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ECONOMY IN FEEDING THE FAMILY

I

Some Essential Facts Regarding Nutrition

By JOHN PHILLIPS STREET and E. H. JENKINS

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Economy in Feeding the Family.

This country is at war for the defense, both of our civil institutions and of our public and private property. It is a war which will be decided not, like most previous wars, by generals and armed men alone, but by the great home army of producers and savers. Its outcome depends largely on efficient production on the farm and self-denial in the home.

For the first time in our history the food supply of the country is not sufficient to meet the demands for it and those in authority call on the whole population to reduce to the utmost their use of wheat, beef, pork, sugar and animal fats.

This reduction is quite possible if done reasonably. A sudden and very radical change of diet, however, if not wisely made, may result in harm to many individuals.

It is most urgent that those who provide the food of families should have a clearer understanding of the principles of nutrition, of the amount of food necessary for health and efficiency and of the most economical methods of buying and preparing food. At present, there is much more thought, care and skill shown in selecting the rations of dairy stock and swine than in selecting the rations for human beings.

This and the following bulletins are meant to help in the diffusion of this necessary knowledge. We are aware that the same ground has been covered in many respects more fully and adequately in various books, but the fact that these are not so likely, as are our station bulletins, to reach the families of this state justifies our attempt.

There is also much work of our own station which is directly useful at this time and will here be noticed. This was one of the first of the stations to undertake the examination of foods. For many years its chemical department has been engaged in their analysis and in finding and exposing inferior and adulterated foods.

The researches of Osborne conducted here for many years on the constitution of the protein bodies and the later studies of Osborne and Mendel on animal nutrition have shown that many former assumptions regarding the role of proteins in food were far from the truth and have prepared the way for a great advance in the economy of feeding particularly in the use of proteins.

Preliminary to any comparison of different kinds of food material, a brief statement is needed regarding

The Uses of Food.

Food has two distinct uses. It builds the body up to its adult size and from day to day repairs the wear and tear which life involves; for the body is a machine which only can be repaired while it is running and when it stops can never be started.

Food is the Builder and Repairer.

The other use of food is to furnish power sufficient to run this machine at the required rate of speed. Food is the fuel which gives power to the body, just as coal is the fuel which gives power to the steam engine.

Food is the source of all the body's Energy.

The Chemical Composition of Food.

The nutriment in human food chiefly consists of proteins, carbohydrates, fats and mineral matters along with certain unidentified bodies (vitamines) which are present in very small amounts but are of great importance. Most foods also contain water and vegetable foods contain woody fiber besides, which has no nutritive value for human beings.

Proteins, of which the white of eggs, the curd of milk and gluten of wheat are types, are very complex substances, each being an aggregation of fifteen or more complex bodies (amino-acids) all of them containing nitrogen as a characteristic ingredient, so that foods which contain much protein are commonly called nitrogenous foods. Such foods are fish, eggs and meats of all kinds. Protein is also an important ingredient of milk and with fat makes up most of the substance of cheese.

Important sources of protein are poultry, fish, eggs, milk, cheese, dried beans and dried peas.

It appears that the animal proteins, poultry, fish, eggs and milk, are more valuable as food than those of vegetables and among the vegetables themselves there are great differences. For this reason *milk or meat, in moderate quantities, should make a part of the daily ration, especially that of children.*

Fats scarcely need definition. *Butter, oleomargarine, lard and vegetable oils consist chiefly of fats; and cream, milk, cheese, and certain fish, like salmon, are rich in fat.* Fats are a more costly part of the ration than the other group of energy producers, the carbohydrates.

Carbohydrates are compounds of carbon, hydrogen and oxygen. Common examples are starch and sugar. While there are other carbohydrates than these, starch and sugar make up the bulk of the carbohydrates in human food.

Rice, potatoes, bread, macaroni and corn are all important sources of carbohydrates. They contain protein and fat as well, but their main constituent is starch.

Mineral matters, or ash, are such things as salt, phosphates, etc., which are found in most foods in small amount and which remain as ashes if the food is completely burned. They are necessary to the body, but in a mixed diet rarely need consideration.

"It is evident," says Lusk, "that the science of nutrition includes something more than the production of energy from fats, carbohydrates and protein. There must be certain salts and certain qualities of protein in the diet and there must be minute quantities of vitamines."

Concerning vitamines we have not yet very certain knowledge, but that they are growth-promoting substances and necessary in food seems certain. In a mixed diet containing both animal and vegetable food, probably vitamines are never deficient.

The Special Uses of the Proteins, Carbohydrates and Fats of the Food.

Proteins: To meet the first named use of food; namely, to build and repair the body, is the chief use of the proteins. They are the flesh builders. No other food ingredient can take their place.

One-fifth of the water-free substance of an active man consists of body proteins which are built and repaired from the proteins of the food.

An adult at very moderate work must have for his support at least 75 grams or 2¾ ounces of protein daily.

To meet the second requirement; namely, to supply the power and heat on which life and ability to work depend, is the chief use of the fat and carbohydrates, though the proteins may join in this work when supplied in excess.

Power and heat are produced in the body in the same way as in the furnace of a steam boiler; namely, by the combustion of fuel. Fat, sugar, starch, etc., are chiefly used for fuel. They are burned in the body, forming carbonic acid and water, which are given off in the breath or through the skin and kidneys: But in the process energy is developed which shows itself in forms of work—the unconscious work of the heart and of the muscles which control breathing and do the other housework of the body —as well as in conscious work of all kinds. Incidentally much more than enough heat is produced to keep the body temperature at about 98°F.

Just as coal in the steam engine is burned chiefly to furnish power to the machinery, so food is burned to do the work of the body.

When eaten in quantity more than sufficient to supply energy the fats may also take part in the formation of body fats which serve as stored fuel for emergencies.

How the Quantities of Food Ingredients and Their Energy Are Expressed.

The quantities of protein, fat and other substances which make up a given article of food can be given in weight, ounces or grams, but are usually given in percentages—that is, in parts per 100.

Energy, however, cannot be directly expressed in terms of weight or per cent. Yet we must have an accurate measure of it in order to state at all accurately the amount of energy which the body needs, or a given food supplies. *This measure of energy is the Calory.*

As the foot is a standard for measuring length, so the calory is a standard for measuring heat energy. *A calory is the quantity of heat required to raise the temperature of a kilogram of*

water one degree Centigrade (or to raise the temperature of about four pounds of water 1° Fahr.) This quantity can be very accurately determined in any food by means of an elaborate apparatus called a calorimeter. Many careful experiments with a great number of food ingredients have shown that an ounce of pure protein or of a pure carbohydrate will yield 116 calories or heat units and an ounce of pure fat 264 calories; that is, a given amount of fat has about 2.25 times as much heat value as the same amount of either protein or carbohydrates.

Otherwise stated, one gram of either protein or carbohydrates yields 4.1 calories and one gram of fat yields 9.3. For general use these values may be simplified to 4 and 9.

It appears that proteins and carbohydrates have the same value for energy production, and fats have more than twice this value. The carbohydrates and fat are to a certain extent interchangeable in the diet; that is, in his diet one may get from fat more or less energy, or capacity to do work, according to his taste, or for reasons of economy.

The above explanation will make clear the meaning of the printed analyses of food. For example, the average composition of bread in the Connecticut market as shown by our recent analyses is:

	Per cent. (Parts per 100.)
Water	33.8
Ash	1.4
Protein	9.7
Carbohydrates	53.8
Fat	1.3
	100.0

Calories in 100 grams, 266.

The calories as thus calculated:

Protein and carbohydrates, $[(9.7+53.8)=63.5]\times 4=254.0$.

Fat, $1.3\times 9=11.7$.

Total, 265.7.

To calculate the calories in an ounce, multiply the calories in one gram by 28.4.

How Many Calories Does the Body Need Every Day?

The amount of fuel needed to run any kind of machinery of course depends on the amount of work which it is doing. The same is true of the human being. When more work or harder work is done, more energy, that is, more food, is needed.

It is clear then that the number of calories required in the day's ration varies with the amount of physical exertion. The age, sex and body weight also influence the food requirement. For instance, there are many adults who sit at their work and whose physical exercise is limited to their daily walk to and from work. These require about 2,500 calories daily. Those who chiefly stand during their working hours require 3,000. When the muscular work is constant but not heavy, 3,300 calories. Farmers need 3,500, stone masons and lumberman 4,500 to 5,000, and so on.

The following table summarizes these calory requirements from the standpoint of age and of occupation:

Approximate Number of Calories Required Daily.

Based on Age.		Based on Occupation.	
1 yr.	950	Clerk at desk	2,250
2 yrs.	1,100	Professional man, machinery watcher	2,500
3— 4 yrs.	1,300	Man at light muscular work	2,800
5— 6 yrs.	1,400	Bakers, dentists, shop-keepers, conductors	3,000
7—10 yrs.	1,500	Carpenters, painters	3,300
11—14 yrs.	1,600	Farmers	3,500
15—16 yrs.	2,100	Excavators	4,000
17—18 yrs.	2,250	Stone masons	4,500

A ration may contain, however, the proper number of calories and yet be a very poor ration if the protein, fat and carbohydate are not supplied in proper relative amounts. For instance, 0.7 lb. of butter, or 1.2 lbs. of American cheese, or 1.3 lbs. of sugar, would each yield 2,500 calories, yet it is apparent that none of these foods used alone, even in these amounts, would constitute a proper ration.

The normal man of sedentary habits, or performing light labor, should receive each day 2.6 oz. of protein, 1.8 oz. of fat and from 14 to 18 oz. of carbohydrates, yielding 2,500 calories. In the selection of food these relations must be kept in mind.

The average American dietary contains an excess of protein; that is, *we eat and in the body destroy more protein than the body needs to repair its tissues.* This excess protein has no greater fuel value than so much sugar and starch, and when we remember the difference in cost the great economic waste in this excess consumption of meat and other protein foods is apparent. *A properly constituted ration should contain from one-eighth to one-sixth of its calories in protein.*

A typical ration containing 1,000 calories is given by Lusk as follows:

	Ounces	Calories
Cooked Beans	7⅜	400
Pork	1	234
Bread	2 1-3	180
Butter	½	103
Milk	5	100
Coffee	5	—
Total		1,017

In this ration the protein yields nearly one-sixth of the calories, and the balance is therefore correct. In normal times such a ration would supply one-third the daily need of a man at light work at a cost of 4.25 cents, including the cost of fuel. It shows how cheaply one can supply his body with all of the needed nutriment when normal prices prevail.

How Shall This Knowledge of Calories Be Applied in the Preparation of the Daily Meal?

It would be most fortunate if tables showing the composition of our staple foods could be in every home.* However, even were this the case, many would have great difficulty in making the proper calculations from them.

Gephart and Lusk have greatly simplified this problem. Their extensive study of the standard portions served in a series of chain restaurants in New York City gives us just the data we require. It is quite probable that these portions represent closely

* Such tables by Atwater and Bryant are given in Bulletin 28 of the Office of Experiment Stations.

The tables are also contained in the Report of the Storrs Agricultural Station 1899, p. 111, a limited number of copies of which are available for distribution in this State.

CALORIES YIELDED BY STANDARD PORTIONS OF FOOD.

Food.	Weight of Portions.	Calories in Protein.	Calories Total.
	ozs.		
Apple, baked..	.4	1.4	137.2
" " and cream.....	.8	5.8	393.7
*Bacon, broiled	6.5	70.2	760.8
*Bacon and eggs	8.5	**148.1**	818.1
Bananas, sliced	3.5	5.6	91.5
†Beans, Boston baked.....	9.0	**102.1**	509.4
†Beef, corned beef hash with poached egg.....	6.25	**157.3**	680.0
†Beef, corned beef hash, browned....	7.0	**97.5**	538.3
†Beef, creamed chipped.....	10.0	**160.1**	536.3
†Beef, roast, cold.....	5.5	**155.7**	464.2
†Beef, roast, and mashed potatoes.....	10.5	**141.8**	539.6
Bread and butter, ¾ in. slice 1 tsp. butter	2.75	28.0	202.0
Bread, hot corn	5.5	60.5	474.1
Cakes, wheat, and syrup....	6.5	49.9	476.2
Cantaloupe....	4.5	4.1	37.4
Chicken croquette and French fried potatoes....	6.5	**77.5**	499.7
†Chicken hash.	6.5	**97.1**	468.1
Cocoa.....	9.0	32.9	256.7
†Codfish, creamed, on toast.....	9.5	**155.6**	567.8
Coffee, cup, cream and sugar.....	11.5	27.5	202.9
Corn, stewed..	2.5	7.0	54.5
Corn flakes and milk.....	9.0	**54.7**	237.5
Corn starch with cream...	6.0	27.4	239.3
Crackers, graham.....	2.0	21.4	230.1
Crackers, soda, and milk.....	10.5	**71.6**	397.4
Cream.....	8.5	35.5	515.9
Cream of wheat	7.0	**32.9**	135.2
Crullers.....	4.0	46.0	457.0
Custard, cup...	7.0	**53.4**	234.1
Eclair, chocolate.....	2.5	19.2	193.4
†Eggs, boiled (2).....	4.5	**92.8**	391.0
†Eggs, creamed on toast.....	9.0	**146.6**	663.9
†Eggs, fried (2)	6.0	**105.8**	527.8
†Fish cakes and poached egg.	9.0	**129.5**	603.8
†Frankfurts and potato salad.....	10.0	**114.0**	619.8
Grape fruit.....	7.0	6.3	79.0
*Ham, broiled.	9.0	**158.0**	936.7
*Ham and eggs	10.0	**181.9**	842.6
Ice cream, vanilla.....	5.0	21.9	233.7
*Lamb chops (2).....	5.5	**146.5**	852.9
*Liver and bacon.....	9.0	**177.5**	797.2
†Macaroni and cheese.....	9.0	**69.5**	382.8
Maple flakes with milk...	9.0	**64.0**	283.4
Milk.....	16.0	**79.0**	312.8
Muffins, corn..	3.5	35.9	352.3
Oatmeal and cream.....	10.0	47.1	396.3
†Omelet, plain.	6.0	**117.2**	529.5
Oysters, raw...	3.5	**32.0**	64.9
Pie, apple.....	5.0	20.9	343.1
Pie, mince....	6.0	45.9	401.1
Potatoes, French fried.	5.0	31.8	329.8
Pudding, bread custard.....	7.0	**56.8**	371.4
Pudding, rice, cold.....	8.0	**43.6**	275.4
Pudding, apple tapioca.....	8.0	29.4	225.5
Rhubarb, stewed.....	4.0	4.0	95.0
Rice, boiled....	6.0	17.0	135.6
†Salad, crab meat.....	8.5	**140.9**	437.7

CALORIES YIELDED BY STANDARD PORTIONS OF FOOD—Continued.

Food.	Weight of Portions.	Calories in Protein.	Calories Total.	Food.	Weight of Portions.	Calories in Protein.	Calories Total.
	ozs.				ozs.		
†Salad, potato.	10.0	50.9	448.3	†Soup, vegetable.....	9.5	35.1	206.1
Sandwich, club	4.5	**111.3**	438.6	*Steak, Hamburger.....	10.0	**147.9**	723.8
" fried egg.	5.0	**59.8**	276.0	*Steak, small.	10.0	**237.5**	1032.8
" ham.....	2.0	**48.4**	212.1	†Stew, beef....	16.5	**148.4**	641.4
" roast beef hot.....	3.5	**69.3**	263.9	†Stew, lamb....	15.0	**146.8**	622.2
Sandwich, Swiss cheese.	2.0	**51.5**	258.5	Toast, buttered	2.5	42.7	311.3
Sausage, country.....	3.0	**57.6**	243.9	Toast, milk....	8.0	**59.4**	333.5
Sausage and fried potatoes	6.0	71.5	521.7	Tomatoes, sliced.....	5.0	**6.7**	32.2
Shredded wheat and cream...	6.0	56.4	494.5	Tomatoes, sliced, with lettuce.....	4.5	8.2	52.1
Shredded wheat and milk.....	10.0	**81.2**	404.5	†Veal cutlet and tomato sauce.....	13.0	**177.8**	897.8
Soup, bean, with croutons	10.5	**42.5**	180.8	Watermelon...	38.0	27.6	244.3
†Soup, split pea	9.0	**45.9**	241.1				

* Potatoes and bread and butter served.

† Bread and butter served.

enough the amounts served in the average home, to be a useful guide in making up rations and in substituting cheaper for more expensive foods.

The foregoing table is an abridgment of their tables, somewhat simplified and recalculated in common terms.‡ The first column gives the food served, an asterisk (*) indicating that bread and butter and potatoes were served with it, and a dagger (†) that bread and butter were served; the second column gives the approximate weight of the portion in ounces; the third column, the calories yielded from the protein in the portion; and the fourth column the total calories yielded.

Two important points must be kept in mind in using this table. A considerable portion of the protein in the ration should come

‡ Anyone interested in the facts which they give will find the full compilation in a pamphlet of 84 pages, Analysis and Cost of Ready-to-Serve Foods, by Gephart and Lusk, published by the American Medical Association, 535 N. Dearborn St., Chicago, Ill.

from animal sources, such as poultry, milk, fish or eggs; and about 15 per cent. of the total calories should be derived from the protein. The name of the dish will generally indicate whether animal protein is present, and in the protein calories column full faced type is used where at least 15 per cent. of the total calories is derived from protein.

To illustrate the practical use of the table: portions of Boston baked beans, chicken croquettes, creamed codfish on toast, two fried eggs (all four served with bread and butter) and cream, wheat cakes with syrup, and crullers, all yield about 500 calories per portion, and approximately five portions of each of these would be necessary to supply the daily requirement of 2,500 calories. These seven foods may be divided into two groups. The first four derive at least 15 per cent. of their calories from protein, and in all but the baked beans this protein is chiefly from an animal source; the last three foods are all deficient in protein. It is obvious, therefore, that cold roast beef, creamed codfish and fried eggs might be interchanged in the daily ration without disturbing the balance and at the same time supplying proper nutriment. In other words, five portions of any of these three foods served with bread and butter would provide sufficient protein and calories for the daily need of a light worker. Five portions of baked beans would not do this, for while the total nutriment would be sufficient, no animal protein would be supplied. Five portions of either cream, or wheat cakes, or crullers, would be unsatisfactory because in each case too little protein would be provided.

Of course, the foregoing illustration is not meant as a suggestion to limit one's daily food to cold roast beef, creamed codfish and fried eggs, served with bread and butter. Such a ration would be adequate, and probably for a limited time might be satisfactory, but personal taste must rule in suggesting modifications of this ration which will increase variety and palatability and which will furnish bulk, a characteristic wanting in many American meals and one most essential to health.

The foregoing table may also be used to determine whether the daily food (ration) is adequate or excessive.

To illustrate, there follows a day's bill of fare of one of the Station staff and the corresponding energy value (calories) as given in the table:

	Calories In Protein.	Total.
Breakfast;		
One cup coffee with cream and sugar	27.5	202.9
One apple	1.4	137.2
Oatmeal and milk	50.2	281.0
One thick slice rye bread and butter	28.0	202.0
Dinner		
Bean soup with croutons	42.5	180.8
Roast beef and mashed potatoes	141.8	539.6
Stewed corn	7.0	54.5
Apple tapioca pudding	29.4	225.5
Supper		
Macaroni and cheese	69.5	382.8
Two slices rye bread and butter	56.0	404.0
Apple sauce	2.8	274.4
Chocolate layer cake	20.7	218.3
	476.8	3103.0

It appears that the calories in the protein of the ration make 15.4 per cent. of the total calories, which is near to the standard 15. The total calories, however, considerably exceed the standard of 2,500.

Considering, however, that the portions given in the table are restaurant portions and rather larger on the average than a man at light work takes at his own table, the ration seems satisfactory. On the "meatless" days creamed codfish, fish cakes and poached egg, or plain omelet will be substituted for roast beef or any other meats.

The foregoing discussion concerns the principles of nutrition and may be helpful as a general guide to the housewife in the control of diet. On her, in the final analysis, depends very largely the efficiency of the community.

Her first problem is to supply enough palatable and nutritious food for the family. It is false economy at this time in any way to make the diet less efficient.

The next problems are—to save the family expense and to lessen the home demand for such foods as wheat, beef and pork, sugar and fats, which are needed to send abroad to our own and our allies' armies. In families with very small incomes the first

of these two problems is the more pressing; in families with larger incomes patriotism requires personal sacrifice in the matter of family expense, when it is necessary for a great national work. For instance, families with very limited means cannot substitute poultry and eggs for beef or pork, when the former are more expensive. The well-to-do can and should do this, so far as practicable.

Economies are to be effected by personal instead of telephone marketing, by getting a variety of food which includes a liberal supply of vegetables, by skill in adapting the diet to personal differences in taste and in efficiency of digestion, as well as in the preparation of attractive and appetizing dishes.

If any very radical change in diet is to be made, it should be brought about gradually. A sudden or violent change is likely to produce disturbance of digestion and temporarily, at least, impair efficiency. Many people, for instance, would be seriously affected if rye or corn bread were eaten to the exclusion of wheat bread, for a period of two weeks, and would be prejudiced against any use of them forever afterwards. If, however, either rye or corn breal is used at first quite sparingly and not continuously, it may come to be regarded rather as a grateful change and as a delicacy than as the outward and visible sign of an inward and spiritual resignation to the physical hardship of wartime. The use of these wheat substitutes, therefore, begun in this way, is more likely in the end to lessen the family consumption of wheat, than a more sudden and radical change. It may, indeed, create a tolerance for and a liking of them which will outlast the war and be of considerable economic advantage.

Feeding a family has a psycological side which is often overlooked. The mental attitude of the family, as well as the cookbook, needs to be studied.

The following books treat of the various phases of the science of nutrition and can be recommended to those who wish to become more fully acquainted with the subject:

Mendel, L. B.	Changes in the Food Supply and their Relation to Nutrition. Yale University Press, New Haven.....	$0.50
Lusk, Graham.	The Basis of Nutrition. Yale University Press, New Haven.....	.50

Sherman, H. C.	Chemistry of Food and Nutrition. MacMillan, N. Y.	1.50
Stern & Spitz.	Food for the Worker. Whitcomb & Barrows, Boston	1.00
Green, Mary.	Better Meals for Less Money. Henry Holt & Co., N. Y.	1.25
Rose, Mary S.	Feeding the Family. MacMillan, N. Y.	2.20
Rose, Mary S.	Laboratory Handbook for Dietetics. MacMillan, N. Y.	1.10
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