, United States Commissioner of Education, gives emphatic support to the same proposition. Conversations with a number of leading educators upon the subject have shown a surprising and gratifying unanimity of conviction in this regard. Doubtless, the reason why the subject has not been more dwelt upon in the past is that the science has been so little developed. But the research of later years has certainly brought enough material for a chapter, and a most useful one, in the schoolbooks, and there is a prospect that such a chapter will be introduced in a number of the text-books on physiology which are in use in the schools of the country.

NEED OF RESEARCH.

What is now most needed is research. Of the fundamental laws of nutrition we know as yet too little. Of the actual practice of people in their food economy our knowledge is equally deficient. It is, therefore, most fortunate that, among the forms of inquiry which are being prosecuted by the General Government in the interests of the people, the study of the food and nutrition of man has at length come to be included. At the request of the Secretary of Agriculture, an appropriation of $10,000 was made by Congress for the current fiscal year for investigations on the nutritive value of human foods, with a view to determining ways in which the dietaries of our people might be made more wholesome and economical. The supervision of this work was assigned to the Director of the Office of Experiment Stations, and the writer was appointed special agent in charge of the investigations. Studies of food supply and consumption, and of the dietaries of people of different occupations, have been begun in a number of representative localities, both North and South. In some of these inquiries the special object is to find what food materials people actually buy, how much they pay for them, what nutriment they contain, and what is the

relation between the actual nutriment and the cost; in other cases studies of actual dietaries are made with a view to learning what are the kinds and amounts of food materials actually consumed by people in different places, of different occupations, and under different conditions. In the prosecution of this work the fundamental idea will be to learn as much as practicable of the food economy of our people and the ways for its improvement. Methods of investigation and some of the more scientific problems of human nutrition are also being studied. More thorough study of the laws of nutrition of man is very much needed. On this subject there are many theories, but comparatively little exact information. The necessary researches will require much time and effort, and will be comparatively costly; but until they are made many of the conclusions regarding the nutritive value and digestibility of food will not rest upon a sure basis of ascertained facts. The results of previous investigations in this country and abroad are being compiled for the information of our people. Congress having increased the appropriation for this purpose to $15,000 for the next fiscal year, the scope of the investigations will be somewhat enlarged, and it is hoped that before long results of great value will be obtained. The practical results of investigations relating to food materials and their proper use will be explained concisely and clearly in a series of popular bulletins on food economy, the first of which, Farmers' Bulletin No. 23, Foods: Nutritive Value and Cost, has already been issued.

Until now much that has been done has been at private expense. But in this case, as in so many others, the results of individual effort have opened the way for the larger inquiry and demonstrated its usefulness, so that public funds which are to be used in investigations for the public benefit may be applied in this direction also. But much of the abstract research that is pressingly demanded requires peculiar facilities for its production, such as are found only in the laboratories and libraries of the great educational institutions, and is dependent for its best development upon the intellectual attrition and the opportunities for continuous study which such establishments alone can offer. In the European universities these facilities are provided by the Government; with us they depend upon private munificence. The endowment of such research would bring results of the highest value to the world, and to the donor the richest reward that a lover of his fellow-man can have.

HUMAN FOODS

Ordinary food materials, such as meat, fish, eggs, potatoes, wheat, etc., consist of—

Refuse.—As the bones of meat and fish, shells of shellfish, skins of potatoes, bran of wheat, etc.

Edible portion.—As the flesh of meat and fish, the white and yolk of eggs, wheat flour, etc. The edible portion consists of *water* and *nutritive ingredients* or *nutrients.*

The principal kinds of nutritive ingredients are *protein, fats, carbohydrates,* and *mineral matters.*

The water, refuse, and salt of salted meat and fish are called nonnutrients. In comparing the values of different food materials for nourishment they are left out of account.

Food supplies the wants of the body in several ways. It either—

Is used to form the tissues and fluids of the body;

Is used to repair the wastes of tissues;

Is stored in the body for future consumption;

Is consumed as fuel, its potential energy being transformed into heat or muscular energy, or other forms of energy required by the body; or,

In being consumed protects tissues or other food from consumption.

The fuel value of food.—Heat and muscular power are forms of force or energy. The energy is developed as the food is consumed in the body. The unit commonly used in this measurement is the calorie, the amount of heat which would raise the temperature of a pound of water 4° F.

The following general estimate has been made for the average amount of potential energy in 1 pound of each of the classes of nutrients:

	Calories.
In 1 pound of protein	1,860
In 1 pound of fats	4,220
In 1 pound of carbohydrates	1,860

In other words, when we compare the nutrients in respect to their fuel values, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumen of egg is just about equivalent to a pound of sugar or starch, and a little over 2 pounds of either would be required to equal a pound of the fat of meat or butter or the body fat.

For further explanation see article on Food and Diet, page 357.

TABLE A.—*Composition of different food materials—refuse, water, nutrients—and fuel value per pound.*

Food materials.	Number of specimens analyzed.	Refuse (bones, skin, shell, etc.).	Edible portion.						Fuel value of 1 pound.
			Water.	Nutrients.					
				Total.	Protein.	Fat.	Carbohydrates.	Mineral matters.	
ANIMAL FOODS AS PURCHASED.									
Beef:		*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Neck	14	0.27	0.47	0.26	0.14	0.11	.....	0.01	730
Chuck	19	.15	.53	.32	.16	.15	.....	.01	940
Shoulder	8	.17	.55	.28	.16	.11	.....	.01	760
Shoulder clod with bone	2	.13	.57	.30	.17	.12	.....	.01	830
Whole rib	17	.21	.44	.35	.13	.21	.....	.01	1,140
Loin	11	.15	.52	.34	.15	.18	.....	.01	1,030
Sirloin	10	.10	.54	.36	.17	.19	.....	.01	1,100
Porterhouse	4	.12	.53	.35	.15	.19	.....	.01	1,075
Rump	15	.20	.45	.35	.14	.21	.....	.01	1,130
Round	17	.09	.62	.30	.18	.11	.....	.01	780
Flank	11	.04	.54	.42	.17	.24	.....	.01	1,335
Hind shank	12	.55	.31	.14	.09	.04	.....	.004	355
Liver	3	.....	.70	.30	.22	.05	0.02	.01	665
Heart	2	.....	.63	.37	.16	.20	.....	.01	1,160
Tongue	1	.....	.64	.37	.17	.18	.....	.01	1,085
Dried beef	5	.....	.51	.49	.32	.07	.01	.10	885
Corned rump	3	.06	.60	.34	.16	.15	.....	.03	935
Corned flank	2	.12	.44	.44	.12	.29	.....	.03	1,460
Corned and canned	7	.....	.54	.46	.27	.16	.....	.04	1,170
Tongue, canned	2	.04	.46	.50	.20	.26	.....	.04	1,475
Tripe, pickled	2	.....	.88	.13	.10	.01	.01	.002	260

TABLE A.—*Composition of different food materials—refuse, water, etc.*—Continued.

Food materials.	Number of specimens analyzed.	Refuse (bones, skin, shell, etc.).	Edible portion.						Fuel value of 1 pound.
			Water.	Nutrients.					
				Total.	Protein.	Fat.	Carbohydrates.	Mineral matters.	
ANIMAL FOODS AS PURCHASED—continued.									
Veal:		*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Shoulder	2	.17	.57	.26	.17	.09	.....	.01	675
Chuck	6	.19	.60	.22	.16	.05	.....	.01	510
Flank	6	.....	.67	.33	.19	.13	.....	.01	895
Loin (chops)	10	.18	.56	.26	.16	.09	.....	.01	670
Leg (cutlet)	7	.61	.29	.10	.08	.02	.....	.004	235
Liver	1	.....	.74	.26	.21	.04	.....	.01	560
Mutton:									
Neck	10	.26	.42	.33	.12	.20	.....	.01	1,060
Loin (chops)	16	.14	.41	.45	.13	.31	.....	.01	1,550
Shoulder	9	.22	.45	.32	.13	.19	.....	.01	1,025
Hind leg	15	.18	.52	.31	.15	.15	.....	.01	910
Pork:									
Chuck	2	.18	.42	.40	.14	.26	.....	.01	1,335
Sparerib (chops)	10	.16	.45	.39	.14	.25	.....	.01	1,300
Smoked shoulder	4	.14	.37	.49	.13	.33	.....	.03	1,625
Smoked ham	14	.13	.38	.49	.07	.38	.....	.04	1,725
Bacon	8	.09	.20	.72	.11	.57	.....	.04	2,610
Salt pork	7	.08	.14	.78	.04	.69	.....	.04	2,995
Pork sausage	5	.....	.44	.56	.12	.40	.01	.02	1,945
Bologna sausage	6	.....	.60	.40	.19	.17	.001	.04	1,080
Frankfurt sausage	6	.....	.58	.42	.21	.17	.004	.04	1,110
Poultry:									
Chicken	1	.38	.45	.17	.15	.01	.....	.01	330
Fowl (old hen)	1	.43	.38	.19	.11	.07	.....	.01	510
Turkey	1	.32	.45	.23	.16	.06	.....	.01	550
Fish, etc.:									
Fresh cod, dressed	3	.30	.59	.12	.11	.002	.....	.01	205
Fresh mackerel, dressed	1	.41	.44	.16	.11	.04	.....	.01	360
Bluefish	1	.49	.40	.11	.10	.01	.....	.01	205
Shad, whole	7	.50	.35	.15	.09	.05	.....	.01	375
Smelts, whole	2	.42	.46	.12	.10	.01	.....	.01	230
Lake trout, dressed	1	.35	.45	.20	.12	.07	.....	.01	510
Red snapper	2	.49	.40	.11	.10	.01	.....	.01	205
Halibut, sections	3	.18	.62	.20	.15	.04	.....	.01	465
Fresh salmon, dressed	1	.24	.51	.25	.15	.10	.....	.01	675
Salt cod *a*	2	.25	.40	.18	.16	.004	.....	.01	315
Salt cod, boned *b*	1	.....	.54	.24	.22	.003	.....	.02	425
Salt mackerel, dressed *c*	1	.33	.28	.32	.15	.15	.....	.02	910
Canned salmon *d*	3	.....	.62	.37	.20	.16	.....	.01	1,035
Oysters, solids	4	.....	.87	.13	.06	.02	.05	.01	260
Long clams, solids	4	.....	.86	.14	.09	.01	.02	.03	240
Round clams, solids	1	.....	.86	.14	.07	.004	.04	.03	215
Eggs with shell	4	.12	.63	.25	.13	.12	.....	.01	720
Lard and cottolene	.....	.....	.....	.....	.....	1.00	.....	.....	4,220
Oleomargarine	.....	.....	.11	.89	.01	.85	.004	.03	3,605
Dairy products:									
Milk	.....	.....	.87	.13	.04	.04	.05	.01	325
Skim milk	.....	.....	.90	.10	.04	.01	.05	.01	180
Butter	.....	.....	.11	.90	.01	.85	.01	.03	3,615
Cheese, whole milk	50	.....	.34	.67	.25	.36	.02	.04	2,005
Cheese, skim milk	8	.....	.46	.55	.31	.17	.02	.04	1,345
ANIMAL FOODS, EDIBLE PORTION.									
Beef:									
Neck	.....	.....	.64	.36	.20	.15	.....	.01	1,005
Chuck	.....	.....	.63	.37	.18	.18	.....	.01	1,105
Shoulder	.....	.....	.66	.34	.20	.14	.....	.01	930
Shoulder clod	.....	.....	.65	.35	.20	.14	.....	.01	950
Whole rib	.....	.....	.55	.45	.17	.27	.....	.01	1,455
Loin	.....	.....	.61	.39	.18	.21	.....	.01	1,210
Sirloin	.....	.....	.60	.40	.18	.21	.....	.01	1,215
Porterhouse	.....	.....	.61	.40	.17	.21	.....	.01	1,220
Rump	.....	.....	.56	.44	.17	.26	.....	.01	1,430
Round	.....	.....	.68	.32	.20	.11	.....	.01	845
Flank	.....	.....	.56	.44	.17	.26	.....	.01	1,420
Hind shank	.....	.....	.69	.31	.20	.10	.....	.01	780
Liver	.....	.....	.70	.30	.22	.05	.02	.01	665
Heart	.....	.....	.63	.37	.16	.20	.....	.01	1,160
Tongue	.....	.....	.64	.37	.17	.18	.....	.01	1,085
Dried beef	.....	.....	.51	.49	.32	.07	.01	.01	885
Corned rump	.....	.....	.58	.42	.15	.23	.....	.03	1,270

a Salt, 17.2 per cent. *b* Salt, 21.5 per cent. *c* Salt, 7.1 per cent. *d* Salt, 1 per cent.

TABLE A.—*Composition of different food materials—refuse, water, etc.*—Continued.

Food materials.	Number of specimens analyzed.	Refuse (bones, skin, shell, etc.).	Edible portion.						Fuel value of 1 pound.
			Water.	Nutrients.					
				Total.	Protein.	Fat.	Carbohydrates.	Mineral matters.	
ANIMAL FOODS, EDIBLE PORTION—continued.									
Beef—Continued.		*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Corned flank			.50	.50	.14	.33		.03	1,675
Corned and canned			.54	.46	.27	.16		.04	1,170
Tongue, canned			.47	.53	.21	.28		.05	1,540
Tripe, pickled			.88	.13	.10	.01	.01	.002	260
Veal:									
Shoulder			.68	.32	.20	.11		.01	820
Chuck			.73	.27	.19	.07		.01	630
Flank			.67	.33	.19	.13		.01	895
Loin (chops)			.69	.31	.20	.11		.01	820
Leg (cutlet)			.71	.29	.20	.08		.01	705
Liver			.74	.26	.21	.04		.01	560
Mutton:									
Neck			.56	.44	.17	.26		.01	1,410
Loin (chops)			.48	.52	.15	.36		.01	1,800
Shoulder			.59	.42	.17	.24		.01	1,310
Hind leg			.63	.37	.18	.18		.01	1,095
Pork:									
Chuck			.51	.49	.17	.31		.01	1,625
Spareribs (chops)			.53	.47	.17	.29		.01	1,545
Smoked shoulder			.43	.57	.15	.38		.04	1,890
Smoked ham			.43	.57	.16	.35		.05	1,800
Bacon			.22	.78	.12	.62		.04	2,855
Salt pork			.16	.84	.05	.75		.05	3,255
Pork sausage			.44	.56	.12	.40	.01	.02	1,920
Bologna sausage			.60	.40	.19	.17	.001	.04	1,080
Frankfurt sausage			.58	.42	.21	.17	.004	.04	1,110
Poultry:									
Chicken			.72	.28	.25	.02		.01	535
Fowl			.67	.33	.20	.13		.01	890
Turkey			.66	.34	.24	.09		.01	810
Fish, etc.:									
Fresh cod			.83	.17	.16	.004		.01	310
Fresh mackerel			.74	.26	.19	.06		.01	605
Bluefish			.79	.22	.19	.01		.01	405
Shad			.71	.29	.19	.10		.01	745
Smelts			.79	.21	.17	.02		.02	400
Lake trout			.69	.31	.18	.11		.01	820
Red snapper			.79	.22	.19	.01		.01	400
Halibut, sections			.75	.25	.18	.05		.01	560
Fresh salmon			.67	.33	.19	.13		.01	885
Salt cod [a]			.54	.23	.21	.004		.02	410
Salt cod, boned [b]			.54	.24	.22	.003		.02	425
Salt mackerel [c]			.42	.47	.22	.23		.03	1,365
Canned salmon [d]			.62	.37	.20	.16		.01	1,035
Oysters, solids			.87	.13	.06	.02	.04	.01	260
Long clams, solids			.86	.14	.09	.01	.02	.03	240
Round clams, solids			.86	.14	.07	.004	.04	.03	215
Eggs			.74	.26	.15	.10		.01	720
Lard and cottolene				1.00		1.00			4,220
Oleomargarine			.11	.89	.01	.85	.004	.03	3,605
Dairy products:									
Milk			.87	.13	.04	.04	.05	.01	325
Skim milk			.90	.10	.04	.01	.05	.01	180
Butter			.11	.90	.01	.85	.01	.03	3,615
Cheese, whole milk			.34	.67	.25	.36	.02	.04	2,005
Cheese, skim milk			.46	.55	.31	.17	.02	.04	1,495
VEGETABLE FOODS.									
Flour and meal:									
Wheat flour	22		.13	.88	.11	.01	.75	.01	1,645
Wheat flour ("entire wheat")	2		.13	.87	.14	.02	.70	.01	1,640
Graham flour	3		.13	.87	.12	.02	.72	.02	1,625
Rye flour	4		.13	.87	.07	.01	.79	.01	1,625
Buckwheat flour	9		.15	.85	.06	.01	.77	.02	1,585
Corn or maize meal	104		.15	.86	.09	.04	.71	.01	1,650
White hominy	2		.14	.87	.08	.004	.77	.004	1,620
Oatmeal	10		.08	.92	.15	.07	.68	.02	1,850
Rolled oats	4		.08	.92	.16	.08	.67	.02	1,855
Pearl barley	1		.12	.88	.08	.01	.78	.01	1,635

[a] Salt, 23 per cent. [b] Salt, 21.5 per cent. [c] Salt, 10.6 per cent. [d] Salt, 1 per cent.

TABLE A.—*Composition of different food materials—refuse, water, etc.*—Continued.

Food materials.	Number of specimens analyzed.	Refuse (bones, skin, shell, etc.).	Edible portion.						Fuel value of 1 pound.
			Water.	Nutrients.					
				Total.	Protein.	Fat.	Carbohydrates.	Mineral matters.	
VEGETABLE FOODS—cont'd.		*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Rice	10	.....	.12	.88	.07	.004	.79	.004	1,630
Beans, dry	6	.....	.13	.87	.22	.02	.60	.03	1,605
Peanuts in shells	1	.33	.04	.63	.13	.22	.27	.01	1,660
Peanuts, "meats"	1	.....	.06	.94	.20	.32	.40	.02	2,475
Bread, crackers, etc:									
Wheat bread	13	.....	.32	.68	.10	.01	.55	.01	1,265
Graham bread	1	.....	.34	.66	.10	.01	.53	.02	1,225
Graham crackers	1	.....	.05	.95	.10	.14	.70	.02	2,050
Boston crackers	1	.....	.08	.92	.11	.10	.69	.02	1,895
Milk or cream crackers	1	.....	.07	.93	.09	.13	.69	.01	2,010
Oyster crackers	1	.....	.04	.96	.11	.05	.78	.03	1,855
Macaroni and vermicelli	23	.....	.11	.89	.12	.02	.73	.03	1,640
Starch	.....	.....	.02	.98	.....	.....	.98	.....	1,820
Tapioca, pearl	1	.....	.11	.89	.003	.002	.88	.003	1,655
Sugar, granulated	.....	.....	.....	1.00	.....	.....	1.00	.....	1,860
Molasses	.....	.....	.25	.75	.....	.....	.73	.02	1,360
Vegetables:									
Potatoes	.....	.15	.67	.18	.02	.001	.15	.01	320
Potatoes, edible portion	12	.....	.79	.21	.02	.001	.18	.01	375
Sweet potatoes	.....	.13	.62	.25	.01	.003	.23	.01	460
Sweet potatoes, edible portion	6	.....	.71	.29	.02	.004	.26	.01	530
Beets	.....	.20	.71	.09	.01	.001	.07	.01	160
Beets, edible portion	12	.....	.88	.12	.02	.001	.09	.01	200
Turnips	.....	.30	.63	.07	.01	.001	.06	.01	130
Turnips, edible portion	7	.....	.89	.11	.01	.002	.08	.01	185
Onions	.....	.10	.79	.11	.01	.003	.09	.01	205
Onions, edible portion	6	.....	.88	.12	.01	.003	.10	.01	225
Squash	.....	.50	.44	.06	.004	.001	.05	.003	105
Squash, edible portion	3	.....	.88	.12	.01	.002	.10	.01	215
Cucumbers	.....	.15	.82	.03	.01	.002	.02	.004	60
Cucumbers, edible portion	2	.....	.96	.04	.01	.002	.03	.01	70
Cabbage	.....	.15	.78	.07	.02	.003	.04	.01	120
Cabbage, edible portion	4	.....	.92	.08	.02	.003	.05	.01	140
Cauliflower	1	.....	.92	.08	.02	.01	.05	.01	155
Eggplant	1	.....	.93	.07	.01	.003	.05	.01	130
Lettuce	3	.....	.93	.07	.02	.01	.04	.01	120
Spinach	1	.....	.92	.08	.02	.01	.03	.02	120
Asparagus	3	.....	.94	.06	.02	.002	.03	.01	105
Green peas	1	.....	.78	.22	.04	.01	.16	.01	400
String beans	2	.....	.87	.13	.02	.004	.10	.01	235
Lima beans, green	1	.....	.69	.32	.07	.01	.22	.02	570
Green sweet corn	1	.....	.81	.19	.03	.01	.14	.01	360
Tomatoes	14	.....	.94	.06	.01	.004	.05	.01	115
Watermelon, flesh or pulp	1	.....	.92	.08	.01	.01	.06	.003	160
Fruits, etc.:									
Apples	.....	.25	.62	.13	.004	.01	.12	.004	250
Apples, edible portion	7	.....	.82	.18	.01	.01	.16	.01	335
Bananas, with skin	1	.38	.46	.16	.01	.002	.15	.01	295
Bananas, with pulp	2	.....	.70	.30	.02	.01	.27	.01	555
Cherries, flesh	1	.....	.86	.14	.01	.01	.11	.01	265
Strawberries	19	.....	.91	.09	.01	.01	.07	.01	175
Blackberries	1	.....	.89	.11	.01	.02	.08	.01	245
Whortleberries	1	.....	.82	.18	.01	.03	.14	.004	390
Cranberries	1	.....	.88	.12	.004	.01	.11	.002	350
Grapes	.....	.25	.56	.19	.01	.01	.16	.004	375
Grapes, edible portion	1	.....	.75	.25	.02	.02	.21	.01	500
Lemons, flesh	2	.....	.89	.11	.01	.01	.08	.01	210
Oranges, flesh	13	.....	.88	.12	.01	.01	.09	.01	230
Canned:									
Baked beans, canned	12	.....	.67	.33	.07	.03	.20	.02	645
Peas, canned	82	.....	.85	.15	.04	.002	.10	.01	255
String beans, canned	18	.....	.94	.06	.01	.001	.04	.01	85
Lima beans, canned	15	.....	.80	.20	.04	.003	.14	.02	355
Squash, canned	2	.....	.87	.13	.01	.003	.12	.004	250
Tomatoes, canned	11	.....	.94	.06	.01	.002	.04	.01	110
Corn, canned	44	.....	.75	.25	.03	.01	.20	.01	470
Succotash, canned	1	.....	.76	.24	.04	.01	.19	.01	445

TABLE B.—*Nutrients obtained for 10 cents in different foods at ordinary prices.*

Food materials as purchased.	Prices per pound.	Ten cents will buy—				
		Total food material.	Nutrients.			Fuel value.
			Protein.	Fat.	Carbohydrates.	
ANIMAL FOODS.						
Beef:	*Cents.*	*Pounds.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Neck	4	2.50	0.36	0.28	.....	1,825
Do	6	1.67	.24	.19	.....	1,220
Do	8	1.25	.18	.14	.....	910
Chuck	8	1.25	.19	.19	.....	1,175
Do	10	1.00	.15	.15	.....	940
Do	14	.71	.11	.11	.....	695
Shoulder	6	1.67	.27	.18	.....	1,270
Do	9	1.11	.18	.12	.....	845
Do	12	.83	.14	.09	.....	630
Rib	10	1.00	.13	.21	.....	1,140
Do	12	.83	.11	.18	.....	945
Do	16	.63	.08	.13	.....	720
Sirloin	12	.83	.14	.16	.....	915
Do	15	.67	.11	.13	.....	735
Do	18	.55	.09	.10	.....	605
Do	20	.50	.08	.09	.....	550
Round	10	1.00	.18	.11	.....	780
Do	12	.83	.15	.09	.....	645
Do	15	.67	.12	.07	.....	525
Liver	5	2.00	.43	.11	0.04	1,330
Do	8	1.25	.27	.07	.02	830
Dried and smoked	15	.67	.21	.05	.....	595
Do	20	.50	.16	.03	.....	445
Do	25	.40	.13	.03	.....	355
Canned corned	10	1.00	.27	.16	.....	1,170
Do	12	.83	.22	.13	.....	970
Do	16	.63	.17	.10	.....	735
Veal:						
Shoulder	8	1.25	.21	.11	.....	845
Do	10	1.00	.17	.09	.....	675
Do	14	.71	.12	.06	.....	480
Loin (chops)	15	.67	.11	.06	.....	445
Do	20	.50	.08	.04	.....	335
Leg (cutlet)	15	.67	.05	.02	.....	155
Do	20	.50	.04	.01	.....	120
Mutton:						
Shoulder	5	2.00	.26	.37	.....	2,050
Do	7	1.43	.19	.26	.....	1,465
Do	10	1.00	.13	.19	.....	1,025
Loin (chops)	8	1.25	.16	.39	.....	1,935
Do	12	.83	.11	.26	.....	1,285
Do	16	.63	.08	.19	.....	975
Leg	8	1.25	.19	.19	.....	1,140
Do	12	.83	.12	.12	.....	755
Do	16	.63	.09	.09	.....	575
Pork:						
Spareribs	10	1.00	.14	.25	.....	1,300
Do	12	.83	.12	.20	.....	1,080
Do	14	.71	.10	.17	.....	925
Smoked ham	12	.83	.06	.31	.....	1,430
Do	16	.63	.04	.24	.....	1,090
Do	20	.50	.04	.19	.....	860
Smoked shoulder	8	1.25	.16	.41	.....	2,030
Do	10	1.00	.13	.33	.....	1,625
Do	14	.71	.09	.23	.....	1,150
Salt pork, fat	10	1.00	.04	.69	.....	2,995
Do	14	.71	.03	.49	.....	2,125
Pork sausage	8	1.25	.15	.50	.02	2,430
Do	10	1.00	.12	.40	.01	1,945
Do	12	.83	.10	.33	.01	1 615
Bologna sausage	8	1.25	.24	.22	.....	1,350
Do	10	1.00	.19	.17	.....	1,080
Fish:						
Fresh cod, dressed	6	1.67	.18	.....	.....	340
Do	8	1.22	.13	.....	.....	255
Do	12	.83	.09	.....	.....	170
Fresh mackerel, dressed	12	.83	.09	.03	.....	300
Do	15	.67	.08	.02	.....	240
Do	18	.55	.06	.02	.....	200
Bluefish, dressed	8	1.25	.12	.01	.....	255
Do	12	.83	.08	.01	.....	170
Do	16	.63	.06	.....	.....	130
Halibut steaks	15	.67	.10	.03	.....	310
Do	18	.55	.08	.02	.....	255
Salmon	25	.40	.06	.04	.....	270
Do	50	.20	.03	.02	.....	135

TABLE B.—*Nutrients obtained for 10 cents in different foods at ordinary prices*—Cont'd.

Food materials as purchased.	Prices per pound.	Ten cents will buy—				
		Total food material.	Nutrients.			Fuel value.
			Protein.	Fat.	Carbohydrates.	
ANIMAL FOODS—continued.						
Fish—Continued.	*Cents.*	*Pounds.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Salt mackerel	8	1.25	.18	.19	.....	1,135
Do	12	.83	.12	.13	.....	755
Salt cod, dry	6	1.67	.28	.01	.....	525
Do	8	1.25	.20	.01	.....	395
Boned salt cod	9	1.11	.25	.....	.....	470
Do	10	1.00	.22	.....	.....	425
Oysters:						
30 cents a quart	15	.67	.04	.01	.03	175
40 cents a quart	20	.50	.03	.01	.02	130
50 cents a quart	25	.40	.03	.01	.01	105
Eggs:						
15 cents a dozen	10	1.00	.13	.12	.....	720
20 cents a dozen	13⅓	.75	.09	.09	.....	540
25 cents a dozen	16⅔	.60	.08	.07	.....	430
30 cents a dozen	20	.50	.07	.06	.....	360
Milk:						
Sweet—						
4 cents a quart	2	5.00	.18	.20	.24	1,625
6 cents a quart	3	3.33	.12	.13	.16	1,080
8 cents a quart	4	2.50	.09	.10	.12	815
Skim, 3 cents a quart	1½	6.67	.23	.03	.34	1,200
Butter	16	.63	.....	.54	.....	2,275
Do	24	.42	.....	.36	.....	1,520
Do	32	.31	.....	.26	.....	940
Cheese:						
Whole milk	12	.83	.23	.30	.01	1,665
Do	16	.63	.16	.23	.01	1,265
Skim milk	10	1.00	.31	.17	.16	1,345
VEGETABLE FOODS.						
Wheat flour	2	5.00	.55	.06	3.74	8,225
Do	2½	4.00	.44	.04	2.99	6,580
Do	3	3.33	.33	.03	2.49	5,480
Corn meal	2	5.00	.46	.18	3.56	8,250
Do	3	3.33	.31	.12	2.37	5,495
Oatmeal	3	3.33	.50	.24	2.27	6,160
Do	4	2.50	.38	.18	1.71	4,625
Do	5	2.00	.30	.14	1.36	3,700
Rice	5	2.00	.15	.01	1.59	3,260
Do	7	1.43	.11	.01	1.14	2,330
Wheat bread	4	2.50	.26	.03	1.38	3,160
Do	5	2.00	.22	.02	1.11	2,530
Do	6	1.67	.17	.02	.92	2,110
Do	8	1.25	.13	.01	.69	1,580
Boston crackers	5	2.00	.21	.20	1.37	3,790
Do	6	1.67	.18	.17	1.15	3,160
Milk crackers	6	1.67	.16	.22	1.16	3,355
Do	9	1.11	.10	.15	.77	2,230
Oyster crackers	6	1.67	.19	.08	1.29	3,095
Do	9	1.11	.13	.05	.86	2,060
Corn starch and tapioca	8	1.25	.....	.....	1.23	2,275
Do	10	1.00	.....	.....	.98	1,820
Sugar, granulated	4	2.50	.....	.....	2.50	4,650
Do	5	2.00	.....	.....	2.00	3,720
Do	6	1.67	.....	.....	1.67	3,105
Potatoes:						
45 cents a bushel	¾	13.33	.24	.01	2.03	4,265
60 cents a bushel	1	10.00	.18	.01	1.52	3,200
75 cents a bushel	1½	8.00	.14	.01	1.22	2,560
90 cents a bushel	1½	6.67	.12	.01	1.01	2,135
Sweet potatoes:						
90 cents a bushel	1½	6.67	.09	.02	1.52	3,070
$1.20 a bushel	2	5.00	.06	.02	1.14	2,300
$1.50 a bushel	2½	4.00	.05	.01	.91	1,840
Turnips	1½	8.00	.07	.01	.46	1,040
Beans	3	3.33	.74	.06	1.98	5,345
Do	4	2.50	.56	.05	1.49	4,010
Do	5	2.00	.45	.04	1.19	3,210

TABLE C.—*Prices used in estimating cost of daily dietaries.*

Food material.	Price per pound.		
	Cheap.	Medium.	Expensive.
Beef:	*Cts.*	*Cts.*	*Cts.*
Neck	4	6	8
Chuck	8	10	14
Shoulder	6	9	12
Shoulder clod	9	10	12
Round	10	12	15
Liver	5	8	10
Canned corned	10	12	16
Corned	8	10	12
Dried	15	20	25
Mutton chops	8	12	16
Pork:			
Spareribs	10	12	14
Smoked ham	12	16	20
Salt pork	10	14	....
Sausage	8	10	12
Fish:			
Fresh cod	6	8	12
Salt cod	6	8	....
Boned cod	9	10	....
Salt mackerel	8	12	....
Canned salmon	12	16	20
Butter	16	24	32
Cheese	12	16	....
Milk—4, 6, and 8 cents quart	2	3	4
Eggs—15, 24, and 30 cents dozen	10	16	20
Lard	8	10	12
Flours, etc.:			
Wheat flour	2	2½	3
Graham flour	3	4	....
Rye flour	2	3	....
Corn meal	2	3	....
Oatmeal	3	4	5
Rice	5	7	....
Bread, etc.:			
Wheat bread	4	6	8
Rye bread	4	6	....
Brown bread	4	5	6
Milk crackers	6	9	....
Boston crackers	5	6	....
Corn starch	9	10	....
Sugar	4	5	6
Molasses — 50, 60, and 70 cents gallon	6¼	7½	8¾
Vegetables:			
Potatoes—60, 75, and 90 cents bushel	1	1½	1½
Vegetables—con'd.			
Sweet potatoes—$0.90, $1.20, and $1.50 bushel	1½	2	2½
Turnips—60 and 90 cents bushel	1	1½	....
Beets — 22, 30, and 38 cents peck	1½	2½	2½
Onions—15, 22, and 30 cents peck	1	2	3
Squash	2	3	4
Beans	3	4	5
Canned tomatoes	4	6	8
Fruit:			
Strawberries	4	7	10
Oranges	3	5	7
Bananas	3	4	5
Apples	1	1½	2
Grapes	3	8	12

TABLE D.—*Daily dietaries.—Food materials furnishing approximately the 0.28 pound of protein and 3,500 calories of energy of the standard for daily dietary of a man at moderate muscular work.*[1]

[Cost estimated from prices given in Table C.]

Food materials.	Amount.	Cost.			Nutrients.				Fuel value.
		Cheap.	Medium.	Expensive.	Total.	Protein.	Fat.	Carbohydrates.	
	Ounces.	*Cents.*	*Cents.*	*Cents.*	*Lbs.*	*Lb.*	*Lb.*	*Lbs.*	*Calories.*
Salt pork	½	0.3	0.4	0.4	0.02	.....	0.02	.....	95
Milk, 1 pint	16	2	3	4	.13	0.04	.04	0.05	325
Butter	½	.5	.8	1	.03	.....	.03	.....	115
Cheese	1	.8	1	1	.04	.02	.02	.....	125
Potatoes	8	.5	.6	.7	.09	.01	.....	.08	160
Beans	6	1.1	1.5	1.9	.31	.08	.01	.22	800
Flour	8	1	1.3	1.5	.44	.06	.01	.37	820
Corn meal	8	1	1.5	1.5	.43	.05	.02	.36	825
Rye meal	2	.3	.4	.4	.11	.01	.....	.10	205
Sugar	1	.2	.3	.4	.06	.....	.....	.06	115
Molasses	2	.8	.9	1.1	.09	.....	.....	.09	165
Total	53	8.5	11.7	13.9	1.75	.27	.15	1.33	3,550
Salt cod	6	2.3	3	3	.06	.06	.....	.....	120
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Butter	2	2	3	4	.10	.....	.10	.....	450
Lard	½	.2	.3	.4	.03	.....	.03	.....	130
Salt pork	½	.3	.4	.4	.02	.....	.02	.....	95
Potatoes	6	.4	.5	.6	.07	.01	.....	.06	120
Beans	7	1.3	1.7	2.2	.37	.10	.01	.26	700
Wheat flour	12	1.5	1.9	2.2	.65	.08	.01	.56	1,230
Oatmeal (or corn meal, 3 ounces)	2½	.5	.6	.8	.14	.02	.01	.11	290
Sugar	1½	.4	.5	.6	.09	.....	.....	.09	175
Total	46	9.9	13.4	16.2	1.59	.29	.20	1.10	3,475

[1] In some cases supplementary items are given to show the effect of the addition of particular food materials on the cost and nutritive value of a dietary.

TABLE D.—*Daily dietaries.—Food materials, etc.*—Continued.

[Cost estimated from prices given in Table C.]

Food materials.	Amount.	Cost.			Nutrients				Fuel value
		Cheap.	Medium.	Expensive.	Total.	Protein.	Fat.	Carbohydrates	
	Ounces.	*Cents.*	*Cents.*	*Cents.*	*Lbs.*	*Lb.*	*Lb.*	*Lbs.*	*Calories.*
Pork, salt	½	.3	.4	.4	.02	.....	.02	.....	95
Canned corned beef	4	2.5	3	4	.11	.07	.04	.....	290
Lard	½	.3	.3	.4	.03	.....	.03	.....	130
Milk	4	.5	.8	1	.03	.01	.01	.01	80
Butter	1	1	1.5	2	.05	.....	.05	.....	225
Egg, 1	2	1.2	2	2.5	.03	.02	.01	.....	90
Potatoes	8	.5	.6	.8	.09	.01	.....	.08	160
Beans	5	.9	1.3	1.6	.27	.07	.01	.19	500
Wheat flour	8	1	1.3	1.5	.44	.06	.01	.37	820
Corn meal	4	.5	.7	.7	.21	.02	.01	.18	410
Rye meal	4	.5	.7	.7	.22	.02	.....	.20	405
Sugar	3	.8	.9	1.1	.19	.....	.....	.19	350
Total	44	10	13.5	16.7	1.69	.28	.19	1.22	3,555
Apples	8	.5	.8	1	.06	.....	.....	.06	125
Turnips	4	.3	.4	.4	.01	.....	.....	.01	35
Total	56	10.8	14.7	18.1	1.76	.28	.19	1.29	3,715
Beef neck	10	2.5	3.7	5	.15	.08	.07	.....	455
Boned cod	4	2.3	2.5	2.5	.06	.06	.....	.....	105
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Butter	1½	1.5	2.3	3	.08	.....	.08	.....	340
Lard	1	.5	.6	.7	.06	.....	.06	.....	265
Potatoes	10	.6	.8	.9	.11	.01	.....	.10	200
Flour	16	2	2.5	3	.87	.11	.01	.75	1,645
Rice	2	.6	.9	.9	.11	.01	.....	.10	205
Sugar	1	.3	.3	.4	.06	.....	.....	.06	115
Total	53½	11.3	15.1	18.4	1.56	.29	.24	1.03	3,495
Bananas (or apples, 7)	6	1.1	1.5	1.9	.05	.....	.....	.05	110
Canned tomatoes (or grapes, 3 ounces)	10	2.5	3.7	5	.03	.....	.....	.03	70
Total	69½	14.9	20.3	25.3	1.64	.29	.24	1.11	3,675
Milk, 1 quart	32	4	6	8	.24	.07	.08	.09	650
Cheese	6	4.5	6	6	.22	.09	.13	.....	750
Boston crackers	18	5.6	5.8	5.8	1.01	.12	.11	.78	2,130
Total	56	14.1	17.8	19.8	1.47	.28	.32	.87	3,530
Beef, shoulder	12	4.5	6.8	9	.20	.12	.08	.....	570
Canned salmon	4	3	4	5	.09	.05	.04	.....	260
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Butter	1	1	1.5	2	.05	.....	.05	.....	225
Lard	2	1	1.2	1.5	.13	.....	.13	.....	530
Potatoes	10	.6	.8	.9	.11	.01	.....	.10	200
Flour	10	1.3	1.6	1.9	.55	.07	.01	.47	1,025
Rice	2½	.8	1.1	1.1	.13	.01	.....	.12	255
Sugar	2	.5	.6	.8	.13	.....	.....	.13	235
Total	51½	13.7	19.1	24.2	1.45	.28	.33	.84	3,465
Canned tomatoes	6	1.5	2.2	3	.02	.....	.....	.02	40
Squash	3	.4	.6	.8	.01	.....	.....	.01	20
Total	60½	15.6	21.9	28	1.48	.28	.33	.87	3,525
Corned beef	9	4.5	5.6	6.8	.18	.09	.09	.....	525
Milk, three-fourths pint	12	1.5	2.3	3	.10	.03	.03	.04	245
Butter	2	2	3	4	.10	.....	.10	.....	450
Egg, 1	2	1.3	2	2.5	.03	.02	.01	.....	90
Potatoes	10	.6	.8	.9	.11	.01	.....	.10	200
Turnips	5	.3	.4	.5	.02	.....	.....	.02	45
Flour	8	1	1.2	1.5	.44	.06	.01	.37	820
Rye bread	8	2	3	4	.31	.04	.....	.27	640
Oatmeal	2	.4	.5	.6	.12	.02	.01	.09	230
Sugar	3	.7	.9	1.1	.19	.....	.....	.19	350
Total	61	14.3	19.7	24.9	1.60	.27	.25	1.08	3,595
Corned beef	8	4	5	6	.16	.08	.08	.....	470
Pork sausage	4	2	2.5	3	.13	.03	.10	.....	485
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Butter	1	1	1.5	2	.05	.....	.05	.....	225
Cheese	2	1.5	2	2	.07	.03	.04	.....	250
Potatoes	12	.7	.9	1.1	.12	.01	.....	.11	240

TABLE D.—*Daily dietaries.—Food materials, etc.*—Continued.

[Cost estimated from prices given in Table C.]

Food materials.	Amount.	Cost.			Nutrients.				Fuel value.
		Cheap.	Medium.	Expensive.	Total.	Protein.	Fat.	Carbohydrates.	
	Ounces.	*Cents.*	*Cents.*	*Cents.*	*Lbs.*	*Lb.*	*Lb.*	*Lbs.*	*Calories.*
Bread	10	2.5	3.8	5	.42	.06	.01	.35	290
Flour	6	.8	.9	1.1	.32	.04	.....	.28	615
Molasses	3	1.2	1.4	1.6	.14	.....	.....	.14	250
Total	54	14.7	19.5	23.8	1.47	.27	.30	.90	2,990
Canned corned beef	3	1.9	2.3	3	.08	.05	.03	.....	225
Fresh cod	8	3	4	6	.05	.05	.....	.....	100
Milk, 1 pint	16	2	3	4	.13	.04	.04	.05	325
Butter	2½	2.5	3.7	5	.13	.....	.13	.....	565
Potatoes	12	.7	.9	1.1	.12	.01	.....	.11	240
Flour	8	1	1.2	1.5	.44	.06	.01	.37	820
Corn meal	3	.4	.6	.6	.16	.02	.01	.13	310
Graham flour	3	.6	.8	.8	.15	.02	.....	.13	300
Wheatlet	2	.5	.6	.7	.11	.02	.....	.09	200
Sugar	2	.5	.6	.7	.13	.....	.....	.13	235
Molasses	1	.4	.5	.6	.05	.....	.....	.05	85
Total	60½	13.5	18.2	24	1.55	.27	.22	1.06	3,405
Egg, 1	2	1.2	2	2.5	.03	.02	.01	.....	90
Total	62½	14.7	20.2	26.5	1.58	.29	.23	1.06	3,495
Shoulder clod (or neck)	8	4.5	5	6	.17	.10	.07	.....	465
Boned cod	4	2.3	2.5	2.5	.06	.06	.....	.....	105
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Butter	2½	2.5	3.7	5	.13	.....	.13	.....	565
Potatoes	7	.4	.6	7	.08	.01	.....	.07	140
Lard	1	.5	.6	.7	.06	.....	.06	.....	265
Wheat flour	8	1	1.3	1.5	.44	.06	.01	.37	820
Oatmeal	2	.4	.5	.6	.12	.02	.01	.09	230
Brown bread	6	1.5	1.9	2.3	.17	.01	.01	.15	365
Cornstarch	½	.3	.3	.3	.03	.....	.....	.03	55
Sugar	3	.7	.9	1.1	.19	.....	.....	.19	350
Total	50	15.1	18.8	29	1.51	.28	.31	.92	3,525
Beef, round	12	7.5	9	11.3	.22	.14	08	.....	585
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Butter	2½	2.5	3.8	5	.13	.....	.13	.....	565
Potatoes	16	1	1.3	1.5	.17	.02	.....	.15	320
Bread	8	2	3	4	.34	.05	.01	.28	630
Corn meal	7	.9	1.3	1.3	.37	.04	.02	.31	720
Sugar	3	.7	.9	1.1	.19	.....	.....	.19	350
Total	56½	15.6	20.8	26.2	1.48	.27	.26	.95	3,335
Bananas	6	1.1	1.5	1.9	.05	.....	.....	.05	110
Canned tomatoes	4	1	1.5	2	.01	.....	.....	.01	25
Beets	4	.4	.5	.6	.01	.....	.....	.02	40
Total	70½	18.1	24.3	30.7	1.55	.27	.26	1.03	3,510
Mutton chops	8	4	6	8	.22	.07	.15	.....	775
Dried beef	3	2.8	3.8	4.7	.08	.06	.01	.01	165
Milk, three-fourths pint	12	1.5	2.3	3	.10	.03	.03	.04	245
Butter	2	2	3	4	.10	.....	.10	.....	450
Potatoes	10	.6	.8	.9	.11	.01	.....	.10	200
Bread	10	2.5	3.7	5	.42	.06	.01	.35	790
Oatmeal	1	.2	.2	.3	.05	.01	.....	.04	115
Milk crackers	2	.8	1.1	1.1	.12	.01	.02	.09	250
Flour	3	.4	.5	.6	.16	.02	.....	.14	310
Sugar	1	.2	.3	.4	.06	.....	.....	.06	115
Total	52	15	21.7	28	1.42	.27	.32	.83	3,415
Egg, 1	2	1.3	2	2.5	.03	.02	.01	.....	90
Squash	4	.5	.8	1	.01	.....	.....	.01	25
Strawberries (or oranges, 6 ounces)	6	1.5	2.6	3.7	.03	.....	.....	.03	65
Total	64	18.3	27.1	35.2	1.49	.29	.33	.87	3,595
Pork, ham	8	6	8	10	.23	.04	.19	.....	860
Beef liver	6	1.9	3	3.8	.11	.08	.02	.01	250
Milk, 1¼ pints	20	2.5	3.8	5	.16	.05	.05	.06	405
Butter	1	1	1.5	2	.05	.....	.05	.....	225
Potatoes	12	.7	.9	1.1	.12	.01	.....	.11	240

TABLE D.—*Daily dietaries.—Food materials, etc.*—Continued

[Cost estimated from prices given in Table C.]

Food materials	Amount.	Cost.			Nutrients.				Fuel value.
		Cheap.	Medium.	Expensive.	Total.	Protein.	Fat.	Carbohydrates.	
	Ounces.	*Cents.*	*Cents.*	*Cents.*	*Lbs.*	*Lb.*	*Lb.*	*Lbs.*	*Calories.*
Flour	8	1	1.3	1.5	.44	.06	.01	.37	820
Corn meal	4	.5	.7	.7	.21	.02	.01	.18	410
Sugar	2	.5	.6	.8	.13	.....	.....	.13	235
Total	61	14.1	19.8	24.9	1.45	.26	.33	.86	3,445
Egg, 1	2	1.3	2	2.5	.03	.02	.01	.....	90
Total	63	15.4	21.8	27.4	1.48	.28	.34	.86	3,535
Beef, chuck	10	5	6.2	8.7	.20	.10	.10	.....	590
Butter	1½	1.5	2.3	3	.05	.....	.08	.....	340
Cheese	3	2.2	3	3	.12	.05	.07	.....	375
Potatoes	12	.8	.9	1.1	.12	.01	.....	.11	240
Bread	16	4	6	8	.66	.10	.01	.55	1,265
Milk crackers	4	1.5	2.3	2.3	.22	.02	.03	.17	500
Sugar	1	.3	.3	.4	.06	.....	.....	.06	115
Total	47½	15.3	21	26.5	1.43	.28	.29	.89	3,425
Apples	10	.6	.9	1.3	.08	.....	.....	.08	155
Turnips	2	.1	.2	.2	.01	.....	.....	.01	15
Total	59½	16	22.1	28	1.52	.28	.29	.98	3,595
Beef, round	6	3.8	4.5	5.6	.11	.07	.04	.....	295
Dried beef	3	2.8	3.7	4.7	.08	.06	.01	.01	165
Milk, three-fourths pint	12	1.5	2.2	3	.10	.03	.03	.04	245
Butter	3	3	4.5	6	.16	.....	.16	.....	680
Egg, 1	2	1.2	2	2.5	.03	.02	.01	.....	90
Potatoes	10	.6	.8	.9	.11	.01	.....	.10	200
Wheat flour	3	.4	.5	.6	.16	.02	.....	.14	310
Bread	8	2	3	4	.34	.05	.01	.28	630
Corn meal	4	.5	.8	.8	.21	.02	.01	.18	410
Sugar	2½	.6	.8	.9	.16	.....	.....	.16	295
Total	53½	16.4	22.8	29	1.46	.28	.27	.91	3,320
Tapioca	1½	.8	.9	.9	.07	.....	.....	.07	155
Apples	4	.2	.4	.5	.03	.....	.....	.03	60
Total	59	17.4	24.1	30.4	1.56	.28	.27	1.01	3,565
Constant:									
Butter	½	.5	.7	1	.03	.....	.03	.....	115
Milk, one-half pint	8	1.	1.5	2	.06	.02	.02	.02	165
Potatoes	12	.8	.9	1.1	.12	.01	.....	.11	240
Wheat flour	12	1.5	1.9	2.3	.65	.08	.01	.56	1,230
Corn meal	6	.7	1.1	1.1	.31	.03	.01	.27	620
Milk crackers	2	.8	1.1	1.1	.12	.01	.02	.09	250
Sugar	1	.3	.3	.4	.06	.....	.....	.06	115
Total constant	41½	5.6	7.5	9	1.35	.15	.09	1.11	2,735
Variable A:[1]									
Beef, sirloin	9	6.7	9	11.2	.20	.09	.11	.....	620
Dried beef	2	1.9	2.5	3.1	.06	.04	.01	.01	110
Total	52½	14.2	19	23.3	1.61	.28	.21	1.12	3,465
Variable B:[1]									
Beef, neck	6	1.5	2.3	3	.09	.05	.04	.....	275
Canned corned beef	4	2.5	3	4	.11	.07	.04	.....	290
Oatmeal	1½	.3	.4	.5	.08	.01	.01	.06	175
Total	53	9.9	13.2	16.5	1.63	.28	.18	1.17	3,475
Variable C:[1]									
Salt cod	5	1.9	2.5	2.5	.05	.05	.....	.....	100
Beans	6	1.1	1.5	1.9	.31	.08	.01	.22	600
Total	52½	8.6	11.5	13.4	1.71	.28	.10	1.33	3,435
Constant:									
Salt mackerel	4	2	3	3	.08	.04	.04	.....	230
Butter	2	2	3	4	.10	.....	.10	.....	450
Potatoes	16	1	1.2	1.5	.17	.02	.....	.15	320
Wheat flour	8	1	1.2	1.5	.44	.06	.01	.37	820

[1] To make a complete dietary the totals of variable items should be added to totals of the preceding constants.

TABLE D.—*Daily dietaries.—Food materials, etc.*—Continued.

[Cost estimated from prices given in Table C.]

Food materials.	Amount.	Cost.			Nutrients.				Fuel value.
		Cheap.	Medium.	Expensive.	Total.	Protein.	Fat.	Carbohydrates.	
Constant—Continued.	*Ounces.*	*Cents.*	*Cents.*	*Cents.*	*Lbs.*	*Lb.*	*Lb.*	*Lbs.*	*Calories.*
Corn meal	6	.8	1.1	1.1	.31	.03	.01	.27	620
Oatmeal	2	.4	.5	.6	.12	.02	.01	.09	230
Total constant	38	7.2	10	11.7	1.21	.17	.17	.88	2,670
Variable A:[1]									
Beef, sirloin	9	6.7	9	11.3	.20	.09	.11	.....	620
Milk, one-fourth pint	4	.5	.8	1	.03	.01	.01	.01	80
Sugar	1½	.4	.5	.5	.09	.....	.....	.09	175
Total	52½	14.8	20.3	24.5	1.54	.27	.29	.98	3,545
Variable B:									
Beef, round	8	5	6	7.5	.14	.09	.05	.....	390
Milk, three-eighths pint	6	.8	1.1	1.5	.05	.01	.02	.02	120
Sugar	2½	.6	.8	.9	.16	.....	.....	.16	295
Total	54½	13.6	17.9	21.6	1.57	.27	.24	1.06	3,475
Variable C:[1]									
Beef liver	7	2.2	3.5	4.4	.12	.09	.02	.01	290
Milk, one-half pint	8	1	1.5	2	.06	.02	.02	.02	165
Sugar	3	.7	.9	1.1	.19	.....	.....	.19	350
Total	56	11.1	15.9	19.2	1.59	.28	.21	1.10	3,475

[1] To make a complete dietary the totals of variable items should be added to totals of the preceding constants.

STANDARDS FOR DAILY DIETARIES FOR PEOPLE OF DIFFERENT CLASSES.

The figures of the following tables represent the amounts of nutrients which different investigators have estimated to be proper for the daily food of people of different classes. Those of the first table are compiled from European sources; Nos. 1–6 are from investigations mainly by Voit, Förster, and Cammerer in Germany; Nos. 7 and 8 are the well-known standards of Professor Voit, of Munich; No. 9 is by Moleschott, in Italy; No. 10, by Wolff, in Germany; and Nos. 11–15, by Playfair, in England.

The figures for American standards are proposed by Atwater. They are based upon the European and American data. They differ from the European standards mainly in that the quantities are more liberal and that they are expressed simply in terms of protein and energy.

TABLE E.—*European standards for daily dietaries.*

	Class	Nutrients.			Fuel value.	Nutritive ratio.
		Protein.	Fats.	Carbohydrates.		
		Pound.	*Pound.*	*Pounds.*	*Calories.*	
1	Children, 1 to 2 years, average	0.06	0.08	0.17	765	1 : 5.7
2	Children, 2 to 6 years, average	.12	.09	.44	1,420	1 : 5.3
3	Children, 6 to 15 years, average	.17	.10	.72	2,040	1 : 5.6
4	Aged woman	.18	.11	.57	1,860	1 : 4.7
5	Aged man	.22	.15	.77	2,475	1 : 5.0
6	Woman at moderate work	.20	.10	.88	2,425	1 : 5.4
7	Man at moderate work (Voit)	.26	.12	1.10	3,055	1 : 5.3
8	Man at hard work (Voit)	.32	.22	.99	3,370	1 : 4.7
9	Man at moderate work (Moleschott)	.29	.09	1.21	3,160	1 : 4.9
10	Man at moderate work (Wolff)	.28	.08	1.19	3,030	1 : 4.9
11	Subsistence diet (Playfair)	.13	.03	.75	1,760	1 : 6.5
12	Diet of quietude (Playfair)	.16	.06	.75	1,950	1 : 5.7
13	Adults in full health (Playfair)	.26	.11	1.17	3,140	1 : 5.4
14	Active laborers (Playfair)	.34	.16	1.25	3,630	1 : 4.7
15	Hard-worked laborers (Playfair)	.41	.16	1.25	3,750	1 : 3.9

TABLE F.—*American standards for daily dietaries.*

Class.	Protein.	Fuel value.	Nutritive ratio.
	Grams.	*Calories.*	
Woman with light muscular exercise	90	2,400	1 : 5.5
Woman with moderate muscular work	100	2,700	1 : 5.6
Man without muscular work	112	3,000	1 : 5.5
Man with light muscular work			
Man with moderate muscular work	125	3,500	1 : 5.8
Man with hard muscular work	150	4,500	1 : 6.3

FEEDING STUFFS (FOR ANIMALS).

EXPLANATIONS OF TERMS USED IN THE TABLE.

Water.—All feeding stuffs contain water. The amount varies from 8 to 15 pounds per 100 pounds of such dry materials as hay, straw, or grain to 80 pounds in silage and 90 pounds in some roots.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorine, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. Part of the ash constituents of the food is therefore stored up in the animal's body; the rest is voided in the manure.

Protein (or nitrogenous materials) is the name of a group of materials containing nitrogen. Protein furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, and the casein and albumen of milk, etc., and is one of the most important constituents of feeding stuffs.

Fiber.—Fiber, sometimes called cellulose, is the framework of plants, and is, as a rule, the most indigestible constituents of feeding stuffs. The coarse fodders, such as hay and straw, contain a large proportion of fiber, and are, for this reason, less digestible than the grains, oil cakes, etc.

Nitrogen-free extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains. The nitrogen-free extract and fiber are usually classed together under the name of carbohydrates. The carbohydrates form the largest part of all vegetable foods. They are either stored up as fat or burned in the system to produce heat and energy.

Fat, or the materials dissolved from a feeding stuff by ether, is an impure product, and includes, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned to furnish heat and energy.

Composition of feeding stuffs.

Feeding stuff.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
GREEN FODDER.						
Corn fodder, all varieties:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Minimum	51.5	0.6	0.5	1.9	3	0.1
Maximum	93.6	2.6	4	11.4	36.3	1.6
Average	79.3	1.2	1.8	5	12.2	.5
Rye fodder, average	76.6	1.8	2.6	11.6	6.8	.6
Oat fodder, average	62.2	2.5	3.4	11.2	19.3	1.4
Redtop (*Agrostis vulgaris*), *a* in bloom, average	65.3	2.3	2.8	11	17.7	.9
Tall oat grass (*Arrhenatherum avenaceum*), *b* average	69.5	2	2.4	9.4	15.8	.9
Orchard grass (*Dactylis glomerata*), average	73	2	2.6	8.2	13.3	.9
Meadow fescue (*Festuca pratensis*), average	69.9	1.8	2.4	10.8	14.3	.8
Italian rye grass (*Lolium italicum*), average	73.2	2.5	3.1	6.8	13.3	1.3
Timothy (*Phleum pratense*), *c* at different stages:						
Minimum	47	1.4	1.3	5.1	1.1	.6
Maximum	78.7	3.2	3.8	19.4	2.6	2
Average	61.6	2.1	3.1	11.8	2	1.2
Kentucky blue grass (*Poa pratensis*), *d* at different stages:						
Minimum	51.7	1.6	2.4	3.8	6.5	.8
Maximum	82.5	4.8	7.2	14.8	26.6	1.9
Average	65.1	2.8	4.1	9.1	17.6	1.3
Hungarian grass (*Setaria*), average	71.1	1.7	3.1	9.2	14.2	.7

a Herd's grass of Pennsylvania.
b Meadow oat grass.
c Herd's grass of New England and New York.
d June grass.