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MILK AS FOOD.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., March 1, 1898.

SIR: I have the honor to transmit herewith an article on milk as food, prepared in this Office, treating of the nutritive value of milk, and suggesting some of the ways in which it may be combined with other food materials to make well-balanced and economical dietaries. In the preparation of this article the results of the investigations on the nutritive value of foods, including milk, made under direction of Prof. W. O. Atwater, have been utilized, as well as information gathered from other authoritative sources. I recommend that the article be published as a Farmers' Bulletin.

Respectfully,

A. C. TRUE,
Director.

HON. JAMES WILSON,
Secretary of Agriculture.

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MILK AS FOOD.

INTRODUCTION.

A quart of milk contains about the same amount of nutriment as three-quarters of a pound of beef, namely, about 4 ounces. Six ounces of bread would likewise supply not far from 4 ounces of nutritive substances. To put it in another way, about one-eighth of the whole weight of the milk, one-third of the beef, and two-thirds of the bread consist of actually nutritive ingredients. The other seven-eighths of the milk and one-third of the bread are water, while the two-thirds of the meat which is not actual nutriment is mainly water, but consists in part of bone.

But while the quart, or 2 pounds, of milk, the 12 ounces of beef, and the 6 ounces of bread all supply like amounts of nutriment, the nutritive values are not exactly the same; in other words, they would not be equally useful for food. Either the milk or the bread eaten alone would make a better balanced food for man than the meat, because it contains the different kinds of nutritive ingredients, or nutrients, in proportions more nearly adapted to supply the wants of the body than is the case with the nutrients of the meat.

Milk contains all of the ingredients needed for nourishment; that is, it furnishes the materials which build up the body and keep it in repair, and also those which supply it with fuel to keep it warm and to furnish the animal machine with the power needed to do its work.

The composition of milk and other food materials, the kinds and amounts of different ingredients they contain, are found by analysis in the chemical laboratory. But (since analysis is a separation into constituent parts) a rough analysis of milk is made in the dairy and in the kitchen. When milk stands the cream rises. This cream consists of minute particles of fat, surrounded by casein and other substances. The cream is put in the churn and shaken, and the globules of fat gather together as butter. This separation of the butter fat is a partial analysis of the milk. When rennet is added to milk it is curdled. The ferment of the rennet causes the casein to coagulate, forming the curd. This is put in the cheese press, the liquid is pressed out, and the curd is changed to cheese, which contains the casein and with it fat and other materials which were in the milk and were entangled or inclosed in the coagulated casein. The whey from which the curd has been separated contains a kind of sugar, which can in its turn be separated from the fluid, and is prepared commercially and sold as milk sugar. After the sugar has been removed there still remains in the milk considerable amounts of mineral compounds.

If at the outset the milk had been heated, the water might have been evaporated and the casein, fat, sugar, mineral salts, and other materials would have remained as the milk solids. These together make up the nutrients of the milk.

When milk is used for food the casein and allied compounds serve the body for building and repair, and are also used for fuel. The fat and sugar are the chief fuel ingredients. The mineral compounds aid in forming tissue, and have other uses as well, but they are needed only in small quantities.

The value of milk for nourishment is not as well understood as it should be. Many people think of it as a beverage, rather than a food. To understand its nutritive value, and how it compares with other food materials in this regard, we must consider, briefly, the nature, composition, and uses of food materials.

FOOD AND ITS FUNCTIONS.

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 force and heat. It is used to form the tissues and fluids of the body, such as muscle, blood, bone, and brain, to repair their waste, and, if in excess of the daily requirements, it may be stored in the body for future consumption. The material thus stored is principally fat. When food or body tissue is consumed in the system, the energy which lay latent therein becomes active and manifests itself in the force or heat required for the various bodily uses.

The best foods are those which perform their function in the most thorough and complete manner; that is, with as little waste as possible and with the best physiological results. We usually judge of the value of a food by several different standards. Thus, it must be digestible and palatable, furnish the ingredients needed by the system in proper amounts, and be reasonably cheap.

Some food materials contain inedible portions, such as bone, shell, skin, etc. The edible portion of food materials consists of water and of some or all of the four classes of nutrients—protein, fat, carbohydrates, and mineral matter. The protein compounds are those which contain nitrogen, and are necessary for the repair of old and the building of new tissue. When in excess of what is thus needed they may be simply burned to produce the required force. Body tissue when broken down also yields energy. Familiar examples of protein are lean of meat and fish, white of egg, casein of milk (and cheese), and gluten of wheat. The fats and carbohydrates are used as a source of energy or force. Fat is found in fat meats, lard, fat of milk (butter), and oils—such as olive oil. Starches, sugars, and woody fiber or cellulose form the bulk of the carbohydrates. The protein, fats, and carbohydrates are all organic substances; that is, they can be burned with the formation of various gases, chiefly carbon dioxid and water, leaving no solid residue. The mineral matters will not burn and are left behind when organic matter is ignited.

The most familiar mineral compounds in food are perhaps calcium phosphate (bone phosphate, or phosphate of lime) and sodium chlorid (common salt).

In order to have some measure for expressing the amount of heat that a given substance is capable of yielding, the calorie is taken as a unit. Roughly speaking, this is the amount of heat required to raise the temperature of 1 pound of water 4 degrees Fahrenheit. One pound of sugar or starch would, if burned and all the heat utilized, raise 1,860 pounds of water 4 degrees in temperature; or it would raise 5 gallons of water from the freezing point to the boiling point, but would not cause it to boil.

The fuel value of a pound of protein as it is ordinarily burned in the body is very nearly the same as that of a pound of carbohydrates, but fats have a fuel value 2¼ times that of protein and carbohydrates, or 4,220 calories per pound.

COMPOSITION OF MILK.

The chief bulk of milk is, of course, made up of water, the amount of which may vary even in ordinary unadulterated milk from 90 per cent in a very poor product to 84 per cent in an unusually rich milk. The corresponding solid matter, or "total solids," varies from 10 per cent to 16 per cent. This solid matter, or "total nutrients," is made up of protein, fats, carbohydrates, and mineral matter. The proportion of these vary within certain limits; but, roughly speaking, one twentieth of the total solids are mineral substances, one-fourth protein, three-tenths fat, and four-tenths carbohydrates.

The protein compounds of milk.—The principal nitrogenous compound of milk is casein. This, when the milk is drawn from the cow, is in a form which is called caseinogen, but undergoes changes which bring it into the form of casein. For convenience it is here referred to in all its forms as casein. In chemical composition the casein differs from the other protein compounds of milk in that it contains both phosphorus and sulphur. Besides the casein there is a certain amount of albumin present, called lact-albumin, or albumin of milk. This is more or less similar to the albumin which occurs in blood and in white of egg. The quantity of albumin is very much smaller than that of the casein, being on the average about one-seventh of the total protein.

There are other nitrogenous substances occurring in milk, but in insignificant quantities. The total protein of milk should not vary in any great degree. It will average not far from 3.3 per cent of the whole milk, or about 25 per cent of the total solids.

The fats of milk.—The fat of milk is commercially the most important of its constituents, since it is the source of butter and enters largely into the composition of cheese. Chemically speaking, the fat of milk, or butter fat, as it is more often called, consists of several different fats. The chief of these are the same fats that make up the bulk of fat meat (tallow, lard, etc.), as well as many vegetable fats. They are called stearin, palmitin, and olein. Besides these three fats there are others in smaller amounts, but of considerable importance, since it is to them that the flavor and aroma of the butter is due. The amount of fat in milk varies widely, the amount in normal milk depending upon various conditions, some of which are mentioned beyond. The amount of fat should not fall below 3 per cent, and, except in unusually rich milk, will not exceed 5 per cent. Good unadulterated milk from a herd of well-fed cows should average not far from 4 per cent of butter fat, or about 31 per cent of the total solids of the milk.

The carbohydrates of milk.—The chief compound of this class which occurs in milk is lactose, or sugar of milk. Milk sugar is similar in chemical composition to cane sugar, but is not nearly as sweet. It is largely used by physicians and pharmacists as the basis of powders and pills. In amount it ranges from 4 to 6 per cent, but on the average may be said to be 5 per cent, of the milk, or about 38 per cent of the total solids.

There is a considerable variation in the composition of the milk of different animals. The richest milk appears to come from the dog, the poorest from the horse. Human milk is richer in sugar and poorer in protein than cow's milk, but the fuel value is about the same. These facts are brought out in the following table:

Comparative composition of various kinds of milk.[1]

Kind of milk.	Water.	Total solids.	Total solids.						Fuel value per pound.
			Protein.			Fat.	Carbohydrates (milk sugar).	Mineral matters (ash).	
			Casein.	Albumin.	Total protein.				
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Woman	87.4	12.6	1.0	1.3	2.3	3.8	6.2	0.3	319
Cow	87.2	12.8	3.0	.5	3.5	3.7	4.9	.7	313
Dog	75.4	24.6	6.1	5.1	11.2	9.6	3.1	.7	671
Ewe	80.8	19.2	5.0	1.5	6.5	6.9	4.9	.9	503
Buffalo	81.4	18.6	5.8	.3	6.1	7.5	4.1	.9	506
Cat	82.1	17.9	3.1	6.0	9.1	3.3	4.9	.6	400
Goat	85.7	14.3	3.2	1.1	4.3	4.8	4.4	.8	365
Llama	86.5	13.5	3.0	.9	3.9	3.2	5.6	.8	312
Ass	89.6	10.4	.7	1.6	2.3	1.6	6.0	.5	222
Mare	91.5	8.5	1.2	.1	1.3	1.2	5.7	.3	180

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[1] König, Chemie der menschlichen Nahrungs- und Genussmittel, 3d ed., I, pp. 267-362.

CHARACTERISTICS AND PROPERTIES OF MILK.

The color and opaqueness of milk are due mainly to globules of fat, which are very minute and almost numberless. These are held in suspension in the liquid in the form of an emulsion; but, since they are lighter than water, after the milk has stood for some time they gradually rise to the surface, and thus accumulating form the cream. The action of the separator is on the same principle, only in this case the heavier portion of milk, i. e., the water, casein, and sugar, are thrown as far from the center as possible by the rapidly rotating machine, and the lighter cream, being thus forced to the center, can be drawn off.

When milk has stood for some time, the milk sugar undergoes decomposition, whereby lactic acid is formed and the milk becomes sour. Accompanying this souring of milk, there is a change in its consistency and it becomes thick or curdled. The same change can be brought about by the addition of an acid, vinegar for example. If milk thus curdled is neutralized with some alkali, such as limewater or soda, the curd is redissolved. Milk is also curdled or coagulated by rennet, and the curd thus produced is utilized in the manufacture of cheese. This curd, unlike that of ordinary sour milk, is not dissolved by the addition of limewater or soda.

A scum forms upon the surface of milk when it is boiled. This is probably due to the coagulation by heat of the protein of the milk, chiefly its albumin, but perhaps to a slight extent its casein also.

Milk is slightly heavier than water, its specific gravity ranging from 1.029 to 1.034 at 60° F. This means that while a quart of water weighs 2 pounds 1⅓ ounces, a quart of milk weighs from 1.029 to 1.034 times as much, or not far from 2 pounds 2½ ounces. The specific gravity depends upon the proportion of water and other substances. Since the fat is lighter than water, the richer the milk is in butter fat the lower its specific gravity, provided, of course, that the other solids are not increased proportionally. It follows, also, that the removal of the fat increases the specific gravity, so that skim milk has a specific gravity of from 1.033 to 1.037. On the other hand, the addition of water to skimmed milk brings down the specific gravity.

VARIATIONS IN MILK.

Excepting meats, there is probably no one article of food which is liable to so wide a variation in its percentage composition as the milk supplied the consumer. The variations are so great, in fact, as to make it entirely possible that one man may pay nearly twice as much as his neighbor for the same amount of nutrients when both buy it at the same price per quart. The causes of such variations are quite numerous and need be touched upon but briefly. The variation in composition of pure milk is due in a large degree to the breed or individuality of the cow, to the methods of feeding and handling, and the length of time since calving.

With regard to this subject Professor Voorhees[1] says:

> The influence of breed is very marked, so much so that dairy breeds are classified into milk and butter breeds—that is, those which give a large quantity of poorer quality, and those which give a smaller quantity of a higher quality. * * * With the improvement of the stock by the introduction of recognized butter-producing breeds of cows the quality of the product also materially improves.

In general young cows produce richer milk than old ones, though much depends upon the health and vigor of the animal. A well-fed cow gives more and better milk than one which is poorly fed, but the relative proportions of fat, casein, and sugar do not appear to be greatly influenced by the composition of the food. The average cow of a given breed possesses certain capabilities for producing milk, but does not reach her normal capacity of milk production unless she is well fed. When once she has a sufficient and well-balanced ration, neither the composition nor the amount of the milk yield seems to be greatly improved by either increasing the ration or changing the proportion of its ingredients.

The milk flow of a given cow is usually largest soon after calving; as the period of lactation increases, the flow gradually falls off, and, as a rule, the milk grows richer, i. e., the proportion of solids increases. The proportion of fat to the other solids in the milk of a given cow varies from day to day and from milking to milking.

Another cause of variation in milk is found in the temptation of unprincipled milkmen to adulterate their product. The chief methods of adulteration are (1) the addition of water, (2) the removal of a portion of the fat, either with or without the addition of water, and (3) the addition of preservatives. The two former methods result in a greater or less diminution of the food value, depending upon the extent of adulteration. The latter method does not detract from the total nutrients in the milk but it adds substances which, while not active poisons, may, when taken in the milk regularly in small amounts, produce deleterious results. The specific gravity of the milk is sometimes used as a test of its purity, but since removing part of its fat in form of cream raises and adding water lowers the specific gravity, one form of adulteration may counteract and cover up the other, and thus render this test alone unreliable.

The flavor of milk is frequently affected by the food eaten by the cow. It is a familiar fact that turnips when fed to cows give a peculiar taste or flavor to the milk.

The milk of diseased cows may be very abnormal in composition and may be the means of conveying disease. It is well understood that milk can act as a carrier of infection, and it is therefore of the greatest importance that especial care be taken in the dairy to insure the cleanliness of milk and to render its exposure to any germs of infec-

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 35.

tious diseases or to impure air of any sort impossible. It should be possible in all large cities, as well as in the smaller cities and country towns, to obtain some assurance that the milk received comes from healthy animals and receives proper care and attention after being drawn from the cow. This assurance should be obtained either by the public authorities, by the employment of honest reputable dealers, or by personal inspection and examination. The subject of the control and examination of the milk supply is treated at further length in Farmers' Bulletin No. 42 of this Department.[1]

NUTRITIVE VALUE OF MILK.

Milk is peculiarly adapted for use as a food by man for several reasons. It contains all of the four classes of nutrients—protein, fats, carbohydrates, and mineral matter in more nearly the proper proportion to serve as a complete food than any other food material, although no one substance can furnish a complete food for an adult for reasons referred to beyond. It is in a form well adapted for varied uses either alone or more especially in combination with other food substances and in the preparation of various dishes for the table. Its use is already considered indispensable in many such cases and it might profitably be used in many more. At the price ordinarily paid for milk in our large cities it is a food of reasonable cheapness, and at the prices prevailing in small cities and country towns it is an economical food. (See p. 20.)

DIGESTIBILITY OF MILK.

In general, milk ranks as a very digestible food, but when we come to speak more definitely as to its digestibility there are difficulties of two kinds. One of these has to do with what is understood by the term digestibility; the other has to do with the differences of different persons in respect to their powers of digestion.

By digestibility of food several things are, or may be, meant. One is the proportion of a given food material or of each of its several constituents which an ordinary person may digest. Another is the ease with which it is digested or the time required by the process. As the word is ordinarily used, however, it includes still another consideration, namely, whether the food material does or does not agree with the user.

Proportions of nutrients digested.—"We live not upon what we eat, but upon what we digest." In other words, the value of food for nutriment depends not only upon how much of the nutrients it contains, but upon how much of these the body actually digests and uses for its support. To put it in another way, the most important factor of digestibility, so far as the nutritive value of food is concerned, is found in the proportions of its different nutrients which can actually be digested by healthy persons and used for nourishment. Considerable experimenting has been done upon this subject. While it is found that different people vary in the amounts which they can digest from the same food, the dif-

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[1] See also U. S. Dept. Agr., Bureau of Animal Industry Bul. 20.

ferences are not as great as might be supposed. The results, in so far as they apply to milk alone, and in comparison with other food materials, may be briefly summarized as follows: The protein of milk, especially when it is used with other food materials, is quite readily and completely digested. In this respect it is like the protein of ordinary meats and fish. The protein of vegetable foods is much less completely digested. Thus, in potatoes and whole wheat and rye flour it may sometimes happen that as much as one-fourth of the protein may escape digestion and thus be useless for nourishment. From one-sixth to one-tenth of the protein of wheat flour, corn meal, beans, and peas may in like manner be assumed to escape digestion, or rather to leave the body without being used for nutriment. These estimates assume that the materials are cooked and eaten in the usual way. Under the same circumstances, from nine-tenths to the whole of the protein of milk, meats, and fish are assumed to be digested. The digestibility of the fats is likewise variable. Sometimes a large part of the fat of the food fails of digestion. In general it may be assumed that about 5 per cent of the fat of milk, meat, eggs, butter, and lard, and a considerably larger proportion of the fats of some vegetable foods, will usually escape digestion. When, however, the diet contains a very large amount of fat—for instance, when it consists largely of fat meat—the digestion is less complete. One way in which the fat of ordinary foods is digested is by being made into an emulsion in the intestine. The fat of milk is an extremely fine emulsion and is thus in a sense "predigested" or in a partly digested form before it is taken into the stomach. This may help to explain why it is so easily digested.

The carbohydrates, which make up a large part of vegetable foods, are in general very digestible. Cane sugar is believed to be completely digested, and this is assumed to be the case with the sugar of milk.

The animal foods have in general the advantage of the vegetable foods in digestibility in that they contain more protein and their protein is more digestible. Milk ranks among the most digestible of the animal foods in respect to all its ingredients.

The process of digestion.—When milk is taken into the stomach, it is speedily curdled by the action of the pepsin and acid of the gastric juice. When milk is eaten alone or in large quantities, the casein gathers in large lumps, which may be difficult of digestion by some. This is particularly the case with infants and with adults whose digestion is weak, and is one of the reasons why milk should be used with other foods and not taken in large quantities alone. Human milk differs from cow's milk in the way in which it curdles when taken into the stomach. The casein of the former is not precipitated in such large lumps, but is more flocculent, and is thus more easily digested and does not cause irritation. This explains one reason why woman's milk is believed to be better than cow's milk for infants. The small flocculent particles of casein of the former are digested more easily and do not produce the bad effects which sometimes come from the curdling of the latter. When cow's milk has been boiled before it is taken into the stomach, it is likely to be precipitated in more flocculent form. It is supposed by some chemists that when milk is boiled part of the phosphate of lime is precipitated, and that when the latter is thus removed the curd is more flocculent. It is also believed that lime tends to prevent the curdling of the casein in lumps, doing so both by neutralizing the acid and also by its intrinsic power of retarding coagulation. For this reason a little limewater is frequently added to milk that is to be fed to infants. For the same reason some adults of delicate digestion who find that fresh milk does not agree with them can use it with impunity if it has been boiled or if limewater is added.

In the processes of digestion and assimilation the different ingredients of the food undergo a great variety of chemical changes, and some of the compounds that are formed may be at times harmful in one way or another. Indeed, some of the compounds produced from the food in the body may be actually poisonous. Different persons are differently constituted with respect to these chemical changes which the food undergoes and the effects produced, so that it may be literally true that "one man's meat is another man's poison." This is the case with milk. While for most persons it is a very wholesome, digestible, and nutritious food, there are those who are made ill by drinking it. In like manner some people are made seriously ill by eating eggs, fruits, or other food materials.

Digestion v. utilization of food.—One important thing to remember is that the food which we digest is not always utilized to the best advantage. Different people differ greatly in this respect. One man may be able to do a large amount of work and another very little, when both have the same diet and digest the same amount of nutrients from it. One person will grow fat upon an amount of digested material with which another will hardly hold his own. The getting of the most good from food is not so much a matter of digestion as of making use of what is digested.

All persons 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, even among those in good health.

For persons 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 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.

Effects of cooking.—Cooking changes the texture of a food material and affects its digestibility to a greater or less extent. In general it increases the digestibility of the vegetable food materials. This is true more especially of boiling or steaming. During the process of cooking, the cells of vegetables burst and the tissue of meat becomes softened and loosened, thus facilitating digestion by exposing them more fully to the action of the digestive juices.

In the case of milk the experience of different persons with cooked and uncooked milk is quite varied, and the results of the experiments upon the subject are conflicting. The more common experience seems to indicate that cooking or heating the milk makes the proteids somewhat more difficult for most persons to digest, but there are exceptions to this rule, if it be a rule. For instance, as above stated, there are persons who can not take fresh milk with comfort, but with whom boiled milk agrees very well.

SKIM MILK.

Even after average milk is skimmed it still contains nearly 10 per cent (one-tenth of its weight) of solids or nutritive ingredients. The amount of fat left in skim milk varies greatly with the method of creaming. Ordinary open shallow pan setting leaves anywhere from one tenth to one-quarter of the original fat of the milk in the skim milk. Deep cold setting removes the fat much more completely, so that Cooley skim milk has from a trace to three-tenths or four-tenths of one per cent of fat. Separator skim milk has usually less fat than that from deep cold setting. It is not far out of the way to say that a pound of skim milk contains 0.034 pound protein and has a fuel value of 170 calories or a little more protein than the same weight of whole milk and about one-half the fuel value.

At first thought it may be difficult to understand how removing the fat increases the amount of protein, but the explanation is simple. One pound of whole milk contains on the average 3.3 per cent or 0.033 pound of protein and 4 per cent or 0.04 pound of fat. If all the fat is removed, there will be left 0.96 pound of skim milk containing 0.033 pound of protein, or about 3.5 per cent, so that 1 pound of skim milk would contain about 0.035 pound of protein. For the same reason there is a slightly larger proportion of milk sugar in skim milk than in whole milk.

The value of skim milk as food is not generally appreciated. Taken by itself it is rather "thin" and, to use a common expression, "does not stay by." The reason for this is simple: One has to drink a large quantity to get the needed nourishment, and, further, it is so readily disposed of that it does not satisfy the sense of hunger. But when taken with bread or used in cooking, it forms a very nutritious addition to the food. A pound of lean beef (round steak, for example) contains about 0.18 pound of protein and has a fuel value of 870 calories. Two and a half quarts, or 5 pounds, of skim milk will furnish nearly the same amount of protein and have about the same fuel value as the pound of round steak. Two quarts of skim milk has a greater nutritive value than a quart of oysters; the skim milk has 0.14 pound of protein and a fuel value of 680 calories, while the oysters contains only 0.12 pound of protein and have a fuel value of 470 calories. The nutriment in the form of oysters would cost from 30 to 50 cents, while the 2 quarts of skim milk would have a market value of from 4 to 6 cents and a value on the farm of from 2 to 4 cents. An oyster stew made of one part oysters and two parts skim milk would owe its nutriment more to the milk than to the oysters. Bread made with skim milk would contain more protein than when made with water. A lunch or meal of bread and skim milk is very nutritious, as the following computation shows:

Composition and cost of a lunch or meal of bread and skim milk.

Food materials.	Amount.	Estimated cost.	Protein.	Fuel value.
		Cents.	*Pound.*	*Calories.*
Bread	10 oz.	3	0.06	755
Skim milk	1 pt.	1	.03	170
Total	....	4	.09	925

The commonly accepted standard for a man at ordinary muscular work calls for 0.28 pound of protein and a fuel value of 3,500 calories per day, so that the above lunch furnishes very nearly one-third of a day's nutriment and at a cost of but 4 cents. If whole milk were used instead of skim milk, the cost would be about 6 cents and the fuel value 1,080 calories, while the protein would remain the same in amount.

The following lunch, such as might be obtained in a restaurant or lunch room, will serve for the purpose of comparison:

Estimated cost and nutrients of a restaurant lunch.

Food materials.	Amount.	Estimated cost.	Protein.	Fuel value.
	Ounces.	*Cents.*	*Pound.*	*Calories.*
Soup	8	....	0.01	75
Beef	2	....	.02	275
Potatoes	2	....	....	100
Turnips	1	....	....	15
Bread	4	....	.02	300
Butter	½	....	....	100
Coffee:				
Milk	1	....	....	20
Sugar	½	....	....	55
Total	....	15 to 20	.05	940

It will thus be seen that the 15-cent lunch containing nine different food materials did not have any greater nutritive value than the 4-cent lunch of bread and skim milk.

The ingredient of our food which costs the most, has the greatest physiological value, and is most apt to be lacking in ordinary dietaries, is protein. Skim milk has nearly all the protein of the whole milk. By the removal of the fat in the cream it loses half its fuel value, but practically none of the protein. What is left has all the value of the whole milk for building and repair of tissue, for the making of blood and muscle and bone, and half the value of whole milk for supplying heat and muscular power. When these facts are fully understood, skim milk will doubtless be more wisely utilized. The ways in which a skillful cook can utilize skim milk in cooking are almost endless and the protein thus added to the daily ration is of the utmost importance.

CREAM.

When the globules of fat rise in the milk, they entangle among them a considerable amount of milk which is removed with the fat as cream. Cream is thus the butter fat of the milk with some protein and carbohydrates due to the intermixed milk, and contains on the average about four and one-half times the amount of fat contained in an equal volume of milk. The amount of protein and of carbohydrates is slightly less than in whole milk. The fuel value of a pint of cream is not far from 1,425 calories, or about the same as 1⅛ pounds of bread, or 1½ dozen bananas, or 4½ pounds of potatoes. Four quarts of whole milk would not furnish quite as much energy (1,300 calories), but would increase the protein over six times. It is thus seen that cream is valuable chiefly for its heat-giving properties and that the skim milk contains the valuable protein. When it is considered that a pint of cream retails at from 12 to 25 cents, and a pound of butter from 18 to 36 cents, and that the latter is worth two and a half times the former as a source of energy, it will be seen that cream is not, as a rule, an economical food.

BUTTERMILK.

Besides skim milk, there is another important by-product resulting from the manufacture of butter—namely, buttermilk. In many places this is used as a beverage to a considerable extent, and thus used furnishes more nutriment than almost any other beverage except whole milk and skim milk, unless it be cocoa and chocolate. To many persons buttermilk is much more palatable than whole milk or skim milk. The average composition of buttermilk is quite similar to that of skim milk, though it contains slightly less protein and sugar and a very little more fat. The fuel value is almost the same, about 165 calories per pint. An ordinary glass of buttermilk would contain as much nourishment as half a pint of oysters, or 2 ounces of bread, or a good sized potato.

Buttermilk represents the milk that was entangled among the globules of fat as the cream was separated from the milk. During the manufacture of butter from cream, the fat globules are brought together and removed, leaving the buttermilk. Buttermilk is thus seen to be practically the same thing as skim milk, only as a rule it is sour, owing to the cream being soured before churning.

NUTRITIVE VALUE OF MILK AS COMPARED WITH OTHER FOODS.

In the following table the amount and fuel value of the nutrients in a pound of whole milk, skim milk, and buttermilk are compared with the nutrients furnished by a pound of some other foods.

As compared with the animal foods, it will be noted from this table that milk contains carbohydrates and has no refuse. In these two respects it resembles more nearly many of the vegetable foods, such as flour, oatmeal, etc. The amount of mineral matter is much the same as in the other fresh substances given. There is a larger proportion of water in milk than in most other food materials, so that a given weight contains less dry matter or nutrients than most foods. It must be remembered, however, that the comparison is here made of a pint of milk with an equal weight of the other more condensed food materials without taking the price into consideration.

Amounts of nutrients in a pound (pint) of milk as compared with a pound of meat, bread, and other food products.

Food materials.	Refuse.	Edible portion.					
		Water.	Nutrients.				Fuel value.
			Protein.	Fat.	Carbohydrates.	Mineral matter.	
Milk (1 pint).	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Whole milk	....	0.87	0.03	0.04	0.05	0.01	325
Skim milk (0.3 per cent fat)	....	.90	.04	....	.05	.01	170
Buttermilk	....	.91	.03	.01	.05	.01	165
Other food materials (1 pound each).							
Cheese	....	.34	.26	.34	.02	.04	1,965
Butter	....	.11	.01	.85	....	.03	3,605
Beef:							
Round	0.08	.61	.18	.12	....	.01	870
Shoulder clod	....	.69	.19	.11	....	.01	835
Sirloin	.13	.53	.16	.17	....	.01	1,040
Fore quarter	.19	.50	.14	.16	....	.01	950
Hind quarter	.16	.51	.15	.17	....	.01	1,000
Mutton, side	.19	.43	.13	.24	....	.01	1,275
Pork:							
Loin	.16	.44	.14	.25	....	.01	1,340
Ham	.14	.35	.13	.34	....	.04	1,655
Salt, fat	....	.07	.02	.87	....	.04	3,715
Chicken	.35	.48	.15	.01	....	.01	325
Codfish:							
Fresh	.30	.58	.11	....	....	.01	205
Salt	.25	.40	.16	....	....	.19	315
Mackerel, salt	.23	.38	.17	.17	....	.10	1,050
Oysters, solids	....	.88	.06	.02	.03	.01	235
Wheat flour	....	.12	.11	.01	.75	.01	1,645
Corn meal	....	.13	.09	.02	.75	.01	1,655
Oatmeal	....	.07	.16	.07	.68	.02	1,860
Wheat bread	....	.35	.10	.01	.53	.01	1,205
Crackers	....	.08	.11	.10	.69	.02	1,895
Dried beans	....	.13	.22	.02	.59	.04	1,590
Beets	.20	.70	.01	....	.08	.01	170
Potatoes	.15	.67	.02	....	.15	.01	325
Turnips	.30	.62	.01	....	.06	.01	135
Apples	.25	.62	.01	....	.12	....	255

If we wish to compare the food values of the actually nutritive ingredients (the dry matter contained in the edible portion) of different food materials, the calculations can be made on the basis of 1 pound of this water-free edible portion. This is an excellent method for comparing the actual values of two or more food materials as sources of protein or of energy. The following figures show the comparison of milk and a few other foods on this basis:

Nutrients and energy in one pound of the water-free edible portion of several food materials.

Food materials.	Protein.	Fat.	Carbohydrates.	Mineral matter.	Fuel value.
	Pound.	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Whole milk	0. 25	0. 31	0. 39	0. 05	2, 475
Skim milk (0.3 per cent fat)	. 36	. 03	. 55	. 06	1, 835
Buttermilk	. 33	. 06	. 53	. 08	1, 845
Cheese	. 39	. 52	. 03	. 06	2, 990
Beef, round	. 57	. 40	....	. 03	2, 750
Smoked ham	. 26	. 66	....	. 08	3, 275
Wheat flour	. 13	. 01	. 85	. 01	1, 865
Wheat bread	. 15	. 02	. 82	. 01	1, 865
Potatoes	. 10	. 01	. 85	. 04	1, 790
Apples	. 03	. 03	. 92	. 02	1, 885

It is seen from the above table that whole milk, skim milk, and buttermilk are all nitrogenous foods, though not as highly nitrogenous as the meats. Not only do they furnish a large proportion of nitrogen, but on account of their fuel ingredients (fats and carbohydrates) they are useful as sources of energy. One pound of the dry substance of skim milk contains nearly three times the protein and very nearly the same fuel value as 1 pound of wheat flour. It is only on account of the large proportion of water that skim milk can not be used to a much greater extent than it is. Both skim milk and whole milk should, as has been urged above, be used much more extensively in cooking.

Chart I (p. 17) shows the relative composition of various foods as compared with whole and skim milk.

THE USE OF MILK WITH OTHER FOODS.

Milk is often spoken of as a "perfect food," but there are three reasons why it can not be considered a perfect food for adults. (1) The proportion of water is so large that great quantities would have to be consumed per day (from 4 to 5 quarts) in order to obtain the necessary nutrients. (2) The protein is present in rather large quantities as compared with the fats and carbohydrates. Thus the milk necessary to furnish the 0.28 pound of protein, estimated to be required by a laboring man per day, would only yield 2,700 calories fuel value, while milk in sufficient quantity to furnish the 3,500 calories fuel value estimated to be required would yield 0.35 pound of protein. (3) It is a well-recognized fact that the digestive functions require that the food shall have a certain bulk other than water. Cattle can not generally be maintained in health upon a condensed ration such as grain; they seem

CHART I.—COMPOSITION OF MILK AND OTHER FOOD MATERIALS.

Nutritive ingredients, refuse, and fuel value.

Nutrients.

- ▩ Protein.
- ▤ Fats.
- ▨ Carbohydrates.
- ▧ Mineral matters.

Non-nutrients.

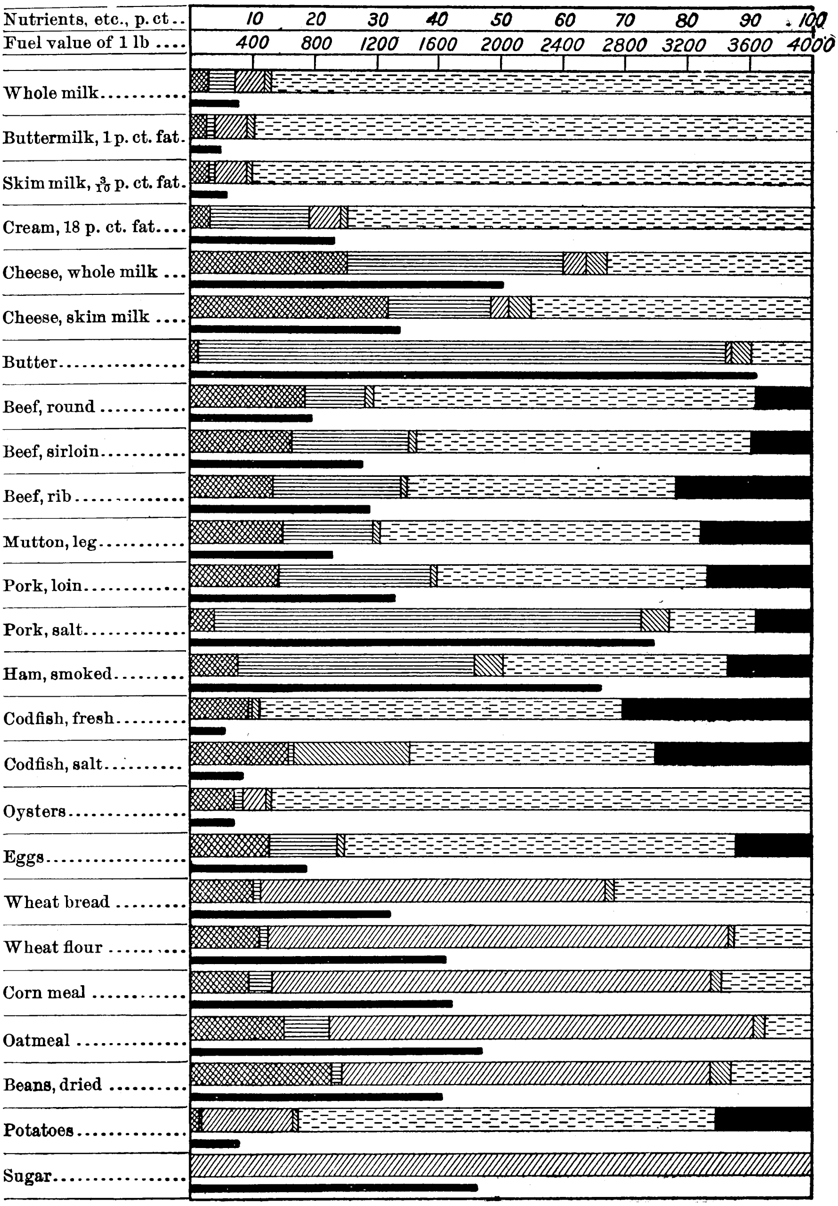
- ┅ Water.
- ■ Refuse.

Fuel value.

- ▬ Calories.

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, }



to require a certain distention of the stomach, such as is brought about by the fiber (cellulose or woody matter) of grass or hay. In like manner it seems desirable that man should have a certain amount of material in his food to produce distention or to promote peristaltic action of the intestines, or for other purposes not well understood.

While milk alone can not be considered as a perfect diet, at least for healthy adults, it is of especial value as a food for invalids. It is, as a rule, easily taken, easily digested, does not irritate the alimentary canal, and the diet is more readily under the control of the physician both as regards quantity and quality than when other foods are used. Life can be supported for a long period on milk alone.

Milk is a perfect food for the young of the species of animal producing the milk. Cows' milk is a perfect food for the new-born calf. Human milk is a perfect food for the new born babe. Cows' milk is not, however, a perfect food for the human infant. One reason is that, as will be seen by reference to the table on p. 6, woman's milk contains less protein and more milk sugar. Numerous explanations of the defects of cows' milk for the nutrition of infants are current, but the subject is hardly well enough understood to-day to warrant its discussion here.

While milk can not in itself be called a perfect food for adults, it is unusually well adapted for use in connection with other foods, either in its uncooked form or incorporated and cooked with other materials. In many culinary products it can be used instead of water. Bread mixed with milk should contain about one-tenth more protein and one-twentieth more fuel than bread mixed with water. The same thing is true of rolls, buns, etc. Milk is very generally used in many kinds of cake and pastry and in custards. Where desirable from economical reasons, or as a means of increasing the proportional amount of protein in a diet, skim milk can be advantageously substituted for whole milk.

A very interesting experiment was recently made at the University of Maine, in cooperation with this Department,[1] in which the effect of a limited and an unlimited amount of milk was tried at the university boarding house or "commons." From these studies the following conclusions were drawn: (1) The dietaries in which milk was more abundantly supplied were somewhat less costly than the others and at the same time were fully as acceptable; (2) the increased consumption of milk had the effect of materially increasing the proportion of protein in the diet; (3) the milk actually supplied the place of other food materials and did not, as many suppose, simply furnish an additional amount of food without diminishing the quantity of other materials; (4) the results indicate that milk should not be regarded as a luxury, but as an economical article of diet which families of moderate income may freely purchase as a probable means of improving the character of the diet and of cheapening the cost of the supply of animal foods.

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[1] See U. S. Dept. Agr., Office of Experiment Stations Bul. 37.

NUTRITIVE VALUE OF MILK AND ITS COST.

A very valuable investigation on this subject has been lately made by the New Jersey Experiment Station in cooperation with the Department of Agriculture. Samples of milk as sold from the milk carts and by retail dealers at their stores in the cities of New Brunswick, Newark, Trenton, and Camden were collected by representatives of the station and analyzed. The price per quart in each case was noted. In a large number of instances inquiries were made among the dairies as to breed, feeding, and care of the cows. The handling of the milk by the dairymen and the wholesale and retail dealers was also noted. The following statements are based on the report of this investigation by Professor Voorhees,[1] of the New Jersey Agricultural Experiment Station.

RELATIVE COST PER POUND OF NUTRIENTS.

The fact that milk varies in composition shows at once that at a uniform price per quart there is a wide variation in the cost of the nutrients to the consumer. It will be observed from a study of the average composition of milk that as the total solids in the milk increase the percentage of fat is increased in greater proportion than the solids not fat. The consumer not only secures his total solids in the richer milk at a lower cost per pound, but also obtains a product which is very much richer in material to supply the body with heat and muscular force. The facts regarding the variation in the cost and quality of the nutrients contained in milk show very clearly that the standard now in use as the basis of sale, viz, the quart, is illogical and unfair both to the consumer and to the producer of good milk. The dairyman who takes his milk to the creamery usually sells it on the basis of the amount of fat it contains, that is, the amount of fat is the measure of value. In like manner in the retailing of milk the fat content should be taken as a standard rather than the quart. For instance, the average fat content of a large number of milks examined for which at the average price of 8 cents per quart $4 per hundred were paid, was, in round numbers, 4 per cent, or 4 pounds of fat per hundred pounds of milk. If milk containing 4 per cent of fat is worth 8 cents per quart, milk containing 3.5 per cent would, on the same basis, be worth 7 cents per quart, 3 per cent milk only 6 cents per quart, and 5 per cent milk 10 cents per quart. If the fat content standard were adopted the consumer would be protected in the sense that he would receive just what he paid for, and the producer of high quality product the advantage of a higher price, which fairly belongs to him, because of the greater cost of producing milk of a better quality. Inasmuch as this method of purchasing milk by actual composition is now used in many creameries with entire satisfaction both to the seller and the buyer, it should be

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 35.

entirely practicable under present conditions for even the smaller producers and dealers to guarantee a product containing a reasonably definite content of fat. Instruments are available for testing the fat content of milk which are inexpensive and simple in operation, and the chief causes of variation in the quality of milk under improved methods of feeding and management are well known and under the control of the dairyman. It remains for the more intelligent consumers and producers alike to demand that the system be adopted.

The use of the fat content as a standard, as above suggested, is the more reasonable, because (1) the fat is the most variable ingredient; (2) a milk rich in fat is generally more apt to be rich in other nutrients, and vice versa; and (3) the most common adulterations of milk reduce the proportion of fat either by skimming or by adding water.

On the other hand, the actual value of milk for nourishment does not depend wholly or chiefly upon the amount of fat. The protein and sugar are of equal importance. Indeed, in one respect the protein is the most valuable of all because it is the nutriment most apt to be deficient in our ordinary food. On this last account, indeed, the fat is of less consequence from the standpoint of general nutritive value than the protein.

COMPARISON OF MILK AND OTHER FOOD MATERIALS—COST OF NUTRIENTS.

In considering the relative values of any two food materials there are two principal factors to be taken into account—the protein content, and the fuel value. A definite comparison of the relative pecuniary economy of two or more foods must be made on the basis of the relative cost of the protein content and also on that of the fuel value. Between these two bases we can have no fixed ratio. The following table shows the amount of whole milk, or of skim milk, necessary to furnish the protein and energy equivalent to that contained in one pound of each of a number of different food materials:

Cost of nutrients in milk as compared with other food materials.

Food materials.	Whole milk.		Skim milk.	
	Amount.	Cost at 6 cents per quart.	Amount.	Cost at 3 cents per quart.
One pound of—				
Beef—	*Quarts.*	*Cents.*	*Quarts.*	*Cents.*
Round furnishes protein equivalent to	2. 7	16	2. 7	8
Round furnishes fuel value equivalent to	1. 3	8	2. 6	8
Shoulder clod furnishes protein equivalent to	2. 9	17	2. 9	9
Shoulder clod furnishes fuel value equivalent to	1. 2	7	2. 5	7
Sirloin furnishes protein equivalent to	2. 4	14	2. 4	7
Sirloin furnishes fuel value equivalent to	1. 6	10	3. 2	10
Mutton loin furnishes protein equivalent to	2. 0	12	2. 0	6
Mutton loin furnishes fuel value equivalent to	2. 2	13	4. 4	13
Pork—				
Fresh, furnishes protein equivalent to	2. 1	13	2. 1	6
Fresh, furnishes fuel value equivalent to	2. 1	13	4. 1	12
Salt: Fat furnishes protein equivalent to	2. 3	2	. 3	1
Salt: Fat furnishes fuel value equivalent to	5. 7	34	11. 3	34
Smoked ham furnishes protein equivalent to	2. 0	12	2. 0	6
Smoked ham furnishes fuel value equivalent to	2. 5	15	5. 0	15

Cost of nutrients in milk as compared with other food materials—Continued.

Food materials.	Whole milk.		Skim milk.	
	Amount.	Cost at 6 cents per quart.	Amount.	Cost at 3 cents per quart.
One pound of—	*Quarts.*	*Cents.*	*Quarts.*	*Cents.*
Chicken furnishes protein equivalent to	2.2	13	2.2	7
Chicken furnishes fuel value equivalent to	.5	3	1.0	3
Salt cod furnishes protein equivalent to	2.4	14	2.4	7
Salt cod furnishes fuel value equivalent to	.5	3	1.0	3
Oysters, "solid," furnishes protein equivalent to	1.9	11	1.9	6
Oysters, "solid," furnishes fuel value equivalent to	.4	2	.7	2
Wheat flour furnishes protein equivalent to	1.7	10	1.7	5
Wheat flour furnishes fuel value equivalent to	2.5	15	5.0	15
Wheat bread furnishes protein equivalent to	1.4	8	1.4	4
Wheat bread furnishes fuel value equivalent to	1.9	11	3.7	11
Beans, dried, furnishes protein equivalent to	3.3	20	3.3	10
Beans, dried, furnishes fuel value equivalent to	2.4	14	4.8	14
Potatoes furnishes protein equivalent to	.3	2	.3	1
Potatoes furnishes fuel value equivalent to	.5	3	1.0	3
Turnips furnishes protein equivalent to	.2	1	.2	1
Turnips furnishes fuel value equivalent to	.2	1	.4	1

The quantity of milk in the above table is given in quarts and tenths of a quart. It is probable that 6 cents a quart for whole milk and 3 cents a quart for skim milk, the prices assumed in the table, represent as nearly the average retail prices paid by consumers as any rate that could be taken. Of course many pay much more and others much less than 6 cents a quart for whole milk. For those who pay more or less, the actual cost of the milk equivalent to the protein or fuel value of 1 pound of any of the foods enumerated is easily calculated by multiplying the equivalent number of quarts of milk by the price paid per quart. This table shows that 1 pound of sirloin steak (costing from 16 to 22 cents) contains the same amount of protein that would be obtained in 2.4 quarts of whole milk costing, at 6 cents per quart, 14 cents, and the same fuel value that would be obtained in 1.6 quarts of whole milk costing 10 cents. Skim milk would furnish the energy at the same price as the whole milk, but the protein would cost only half as much as when furnished by whole milk.

Whole milk and skim milk contain practically the same amount of protein, but the former costs at least twice as much per quart. As a source of protein, therefore, skim milk is twice as economical as whole milk. On the other hand, the fuel value of skim milk is practically but one-half that of whole milk, so that a given amount of energy is furnished for the same price, either in whole milk or skim milk.

From the above table it will be seen that 16 cents' worth of whole milk or 8 cents' worth of skim milk would furnish the same amount of protein as would be obtained in 1 pound of beef round, while the corresponding fuel value would be obtained in 8 cents' worth of either kind of milk. Compared with round steak at from 12 to 16 cents a pound the whole milk certainly is as economical and skim milk a more economical food material. The same point is illustrated with other animal foods, especially with those whose chief value lies in their content of protein. Milk can not, however, be substituted in place of an essentially energy-yielding food, such as salt fat pork.

The cereal foods, wheat flour and other flours, bread, crackers, etc., as also beans and peas, are a much cheaper source of nutrients than milk. It is, however, impracticable to live altogether on these foods even if economical reasons should make it desirable. Some other foods are necessary, and among these milk is one of the best and as a rule one of the most economical.

Chart II (p. 23) shows the quantities of nutrients obtained in 10 cents' worth of whole and of skim milk, at different prices per quart, as compared with 10 cents' worth of other food materials at common prices.

DAILY MENUS CONTAINING MILK.

DIETARY STANDARDS.

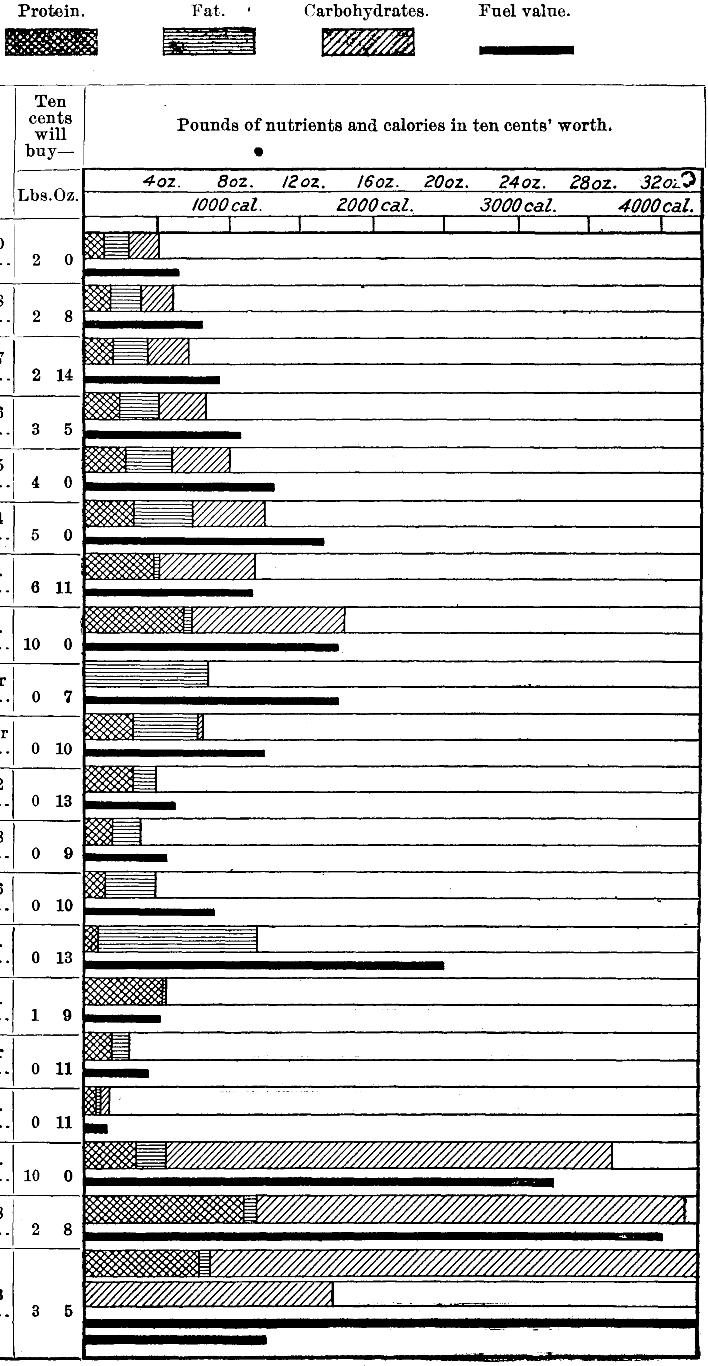
In order that food shall be adapted to the needs of the body, it should have the protein and fuel ingredients in the proper proportions. It has been assumed from the most accurate observations available that an average man doing an ordinary amount of manual labor—a carpenter or mason, for instance—requires in his daily food about 0.28 of a pound of protein, and in addition enough fats and carbohydrates to make the fuel value 3,500 calories. Men in professional life, with less muscular work, generally need less. Standards prepared for men of this class call for 0.22 to 0.25 of a pound of protein and from 2,700 to 3,000 calories of energy. Various combinations of foods for daily dietaries on either of the bases noted above may be made by using calculations based on the chemical composition of various foods. A few such calculations are here given in the form of daily menus which give the actual amounts of different food materials thus required by a family equivalent to four men at ordinary manual labor.

Such a family might, for example, consist of a mechanic and wife with four children—two girls of 12 and 6 and two boys of 10 and 8 years, respectively. Here it would be assumed that the man was engaged at moderately hard manual work. In like manner, the family might consist of a man of sedentary occupation—a bookkeeper, for example—his wife, three children of 11, 9, and 6 years, and a female servant. Estimated in the same way, a day laborer's family, consisting of a father and mother with three children of 1, 3, and 6 years of age, would be equivalent to three men at active work, and would require three-fourths of the quantities in the following menus.

The equivalent of any family in terms of one adult man at moderate work one day can be easily calculated by the use of the following factors, which are based in part upon experimental data and in part upon arbitrary assumption. While these factors do not represent the proportional amount consumed by every child of a given age, they are

CHART II.—PECUNIARY ECONOMY OF MILK AND OTHER FOODS.

Amounts of actual nutrients obtained in different food materials for ten cents.



Food material.	Ten cents will buy— Lbs.	Oz.
Whole milk, 10 cts. per qt	2	0
Whole milk, 8 cts. per qt	2	8
Whole milk, 7 cts. per qt	2	14
Whole milk, 6 cts. per qt	3	5
Whole milk, 5 cts. per qt	4	0
Whole milk, 4 cts. per qt	5	0
Skim milk, 3 cts. per qt	6	11
Skim milk, 2 cts. per qt	10	0
Butter, 24 cts. per lb	0	7
Cheese, 16 cts. per lb	0	10
Beef, round, 12 cts. per lb	0	13
Beef, sirloin, 18 cts. per lb	0	9
Mutton, loin, 16 cts. per lb	0	10
Pork, salt, 12 cts. per lb	0	13
Cod, salt, 6 cts. per lb	1	9
Eggs, 22 cts. per doz	0	11
Oysters, 30 cts. per qt	0	11
Potatoes, 60 cts. per bu	10	0
Beans, dried, 8 cts. per qt	2	8
Wheat flour, 3 cts. per lb	3	5

probably on the whole as nearly accurate as can be obtained without considerable more experimental data. The factors are as follows:

A woman requires about 0.8 the food of a man.[1]
A boy 14 to 16 years old requires about 0.8 the food of a man.
A girl 14 to 16 years old requires about 0.7 the food of a man.
A child 10 to 13 years old requires about 0.6 the food of a man
A child 6 to 9 years old requires about 0.5 the food of a man.
A child 3 to 5 years old requires about 0.4 the food of a man.
A child under 2 years old requires about 0.3 the food of a man.

THE MENUS.

To illustrate the ways in which milk may be combined with other food materials to form daily dietaries with about the amount of protein and the fuel value called for by the standard for men at moderate muscular work, a few menus are given in the following pages. These menus are intended to show how approximately the same nutritive value may be obtained by food combinations differing widely as regards the number, kind, and price of the food materials used to make up three daily meals. They also illustrate how the cost of the daily menu may vary greatly with the kind and variety of materials purchased though the nutritive value remains the same. These sample menus should not, however, be regarded as in any sense "models" to be followed in actual practice. The daily menus for any family will necessarily vary with the market supply, the season, and the relative expensiveness of different food materials, as well as with the tastes and purse of the consumers. The point to which we wish here to draw especial attention is that the prudent buyer of foods for family consumption can not afford to wholly neglect their nutritive value in making such purchases.

With reference to the following daily menus several points must be definitely borne in mind. (1) The amounts given represent about what would be called for in a family equivalent to four full-grown men at ordinary manual labor, such as machinists, carpenters, mill-workers, farmers, truckmen, etc., according to the usually accepted standards. Sedentary people would require somewhat less than the amounts here given. (2) Children as a rule may be considered as having "moderate muscular exercise," and it may easily be understood that the 14-year-old boy eats as much as his father who is engaged in business or professional occupation, both requiring, according to the tentative standard, 0.8 of the food needed by a man with moderate muscular work. (3) It is not assumed that any housewife will find it convenient to follow exactly the proportions suggested in the menus. The purpose is to

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[1] These comparisons are with a man at moderate muscular work. A man without any considerable muscular exercise might require only the eight-tenths here allotted to a woman engaged in ordinary household duties, or a boy from 14 to 16 years old at school.

show her about what amounts and proportions of food materials would give the required nutrients.

Menu I calls for a daily expenditure of 41½ cents per person, the heaviest items of expense therein being the bacon and eggs, the sirup, the lamb, and the chicken croquettes. It is, perhaps, more elaborate and costly than many families would desire. The detailed menu is as follows:

MENU I.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
	Lbs.	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Breakfast.					
Cereal, oatmeal	0	3	2½	0.029	350
Milk		6		.012	64
Sugar		2		....	232
Bacon		8	8	.046	1,390
Eggs, 4		8	8	.065	322
Baked potatoes	1	0	1½	.018	325
Buckwheat cakes, prepared buckwheat		8	4	.034	780
Maple sirup		4	3	....	327
Bread		8	2	.048	603
Butter[1]		1½	3	....	225
Coffee[2]	....		3½	.010	410
Total	....		35½	.262	5,028
Dinner.					
Bouillon	1	0	15	.020	45
Roast lamb, leg	1	8	30	.228	1,282
Mashed potatoes	1	0	2	.018	325
Cucumbers	1	0	3	.009	52
Green peas, shelled	1	8	6	.072	382
Macaroni		4	4	.029	410
Cheese		3	3	.049	369
Fruit pudding:					
1 cup flour		4	9	.028	410
Sugar		4		....	465
1 egg		2		.016	81
½ cup milk		4		.008	81
1 cup fruit		8		.013	817
Foamy sauce for pudding:					
1 egg		2	5	.016	81
½ cup milk		4		.010	102
½ cup sugar		4		....	465
Bread		6	1½	.036	452
Butter		1	2	....	217
Tea or coffee	....		3½	.010	410
Total	....		84	.562	6,446
Supper or lunch.					
Chicken croquettes:					
Chicken meat		8	18	.114	250
Flour		1		.007	103
Onions		1		.001	13
1 egg		2		.016	81
Bread		2		.012	151
Lettuce		8	3	.005	42
Bread		8	2	.048	603
Butter		1½	3	....	325
Cake		6	3	.026	619
Berries	1	0	8	.010	175
Chocolate or cocoa, with milk and sugar, cream		1½	5	.030	625
Total	....		42	.269	2,987
Total per day	....		161½	1.093	14,461
Total for one man	....		40	.270	3,615

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[1] The figures given for butter in these menus are based on the percentage composition as given in U. S. Dept. Agr., Office of Experiment Stations, Bul. 28. This differs slightly from that given on p. 15, which is a recently made average of a larger number of analyses.

[2] The values given under coffee include in all cases the milk and cream and the sugar that would probably be used therein.

A family equivalent to four men having little muscular exercise—i. e., men with sedentary occupation—would require but about 0.8 the quantities indicated in the above menu. It would be very doubtful, however, if they would eat proportionally less of every food material. It would, in fact, be more probable that the amounts of meat, fish, eggs, potatoes, and bread eaten would be reduced to a much greater amount than fruit, pastry, coffee, etc.

Menu I modified so as to furnish the amount of nutrients required by a family equivalent to four adults with little muscular exercise would be as follows:

Menu I modified for a family equivalent to four adults with little exercise.

Breakfast.—Cereal, 2½ ounces; milk, 6 ounces; sugar, 2 ounces; bacon, 6 ounces; potatoes, 12 ounces; buckwheat, prepared, 6 ounces; maple sirup, 3 ounces; other items as in Menu I.

Dinner.—Roast lamb, leg, 1 pound 4 ounces; green peas, shelled, 1 pound 4 ounces; macaroni, 3 ounces; cheese, 2 ounces; other items as in Menu I.

Supper.—Chicken croquettes, chicken meat, 6 ounces; flour, ¾ ounce; onion, ¾ ounce; butter, 1½ ounces; lettuce, 6 ounces; bread, 6 ounces; other items as in Menu I.

By reducing the materials in this menu to the quantities noted above, the average cost of the three meals would be about 37 cents per man, and would furnish not far from 0.24 pound protein and a fuel value of about 3,090 calories to each person.

In Menu II the day's food costs 29½ cents. The largest single item is the meat for dinner. The one giving the least food return in actual nutriment for its cost is the fruit. The amount of protein furnished by the breakfast and supper is small as compared with the fuel value of the food. Consequently, for dinner some meat is used which will furnish considerable protein, but not an excessive amount of fuel ingredients, otherwise the ration will be one-sided Beef, veal, and fish are meats giving a large amount of protein as compared with the fuel value, and it is from one of these classes that the meat is to be selected. The choice might fall on a knuckle of veal for a stew, fried fresh cod, or some lean cut of beef. In this menu the shoulder of beef is chosen. This, when properly boiled, gives a meat very tender, juicy, and palatable; when improperly cooked it adds more odium to the very unjustly despised "beef stew" and "pot roast." If desired, a veal shoulder roast may be substituted. It would require 2½ pounds of this to replace the beef shoulder, and would cost about 30 cents at the rates here assumed. This would make the cost per person about 31 cents for the day.

The details of this menu are as follows:

MENU II.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Bananas, 4	0	12	6	0.005	217
Cereal, oatmeal		2	3	.019	232
Milk		8		.016	162
Sugar		2		....	232
Ham (in omelet)		2	3	.016	207
Eggs, 4		8	9	.065	322
Bread	1	0	4	.096	1,206
Butter		2½	5	....	542
Coffee	....		5	.015	615
Total	....		35	.232	3,735
Dinner.					
Boiled beef, shoulder	2	0	24	.386	1,670
Potatoes	1	12	2	.031	569
Green peas[1]	1	12	6	.039	350
Butter		1¾		....	380
Bread pudding:					
Bread		4	10	.024	301
Milk	1	8		.049	487
1 egg		2		.016	81
Sugar		3		....	350
Butter		½		....	108
Bread		12	3	.071	904
Butter		1½	3	....	325
Cheese		2	2	.032	246
Coffee	....		5	.015	615
Total	....		55	.663	6,386
Supper or lunch.					
Mutton chops, shoulder		10	10	.084	682
Fried potatoes:					
Potatoes		10	2	.011	203
Lard		½		....	132
Rolls:					
3 cups flour		12	8	.085	1,230
1 egg		2		.016	81
Butter		1		....	217
Stewed apples:					
Apples		12	3	.003	191
Sugar		3		....	350
Cake		4	2	.017	412
Tea or coffee	....		3½	.010	410
Total	....		28½	.226	3,908
Total per day	....		118½	1.121	14,029
Total for one man	....		29½	.280	3,507

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[1] Weight with pods.

It is customary in very many families to make some additional preparation for the Sunday table. In the following menu is given a rather more elaborate and varied diet, such as might be prepared for Sunday. The estimated cost per man per day of this ration is 46 cents, the chief items being the fruit, chicken, and ice cream. The details of this menu are as follows:

MENU III.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Oranges, 4	1	8	10	0.009	480
Cereals, wheat preparation		4	2	.031	421
Milk		4		.008	81
Sugar		2		....	234
Fried perch:					
Perch	1	0	8	.072	195
Lard		¼		....	66
Oyster fritters:					
½ pint oysters		8	11	.031	117
½ pint milk		8		.016	162
1 cup flour		4		.028	410
Creamed potatoes:					
1 pint potatoes	1	0	5	.018	325
½ pint milk		8		.016	162
Butter		1		....	219
Corn-meal muffins:					
1 cup corn meal		6	4½	.033	621
½ cup flour		2		.014	205
Sugar		1		....	117
1 egg		2		.016	81
1¼ cups milk		10		.021	203
Butter		2	4	....	434
Coffee or tea	....		5	.015	615
Total	....		49½	.328	5,148
Dinner.					
Roast chicken:					
Chicken	2	8	40	.370	812
Bread		4		.024	301
Butter		½		....	108
Onion		1		.001	13
Rice croquettes:					
Rice		4	4	.020	407
1 egg		2		.016	81
Sugar		½		....	58
Mashed potatoes		8	1	.009	162
Baked sweet potatoes		8	1	.007	240
Boiled onions		6	1	.006	79
Cranberry sauce:					
Cranberries		8	4	.003	113
Sugar		4		....	465
Celery		8	2	.007	43
Bread		4	1	.024	301
Butter		1	2	....	219
Ice cream, 1 pint	1	0	25	.025	910
Cake		4	2	.017	412
Fruit	1	0	5	.010	160
Coffee or tea	....		7	.020	820
Total	....		95	.559	5,704
Supper or lunch.					
Potato salad:					
Potato	1	0	2	.018	325
Onion		1		.001	13
Oil		¼		....	66
Cold tongue		8	18	.108	690
Bread		12	3	.071	904
Butter		2	4	....	434
Cheese		2	2	.032	246
Fruit		12	6	.005	217
Coffee or tea	....		3½	.010	410
Total	....		38½	.245	3,305
Total per day	....		183	1.132	14,157
Total for one man	....		46	.280	3,540

In the fourth menu the daily food costs about 26 cents per man. Skim milk is introduced as a beverage for supper instead of tea or coffee. In this way a ration, which would otherwise be slightly deficient in protein, is supplied with the required amount with the addition of but very little of fats and carbohydrates, i. e., fuel ingredients. It will be found that the general tendency in the diet, especially where there is a considerable variety of pastry and desserts, is toward too large a proportion of fats and carbohydrates as compared with the protein. This can be obviated either by the use of more and leaner meats, fish, beans, skim milk or buttermilk, and cheese.

MENU IV.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Baked apples	2	0	2	0.008	510
Boiled hominy		8	4½	.041	823
Milk		10		.020	202
Sugar		3		....	350
Broiled sirloin		10	11	.099	650
Potatoes		8	1	.009	162
Muffins:					
1 egg		4	5	.032	162
2 cups flour		8		.057	820
Butter		2	4	....	435
Coffee	....		3½	.010	410
Total	....		31	.276	4,524
Dinner.					
Tomato soup	2	0	6	.036	370
Veal stew, shoulder	2	0	20	.332	1,350
Potatoes	3	0	4½	.054	975
Apple dumpling:					
1 egg		2	8	.016	81
4 apples	1	8		.006	382
½ cup lard		4		....	1,055
1 cup flour		4		.028	410
Sauce for dumpling:					
Butter		1	3	....	217
Sugar		4		....	465
Bread		12	3	.071	904
Butter		1	2	....	217
Coffee or tea	....		3½	.010	410
Total	....		50	.553	6,836
Supper or lunch.					
Dried canned corned beef		8	6	.142	560
Potato croquette		8	1	.009	162
Biscuit		12	4	.070	1,297
Butter		1½	3	....	325
Oranges, 4	1	4	7	.007	400
Skim milk	1	6	2	.046	234
Total	....		23	.274	2,978
Total for day	....		104	1.103	14,338
Total for one man	....		26	.275	3,585

In illustration of what was said above concerning the tendency of a varied ration to contain too large a proportion of fuel ingredients (fats, starch, sugar, etc.) as compared with the amount of protein, the following menu may be cited (No. 5). The changes necessary to obtain the desired proportions are illustrated in menu No. 6.

It is, of course, not important that each meal, or the total food of each individual day, should have just the right amount of nutrients, or that the proportions of protein and fuel ingredients should be exactly correct so as to make the meal or day's diet well balanced. The body is continually storing nutritive materials and using them. It is not dependent any day upon the food eaten that particular day. Hence an excess one day may be made up by a deficiency the next or vice versa. Healthful nourishment requires simply that the nutrients as a whole, during longer or shorter periods, should be fitted to the actual needs of the body for use.

MENU V.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Bananas, 4 (or grapes, 1 pound)	1	4	6½	0.009	362
Breakfast cereal		4	3	.031	421
Milk		6		.012	122
Sugar		2		....	232
Mutton chops	1	4	20	.165	1,812
Potatoes	1	0	1½	.018	325
Butter		3	6	....	653
Rolls		12	4	.077	1,148
Coffee	....		3½	.010	410
Total	....		44½	.322	5,485
Dinner.					
Tomato soup	2	0	12	.036	370
Roast pork	2	8	32	.353	3,350
Potatoes	1	4	1½	.022	406
Turnips		8	1	.005	67
Tapioca pudding:					
Tapioca		3	7	.001	310
Apples	1	0		.004	255
Sugar		2		....	232
Cream		4		.006	228
Coffee	....		3½	.010	410
Total	....		57	.437	5,628
Supper.					
Milk toast:					
Milk	2	0	18	.066	650
Bread	1	2		.107	1,356
Butter		4		....	869
Cornstarch		2		....	228
Sliced cold pork		8	6	.071	670
Fried potatoes:					
Potatoes		8	1	.009	162
Lard		½		....	132
Cake		6	4	.026	619
Coffee or tea	....		3½	.010	410
Total	....		32½	.289	5,096
Total for day	....		134	1.048	16,209
Total for one man	....		33½	.262	4,052

MENU VI.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel Value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Bananas, 4 (or grapes, 1 pound)	1	4	6½	0.009	362
Breakfast cereal		4	3	.031	421
Milk		8		.016	162
Sugar		1½		....	175
Veal cutlets	1	0	20	.200	775
Potatoes	1	0	1½	.018	325
Butter		3	6	....	653
Rolls		12	4	.077	1,148
Coffee	....		3½	.010	410
Total	....		44½	.361	4,431
Dinner.					
Pea soup:					
Split peas		8	5	.121	820
Butter		1		....	217
Flour		1		.007	103
Roast beef, chuck rib	1	12	21	.275	1,260
Potatoes	1	4	1½	.022	406
Turnips		8	1	.005	67
Cottage pudding with lemon sauce:					
1 cup flour		4	6½	.028	410
Sugar		3		....	350
Butter		1½		....	325
1 cup milk		8		.016	162
Sugar		4	2½	....	465
Cornstarch		1½		....	172
Butter		½		....	108
Coffee	....		3½	.010	410
Total	....		41	.484	5,275
Supper.					
Milk toast:					
Milk	2	0	18	.066	650
Bread	1	2		.107	1,356
Butter		4		....	869
Cornstarch		2		....	228
Canned salmon		8	8	.098	340
Fried potatoes:					
Potatoes		8	1	.009	162
Lard		½		....	132
Cake		6	4	.026	619
Coffee or tea	....		3½	.010	410
Total	....		34½	.316	4,766
Total for day	....		120	1.161	14,472
Total for one man	....		30	.290	3,618

In Menu VII the cost per day amounts to 21 cents, the protein to 0.28½ pound, and the fuel value to 3,410 calories. This ration is slightly deficient in fuel ingredients—those which supply the body with heat and muscular forces—and would best precede or follow one in which fatter meats and more pastry were used, such, for example, as Menu V. If desired, the Indian pudding could be made with whole milk instead of skim milk, when the fuel value per person would be increased to 3,500 calories without affecting the amount of protein, while the cost per man would be increased about 1 cent. In this case the ration becomes well balanced in itself.

MENU VII.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Oatmeal	0	2	2	0.019	232
Milk		6½		.012	122
Sugar		1		....	175
Fresh pork sausage	1	8	18	.192	3,255
Potatoes		12	1	.013	244
Bread		12	3	.071	904
Butter		2	4	....	434
Coffee	....		3½	.010	410
Total	....		31½	.317	5,776
Dinner.					
Beef, for stew	2	8	15	.347	1,900
Potatoes	1	8	2	.027	487
Turnips		8	1	.005	67
Bread		8	2	.048	603
Butter		1	2	....	217
Indian pudding:					
Corn meal		4	6	.022	414
Molasses		4		.007	329
Butter		½		....	108
Skim milk	2	0		.068	340
Coffee	....		3½	.010	410
Total	....		31½	.534	4,875
Supper.					
Corned-beef hash:					
Corned beef, canned		8	6	.142	560
Potatoes		8	1	.009	162
Bread		12	3	.071	904
Butter		2	4	....	434
Apples		12	1	.003	191
Milk	2	0	6	.066	725
Total	....		21	.291	2,976
Total per day	....		84	1.142	13,627
Total for one man	....		21	.285	3,407

In these menus the amount of milk has, as a rule, been taken as representing somewhere near the average consumption. The amount of milk can be increased in any of the menus given above either by substituting it to some extent for coffee or tea, or by using more milk and smaller quantities of meats, butter, or eggs. Roughly speaking, 1 quart of whole milk could be substituted for half a pound of meat or eggs and the amount of nutrients would be the same, while a pint of milk would give as large a fuel value as 1½ ounces of butter, and in addition considerable protein not furnished by the latter.

This replacement of meats by milk is illustrated in the following menu, in which a diet with a rather small quantity of milk is so changed as to include a much larger amount. Thus for breakfast in the modified ration a pint and a half of milk is made to take the place of half a pound of broiled steak. For dinner a quart of skim milk (or buttermilk) is called for, or a glass for each person unless some of it is used in the cooking. At the same time, 4 ounces less roast pork is required. In the same way a glass of whole milk is allowed each person for supper, or the bread can be made into milk toast and the most of the extra milk used in this way. This allows the canned salmon to be reduced 6 ounces.

MENU VIII.—*For family equivalent to 4 men at moderate exercise.*

Food materials.	Weight of food.			
	With small amount of milk.		With large amount of milk.	
Breakfast.	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*
Bananas, apples, or pears	0	12	0	12
Wheat preparation		4		4
Milk		8		8
Sugar		2		2
Broiled sirloin steak	1	4		12
Baked potatoes	1	8	1	8
Hot rolls	1	0	1	0
Butter		2½		2½
Extra milk	....		1	8
Dinner.				
Tomato soup	1	12	1	12
Roast pork	1	12	1	8
Mashed potatoes	1	4	1	4
Turnips		8		8
Apple fritters:				
Apples		8		8
Dinner—Continued.	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*
Apple fritters—Continued.				
Flour		2		2
1 egg		2		2
Lard		1½		1½
Bread		8		8
Butter		2		2
Extra skim milk	....		2	0
Supper.				
Canned salmon	1	6	1	0
Potatoes		12		12
Bread		8		8
Butter		2		2
Berries, canned or fresh		8		8
Extra milk	....		2	0

Cost, protein, and fuel value of the above.

	Cost.	Protein.	Fuel value.
With small amount of milk.	*Cents.*	*Pounds.*	*Calories.*
Breakfast	48	0.39	5,300
Dinner	51	.39	5,800
Supper or lunch	33½	.34	3,200
Total per day	132½	1.12	14,300
Total for one man	33	.28	3,575
With large amount of milk.			
Breakfast	43	.36	5,270
Dinner	47½	.41	5,400
Supper or lunch	34½	.34	3,600
Total per day	125	1.11	14,270
Total for one man	31	.28	3,567

Menus IX, X, and XI, following, are intended to illustrate how nourishing food can be procured in sufficient quantities and moderate variety at a cost of not over 16 cents per day. The cost to the farmer would be much less, since these menus call for considerable amounts of milk, which is hardly worth more than one-half or one-third as much on the farm as it costs in the towns and cities. Coffee has not always been indicated, but can be introduced for any meal at a cost of from ½ to 1½ cents per cup, according to how much coffee is used in making the infusion and how much sugar, milk, and cream are added.

MENU IX.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Corn meal, in mush or cake	0	5	1	0.022	414
Milk		6	1	.012	64
Sugar		2	½		232
Toast		10	2½	.059	753
Butter (24 cents per pound)		2	3		434
Total			8	.093	1,897
Dinner.					
Beef roll (for roasting)	3	0	15	.417	2,280
Potatoes	1	8	2	.026	488
Beets		8	1	.007	85
Bread		10	2½	.059	753
Butter		2	3		434
Total			23½	.509	4,040
Supper.					
Beans, baked	2	0	6	.446	3,180
Pork		12	6	.012	2,556
Potatoes, fried	1	8	2	.026	488
Lard		2	1		537
Bread		10	2½	.059	753
Butter		2	3		434
Total			20½	.543	7,948
Total per day			20½	1.145	13,885
Total for one man			13	.285	3,471

MENU X.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Oatmeal	0	6	2	0.059	697
Skim milk, 1 pint	1	0	1½	.034	170
Sugar		2	½		232
Bread (homemade)	1	0	3	.095	1,205
Sausage		10	6	.080	1,358
Butter (24 cents per pound)		1	1½		217
Total			14½	.268	3,879
Dinner.					
Beef flank, stew	2	8	15	.430	2,988
Potatoes (60 cents per bushel)	3	0	3	.054	975
Cabbage		12	1	.013	105
Corn-meal pudding:					
Corn meal		4	½	.022	414
Skim milk, 1 quart	2	0	3	.068	340
Molasses		12	1	.020	987
Total			22½	.604	5,809
Supper.					
Beef, warmed in gravy	1	8	3	.086	598
Hot biscuit	2	0	6	.340	2,600
Butter		2	3		434
Milk, 1 quart	2	0	6	.033	325
Total			18	.259	3,957
Total per day			55	1.134	3,645
Total for one man			14	.285	3,411

MENU XI.—*For family equivalent to 4 men at moderate muscular work.*

Food materials.	Weight.		Cost.	Protein.	Fuel value.
Breakfast.	*Lbs.*	*Oz.*	*Cents.*	*Pounds.*	*Calories.*
Beef liver	1	0	6	.216	665
Hot biscuit	1	8	4½	.140	2, 595
Butter		2	3	....	434
Milk, 1 quart	2	0	6	.033	325
Coffee	....		2	.010	410
Total	....		21½	.399	4, 429
Dinner.					
Beef brisket, boiled	2	8	15	.313	3, 950
Apple pie	1	0	5	.033	1, 250
Potatoes	2	0	3	.036	650
Bread		8	1½	.048	603
Butter		1	1½	....	217
Skim milk, 1 quart	2	0	3	.033	170
Total	....		29	.463	6, 840
Supper.					
Corn meal in mush or cake	0	6	1	0. 033	621
Skim milk, 1 quart	2	0	3	.068	340
Bacon		8	8	.046	1, 390
Coffee	....		2	.010	410
Total	....		14	.157	2, 761
Total per day	....		64½	1.019	14, 030
Total for one man	....		16	.255	3, 507

DISCUSSION OF THE MENUS.

These menus attempt to give, as nearly as convenient, the range of food materials and the variety of combination which might be found in the average well-to-do household. Some of the menus are more varied and costly than others, and a few are given showing the effect of the use of more milk, and also how a diet might easily become one-sided. The quantities of the different foods used per meal will not, it is believed, be found out of proportion to each other, though of course they will not suit every family. The weights of all materials, oatmeal and other cereals, meat, vegetables, etc., are for these substances as purchased.

The calculations of the quantities of nutrients contained in the different foods is based upon the average percentage composition of these materials. Inasmuch as the fats and carbohydrates are used simply as fuel they are not shown in the menus, only the quantity of protein and the fuel value of the food being of interest.

The cost of the different food materials must of necessity be more or less of a varying quantity, depending upon the season of the year, the character of the markets, large or small, city or country, etc. Of the more important food materials the assumed price per pound is as follows: Beef loin, 18 to 25 cents; shoulder, 12 cents; round, 14 cents; chicken, 15 cents; mutton loin, 16 cents; lamb leg, 20 cents; bacon, 16 cents; sausage, 10 cents; milk, 3 cents (6 cents per quart); skim milk, 1½ cents (3 cents per quart); butter, 32 cents; cheese, 16 cents;

eggs, 16 cents (24 cents per dozen); flour and meal, 2½ to 3 cents; cereals, 5 to 8 cents; bread, 4 cents; potatoes and other vegetables, 1½ cents (90 cents per bushel); bananas, about 8 cents (20 cents per dozen); oranges, about 7 cents (25 to 40 cents per dozen); apples, 1½ cents per pound (90 cents per bushel).

It is probable that the above figures represent more nearly the average prices of the different food materials in the eastern part of the country than in the central and western portions, where meats, cereals, and many other products are somewhat cheaper. It is also to be borne in mind that by observing the markets many food materials can be purchased much cheaper than here indicated, while on the other hand there may be times when they will be much more expensive. The choice of vegetables and fruits will naturally be governed by their abundance and cost.

Another point that must not be overlooked is that the quantities, and consequently the costs, here given are for four working men; that is to say, men engaged in moderately hard muscular labor. Of course, different individuals differ greatly in their needs for food. These figures express only general averages and are based upon the best information accessible.

When a dish is indicated that must be prepared at the home the proportions of nutrients entering therein are indicated, but not of condiments, flavorings, and other accessories. Thus, if lemon sauce is indicated with a pudding no mention is made of the lemon peel, which has little food value and is simply used for the flavor it imparts. Likewise amounts of vinegar are not indicated where salads are called for. The values given under the head "tea or coffee" are obtained by figuring the actual cost and nutrients of the ingredients entering the coffee. It is calculated that for four cups of coffee 2 ounces milk, 2 ounces cream, 2 ounces sugar, and 1½ ounces coffee may be used. These would cost about 3½ cents, and would furnish 0.010 pound of protein and a fuel value of 410 calories. The coffee or tea infusion itself contains no nutrients. In the menus it has been supposed that at times the persons would want but one cup of coffee each, while at times they would desire two cups, and occasionally allowance has been made for six cups for the four persons.

The weights of meats and vegetables given in the menus are for these articles as found in the market. The meats will include, as a rule, more or less bone and the vegetables skin, which is inedible and is rejected. In estimating the nutrients in these foods allowance is made for what has been found to be about an average proportion of bone in different cuts of meat. In vegetables it is supposed that from one-fifth to one-sixth will be thrown away in preparing these for the table. The weights of the cereals are for these in the dry condition before cooking. In cooking it is understood that flour, sugar, butter, milk, etc., are measured rather than weighed, and both the quantity by bulk and by weight are as a rule recorded in the menus. It is a very difficult matter to reduce teaspoonfuls and tablespoonfuls of materials to a definite weight, and even cupfuls are a very unsatisfactory measure. In general the following averages have been taken for the weight of different measures of different foods:

One cupful=one-half pint
=one-half pound of rice, cornstarch, sugar, milk, sirup, butter.
=six ounces of hominy, corn meal, buckwheat.
=one-fourth pound of flour, wheat breakfast foods, cerealine, oatmeal.

One tablespoonful
flour, cereals, etc.=about ½ ounce.
corn meal=about ¾ ounce.
butter, starch, rice, sugar, etc.=about 1 ounce.

The weights of a cupful of the different foods may be considered as fairly accurate, but the estimated weight of one tablespoonful of different materials is one of the crudest makeshifts, depending upon the spoon, and especially upon what the person considers a spoonful.

In the menus given above only such an amount of each food material is indicated as may be completely consumed at each meal. No allowance is made for material to be left over. Of course in the ordinary household it is calculated that there will be a rather larger quantity of the different dishes prepared than will be consumed at one meal. The food remaining is either wasted or warmed up in some of the many ways with which the good cook is familiar.

The principal classes of food materials may be roughly grouped as follows as regards the proportion of protein to fuel value, beginning with those which have the largest proportion of protein and ending with those which contain little or no protein:

Foods containing a large amount of protein as compared with the fuel value.	Fish; veal; lean beef, such as shank, shoulder, canned corned, round, neck, and chuck; skim milk.
Foods containing a medium amount of protein.	Fowl; eggs; mutton leg and shoulder; beef, fatter cuts, such as rib, loin, rump, flank, and brisket; whole milk; beans and peas; mutton chuck and loin; cheese; lean pork; oatmeal and other breakfast foods; flour; bread, etc.
Foods containing little or no protein.	Vegetables and fruit; fat pork; rice; tapioca; starch; butter and other fats and oils; sugar, sirups.

In planning a well-balanced diet the following points must be considered:

(1) The use of any considerable amount of fat meat or starchy food should be offset by the use of some material rich in protein. Thus, if roast pork is to be eaten for dinner, veal, fish, or lean beef might well be eaten for breakfast or supper or both. Bean soup furnishes a considerable amount of protein, while bouillon, consommé, or tomato soup

are practically useless as a source of nutriment. Skim milk also furnishes protein, with but very little accompanying fats and carbohydrates to increase the fuel value.

(2) The use of lean meats or fish for all three meals would require the use of such foods as rice, tapioca, or cornstarch pudding, considerable quantities of sugar and butter, and more vegetables, in order to furnish sufficient fuel value.

(3) Since flour, sugar, and butter or lard enter very largely into pastries and desserts, the larger the quantities of these dishes that are consumed the larger does the fuel value tend to become as compared with the protein.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the bulletins named below are available for distribution:

No. 15. Some Destructive Potato Diseases: What They Are and How to Prevent Them. Pp. 8.
No. 16. Leguminous Plants for Green Manuring and for Feeding. Pp. 24.
No. 18. Forage Plants for the South. Pp. 30.
No. 19. Important Insecticides: Directions for Their Preparation and Use. Pp. 20.
No. 21. Barnyard Manure. Pp. 32.
No. 22. Feeding Farm Animals. Pp. 32.
No. 23. Foods: Nutritive Value and Cost. Pp. 32.
No. 24. Hog Cholera and Swine Plague. Pp. 16.
No. 25. Peanuts: Culture and Uses. Pp. 24.
No. 26. Sweet Potatoes: Culture and Uses. Pp. 30.
No. 27. Flax for Seed and Fiber. Pp. 16.
No. 28. Weeds; and How to Kill Them. Pp. 30.
No. 29. Souring of Milk, and Other Changes in Milk Products. Pp. 23.
No. 30. Grape Diseases on the Pacific Coast. Pp. 16.
No. 31. Alfalfa, or Lucern. Pp. 23.
No. 32. Silos and Silage. Pp. 31.
No. 33. Peach Growing for Market. Pp. 24.
No. 34. Meats: Composition and Cooking. Pp. 29.
No. 35. Potato Culture. Pp. 23.
No. 36. Cotton Seed and Its Products. Pp. 16.
No. 37. Kafir Corn: Characteristics, Culture, and Uses. Pp. 12.
No. 38. Spraying for Fruit Diseases. Pp. 12.
No. 39. Onion Culture. Pp. 31.
No. 40. Farm Drainage. Pp. 24.
No. 41. Fowls: Care and Feeding. Pp. 24.
No. 42. Facts About Milk. Pp. 29.
No. 43. Sewage Disposal on the Farm. Pp. 22.
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No. 51. Standard Varieties of Chickens. Pp. 48.
No. 52. The Sugar Beet. Pp. 48.
No. 53. How to Grow Mushrooms. Pp. 20.
No. 54. Some Common Birds in Their Relation to Agriculture. Pp. 40.
No. 55. The Dairy Herd: Its Formation and Management. Pp. 24.
No. 56. Experiment Station Work—I. Pp. 30.
No. 57. Butter Making on the Farm. Pp. 15.
No. 58. The Soy Bean as a Forage Crop. Pp. 24.
No. 59. Bee Keeping. Pp. 32.
No. 60. Methods of Curing Tobacco. Pp. 16.
No. 61. Asparagus Culture. Pp. 40.
No. 62. Marketing Farm Produce. Pp. 28.
No. 63. Care of Milk on the Farm. Pp. 40.
No. 64. Ducks and Geese. Pp. 48.
No. 65. Experiment Station Work—II. Pp. 32.
No. 66. Meadows and Pastures. Pp 24.
No. 67. Forestry for Farmers. Pp. 48.
No. 68. The Black Rot of the Cabbage. Pp. 22.
No. 69. Experiment Station Work—III. Pp. 32.
No. 70. The Principal Insect Enemies of the Grape. Pp. 24.
No. 71. Some Essentials of Beef Production. Pp. 24.
No. 72. Cattle Ranges of the Southwest. Pp. 32.
No. 73. Experiment Station Work—IV. Pp. 32.
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No. 75. The Grain Smuts. Pp. 20.
No. 76. Tomato Growing. Pp. 30.
No. 77. The Liming of Soils. Pp. 19.
No. 78. Experiment Station Work—V. Pp. 32.
No. 79. Experiment Station Work—VI. Pp. 28.
No. 80. The Peach Twig-borer—an Important Enemy of Stone Fruits. Pp. 16.
No. 81. Corn Culture in the South. Pp. 24.
No. 82. The Culture of Tobacco. Pp. 23.