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# United States Department of Agriculture,

## OFFICE OF EXPERIMENT STATIONS,

A. C. TRUE, Director.

### THE FUNCTIONS AND USES OF FOOD.<sup>1</sup>

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In this circular a number of the terms used in discussing food are defined and some of the principles of nutrition are briefly stated. The average composition of a number of the more common American foods is quoted as well as the commonly accepted dietary standards. With the aid of such data, the nutritive value of any given diet may be computed and its comparative value ascertained. The method of making such calculations is given, as is also a method for calculating the digestibility of different foods.

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

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

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

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

#### USE OF NUTRIENTS.

Food is used in the body to build and repair tissue and to furnish energy. The manner in which the valuable constituents are utilized in the body may be expressed in tabular form as follows:

|  |   |   |
|--|---|---|
| Protein .....  | Forms tissue (muscles, tendon, and probably fat). | } All serve as <i>fuel</i> and yield <i>energy</i> in form of heat and muscular strength. |
| White (albumen) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc. |   |   |
| Fats .....   | Form fatty tissue.                                |   |
| Fat of meat, butter, olive oil, oils of corn and wheat, etc.                     |   |   |
| Carbohydrates .....  | Transformed into fat.                             |   |
| Sugar, starch, etc.  |   |   |
| Mineral matters (ash) .....  | Aid in forming bone, assist in digestion, etc.    |   |
| Phosphates of lime, pot-ash, soda, etc.  |   |   |

<sup>1</sup>This article, which was originally published under the title "Food for Man" in the U. S. Dept. Agr. Yearbook, 1897, pp. 676-682, has been revised and contains some additional matter.

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

Instead of this unit some unit of mechanical energy might be used—for instance, the foot-ton, which represents the force required to raise one ton one foot. One calorie is equal to very nearly 1.53 foot-tons.

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

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

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

Within recent years analyses of a large number of samples of foods have been made in this country. In the table below the average results of a number of these analyses are given.

## Average composition of American food products. (a)

| Food materials (as purchased).            | Refuse.        | Water.         | Protein.       | Fat.           | Carbohy-<br>drates. | Ash.           | Fuel<br>value<br>per<br>pound. |
|---|----------------|----------------|----------------|----------------|---------------------|----------------|--------------------------------|
| ANIMAL FOOD.                              |                |                |                |                |                     |                |                                |
| Beef, fresh:                              | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i>      | <i>Per ct.</i> | <i>Calo-<br/>ries.</i>         |
| Chuck, including shoulder .....           | 17.3           | 54.0           | 15.8           | 12.5           | -----               | 0.7            | 820                            |
| Chuck ribs .....                          | 19.1           | 53.8           | 15.3           | 11.1           | -----               | .8             | 755                            |
| Flank .....                               | 5.5            | 56.1           | 18.6           | 19.9           | -----               | .8             | 1,185                          |
| Loin .....                                | 13.3           | 52.9           | 16.4           | 16.9           | -----               | .9             | 1,020                          |
| Porterhouse steak .....                   | 12.7           | 52.4           | 19.1           | 17.9           | -----               | .8             | 1,110                          |
| Sirloin steak .....                       | 12.8           | 54.0           | 16.5           | 16.1           | -----               | .9             | 985                            |
| Neck .....                                | 31.2           | 45.3           | 14.2           | 9.2            | -----               | .7             | 650                            |
| Ribs .....                                | 20.1           | 45.3           | 14.4           | 20.0           | -----               | .7             | 1,110                          |
| Rib rolls .....                           | -----          | 64.8           | 19.4           | 15.5           | -----               | .9             | 1,015                          |
| Round .....                               | 8.5            | 62.5           | 19.2           | 9.2            | -----               | 1.0            | 745                            |
| Rump .....                                | 19.0           | 46.9           | 15.2           | 18.6           | -----               | .8             | 1,065                          |
| Shank, fore .....                         | 38.3           | 43.2           | 13.2           | 5.2            | -----               | .6             | 465                            |
| Shoulder and clod .....                   | 17.4           | 57.0           | 16.5           | 8.4            | -----               | .9             | 660                            |
| Fore quarter .....                        | 20.6           | 49.5           | 14.4           | 15.1           | -----               | .7             | 905                            |
| Hind quarter .....                        | 16.3           | 52.0           | 16.1           | 15.4           | -----               | .8             | 950                            |
| Beef, corned, canned, pickled, and dried: |                |                |                |                |                     |                |                                |
| Corned beef .....                         | 8.4            | 49.2           | 14.3           | 23.8           | -----               | 4.6            | 1,271                          |
| Tongue, pickled .....                     | 6.0            | 58.9           | 11.9           | 19.2           | -----               | 4.3            | 1,030                          |
| Dried, salted, and smoked .....           | 4.7            | 53.7           | 26.4           | 6.9            | -----               | 8.9            | 780                            |
| Canned boiled beef .....                  | -----          | 51.8           | 25.5           | 22.5           | -----               | 1.3            | 1,425                          |
| Canned corned beef .....                  | -----          | 51.8           | 26.3           | 18.7           | -----               | 4.0            | 1,280                          |
| Veal:                                     |                |                |                |                |                     |                |                                |
| Breast .....                              | 23.3           | 52.5           | 15.7           | 8.2            | -----               | .8             | 635                            |
| Leg .....                                 | 11.7           | 63.4           | 18.3           | 5.8            | -----               | 1.0            | 585                            |
| Leg cutlets .....                         | 3.4            | 68.3           | 20.1           | 7.5            | -----               | 1.0            | 690                            |
| Fore quarter .....                        | 24.5           | 54.2           | 15.1           | 6.0            | -----               | .7             | 535                            |
| Hind quarter .....                        | 20.7           | 56.2           | 16.2           | 6.6            | -----               | .8             | 580                            |
| Mutton:                                   |                |                |                |                |                     |                |                                |
| Flank .....                               | 9.9            | 39.0           | 13.8           | 36.9           | -----               | .6             | 1,815                          |
| Leg, hind .....                           | 17.7           | 51.9           | 15.4           | 14.5           | -----               | .8             | 900                            |
| Shoulder .....                            | 22.1           | 46.8           | 13.7           | 17.1           | -----               | .7             | 975                            |
| Fore quarter .....                        | 21.2           | 41.6           | 12.3           | 24.5           | -----               | .7             | 1,265                          |
| Hind quarter, without tallow .....        | 19.3           | 43.3           | 13.0           | 24.0           | -----               | .7             | 1,255                          |
| Lamb:                                     |                |                |                |                |                     |                |                                |
| Breast .....                              | 19.1           | 45.5           | 15.4           | 19.1           | -----               | .8             | 1,090                          |
| Leg, hind .....                           | 13.8           | 50.3           | 16.0           | 19.7           | -----               | .9             | 1,130                          |
| Pork, fresh:                              |                |                |                |                |                     |                |                                |
| Flank .....                               | 18.0           | 48.5           | 15.1           | 18.6           | -----               | .7             | 1,065                          |
| Ham .....                                 | 10.3           | 45.1           | 14.3           | 29.7           | -----               | .8             | 1,520                          |
| Loin chops .....                          | 19.3           | 40.8           | 13.2           | 26.0           | -----               | .8             | 1,340                          |
| Shoulder .....                            | 12.4           | 44.9           | 12.0           | 29.8           | -----               | .7             | 1,480                          |
| Tenderloin .....                          | -----          | 66.5           | 18.9           | 13.0           | -----               | 1.0            | 900                            |
| Pork, salted, cured, and pickled:         |                |                |                |                |                     |                |                                |
| Ham, smoked .....                         | 12.2           | 35.8           | 14.5           | 33.2           | -----               | 4.2            | 1,670                          |
| Shoulder, smoked .....                    | 18.9           | 30.7           | 12.6           | 33.0           | -----               | 5.0            | 1,625                          |
| Salt pork .....                           | -----          | 7.9            | 1.9            | 86.2           | -----               | 3.9            | 3,670                          |
| Bacon, smoked .....                       | 8.7            | 18.4           | 9.5            | 59.4           | -----               | 4.5            | 2,685                          |
| Sausage:                                  |                |                |                |                |                     |                |                                |
| Bologna .....                             | 3.3            | 55.2           | 18.2           | 19.7           | -----               | 3.8            | 1,170                          |
| Farmer .....                              | 3.9            | 22.2           | 27.9           | 40.4           | -----               | 7.3            | 2,225                          |
| Frankfort .....                           | -----          | 57.2           | 19.6           | 18.6           | 1.1                 | 3.4            | 1,170                          |
| Soups:                                    |                |                |                |                |                     |                |                                |
| Celery, cream of .....                    | -----          | 88.6           | 2.1            | 2.8            | 5.0                 | 1.5            | 250                            |
| Beef .....                                | -----          | 92.9           | 4.4            | .4             | 1.1                 | 1.2            | 120                            |
| Meat stew .....                           | -----          | 84.5           | 4.6            | 4.3            | 5.5                 | 1.1            | 370                            |
| Tomato .....                              | -----          | 90.0           | 1.8            | 1.1            | 5.6                 | 1.5            | 185                            |
| Poultry:                                  |                |                |                |                |                     |                |                                |
| Chicken, broilers .....                   | 41.6           | 43.7           | 12.8           | 1.4            | -----               | .7             | 295                            |
| Fowls .....                               | 25.9           | 47.1           | 13.7           | 12.3           | -----               | .7             | 775                            |
| Goose .....                               | 17.6           | 38.5           | 13.4           | 29.8           | -----               | .7             | 1,505                          |
| Turkey .....                              | 22.7           | 42.4           | 16.1           | 18.4           | -----               | .8             | 1,075                          |
| Fish:                                     |                |                |                |                |                     |                |                                |
| Cod, dressed .....                        | 20.9           | 58.5           | 11.1           | .2             | -----               | .8             | 215                            |
| Halibut, steaks or sections .....         | 17.7           | 61.9           | 15.3           | 4.4            | -----               | .9             | 470                            |
| Mackerel, whole .....                     | 44.7           | 40.4           | 10.2           | 4.2            | -----               | .7             | 365                            |
| Perch, yellow, dressed .....              | 35.1           | 50.7           | 12.8           | .7             | -----               | .9             | 265                            |
| Shad, whole .....                         | 50.1           | 35.2           | 9.4            | 4.8            | -----               | .7             | 380                            |
| Shad, roe .....                           | -----          | 71.2           | 20.9           | 3.8            | 2.6                 | 1.5            | 600                            |
| Fish, salt: Cod .....                     | 24.9           | 40.2           | 19.0           | .4             | -----               | 18.5           | 315                            |

a Condensed from detailed tables in Bulletin No. 28, revised, of the Office of Experiment Stations of this Department.

## Average composition of American food products—Continued.

| Food materials (as purchased).             | Refuse.        | Water.         | Protein.       | Fat.           | Carbohydrates. | Ash.           | Fuel value per pound. |
|--|----------------|----------------|----------------|----------------|----------------|----------------|-----------------------|
| ANIMAL FOOD—continued.                     |                |                |                |                |                |                |                       |
| Fish, canned:                              | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Calories.</i>      |
| Salmon .....                               | 14.2           | 56.8           | 19.5           | 7.5            | -----          | 2.0            | 680                   |
| Sardines .....                             | a 5.0          | 53.6           | 23.7           | 12.1           | -----          | 5.3            | 950                   |
| Shellfish:                                 |                |                |                |                |                |                |                       |
| Oysters, "solids" .....                    | -----          | 88.3           | 6.0            | 1.3            | 3.3            | 1.1            | 230                   |
| Clams .....                                | -----          | 80.8           | 10.6           | 1.1            | 5.2            | 2.3            | 340                   |
| Crabs .....                                | 52.4           | 36.7           | 7.9            | .9             | .6             | 1.5            | 195                   |
| Lobsters .....                             | 61.7           | 30.7           | 5.9            | .7             | .2             | .8             | 140                   |
| Eggs: Hens' eggs .....                     | b 11.2         | 65.5           | 11.9           | 9.3            | -----          | .9             | 635                   |
| Dairy products, etc.:                      |                |                |                |                |                |                |                       |
| Butter .....                               | -----          | 11.0           | 1.0            | 85.0           | -----          | 3.0            | 3,605                 |
| Whole milk .....                           | -----          | 87.0           | 3.3            | 4.0            | 5.0            | .7             | 325                   |
| Skim milk .....                            | -----          | 90.5           | 3.4            | .3             | 5.1            | .7             | 170                   |
| Buttermilk .....                           | -----          | 91.0           | 3.0            | .5             | 4.8            | .7             | 165                   |
| Condensed milk .....                       | -----          | 26.9           | 8.8            | 8.3            | 54.1           | 1.9            | 1,520                 |
| Cream .....                                | -----          | 74.0           | 2.5            | 18.5           | 4.5            | .5             | 910                   |
| Cheese, Cheddar .....                      | -----          | 27.4           | 27.7           | 36.8           | 4.1            | 4.0            | 2,145                 |
| Cheese, full cream .....                   | -----          | 34.2           | 25.9           | 33.7           | 2.4            | 3.8            | 1,950                 |
| VEGETABLE FOOD.                            |                |                |                |                |                |                |                       |
| Flour, meal, etc.:                         |                |                |                |                |                |                |                       |
| Entire-wheat flour .....                   | -----          | 11.4           | 13.8           | 1.9            | 71.9           | 1.0            | 1,675                 |
| Graham flour .....                         | -----          | 11.3           | 13.3           | 2.2            | 71.4           | 1.8            | 1,670                 |
| Wheat flour, patent roller process—        |                |                |                |                |                |                |                       |
| High-grade and medium .....                | -----          | 12.0           | 11.4           | 1.0            | 75.1           | .5             | 1,650                 |
| Low grade .....                            | -----          | 12.0           | 14.0           | 1.9            | 71.2           | .9             | 1,665                 |
| Macaroni .....                             | -----          | 78.4           | 3.0            | 1.5            | 15.8           | 1.3            | 415                   |
| Crushed wheat .....                        | -----          | 10.1           | 11.1           | 1.7            | 75.5           | 1.6            | 1,685                 |
| Buckwheat flour .....                      | -----          | 13.6           | 6.4            | 1.2            | 77.9           | .9             | 1,620                 |
| Corn meal .....                            | -----          | 12.5           | 9.2            | 1.9            | 75.4           | 1.0            | 1,655                 |
| Oatmeal .....                              | -----          | 7.3            | 16.1           | 7.2            | 67.5           | 1.9            | 1,860                 |
| Rice .....                                 | -----          | 12.3           | 8.0            | .3             | 79.0           | .4             | 1,630                 |
| Tapioca .....                              | -----          | 11.4           | .4             | .1             | 88.0           | .1             | 1,650                 |
| Starch .....                               | -----          | -----          | -----          | -----          | 90.0           | -----          | 1,675                 |
| Bread, pastry, etc.:                       |                |                |                |                |                |                |                       |
| White bread .....                          | -----          | 35.3           | 9.2            | 1.3            | 53.1           | 1.1            | 1,215                 |
| Brown bread .....                          | -----          | 43.6           | 5.4            | 1.8            | 47.1           | 2.1            | 1,050                 |
| Graham bread .....                         | -----          | 35.7           | 8.9            | 1.8            | 52.1           | 1.5            | 1,210                 |
| Whole-wheat bread .....                    | -----          | 38.4           | 9.7            | .9             | 49.7           | 1.3            | 1,140                 |
| Rye bread .....                            | -----          | 35.7           | 9.0            | .6             | 53.2           | 1.5            | 1,180                 |
| Cake .....                                 | -----          | 19.9           | 6.3            | 9.0            | 63.3           | 1.5            | 1,675                 |
| Cream crackers .....                       | -----          | 6.8            | 9.7            | 12.1           | 69.7           | 1.7            | 1,990                 |
| Oyster crackers .....                      | -----          | 4.8            | 11.3           | 10.5           | 70.5           | 2.9            | 1,965                 |
| Soda crackers .....                        | -----          | 5.9            | 9.8            | 9.1            | 73.1           | 2.1            | 1,925                 |
| Sugars, etc.:                              |                |                |                |                |                |                |                       |
| Molasses .....                             | -----          | 25.1           | 2.4            | -----          | 69.3           | 3.2            | 1,290                 |
| Candy .....                                | -----          | -----          | -----          | -----          | 96.0           | -----          | 1,785                 |
| Honey c .....                              | -----          | 18.2           | .4             | -----          | 81.2           | .2             | 1,520                 |
| Sugar, granulated .....                    | -----          | -----          | -----          | -----          | 100.0          | -----          | 1,860                 |
| Maple sirup .....                          | -----          | -----          | -----          | -----          | 71.4           | -----          | 1,330                 |
| Vegetables: d                              |                |                |                |                |                |                |                       |
| Beans, dried .....                         | -----          | 12.6           | 22.5           | 1.8            | 59.6           | 3.5            | 1,605                 |
| Beans, Lima, shelled .....                 | -----          | 68.5           | 7.1            | .7             | 22.0           | 1.7            | 570                   |
| Beans, string .....                        | 7.0            | 83.0           | 2.1            | .3             | 6.9            | .7             | 180                   |
| Beets .....                                | 20.0           | 70.0           | 1.3            | .1             | 7.7            | .9             | 170                   |
| Cabbage .....                              | 15.0           | 77.7           | 1.4            | .2             | 4.8            | .9             | 125                   |
| Celery .....                               | 20.0           | 75.6           | .9             | .1             | 2.6            | .8             | 70                    |
| Corn, green (sweet), edible portion .....  | -----          | 75.4           | 3.1            | 1.1            | 19.7           | .7             | 470                   |
| Cucumbers .....                            | 15.0           | 81.1           | .7             | .2             | 2.6            | .4             | 70                    |
| Lettuce .....                              | 15.0           | 80.5           | 1.0            | .2             | 2.5            | .8             | 75                    |
| Mushrooms .....                            | -----          | 88.1           | 3.5            | .4             | 6.8            | 1.2            | 210                   |
| Onions .....                               | 10.0           | 78.9           | 1.4            | .3             | 8.9            | .5             | 205                   |
| Parsnips .....                             | 20.0           | 66.4           | 1.3            | .4             | 10.8           | 1.1            | 240                   |
| Peas ( <i>Pisum sativum</i> ), dried ..... | -----          | 9.5            | 24.6           | 1.0            | 62.0           | 2.9            | 1,655                 |

a Refuse, oil.

b Refuse, shell.

c Contained on an average cane sugar 2.8 and reducing sugar 71.1 per cent. The reducing sugar was composed of about equal amounts of glucose (dextrose) and fruit sugar (levulose).

d Such vegetables as potatoes, squash, beets, etc., have a certain amount of inedible material, skin, seeds, etc. The amount varies with the method of preparing the vegetables, and can not be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinarily prepared.



## Average composition of American food products—Continued.

| Food materials (as purchased).  | Refuse.        | Water.         | Protein.       | Fat.           | Carbohy-<br>drates. | Ash.           | Fuel<br>value<br>per<br>pound. |
|---|----------------|----------------|----------------|----------------|---------------------|----------------|--------------------------------|
| VEGETABLE FOOD—continued.   |                |                |                |                |                     |                |                                |
| Vegetables <i>a</i> —Continued.   | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i>      | <i>Per ct.</i> | <i>Calo-<br/>ries.</i>         |
| Peas ( <i>Pisum sativum</i> ), shelled .....                                |                | 74.6           | 7.0            | 0.5            | 16.9                | 1.0            | 465                            |
| Cowpeas, dried .....  |                | 13.0           | 21.4           | 1.4            | 60.8                | 3.4            | 1,590                          |
| Potatoes .....  | 20.0           | 62.6           | 1.8            | .1             | 14.7                | .8             | 310                            |
| Rhubarb .....   | 40.0           | 56.6           | .4             | .4             | 2.2                 | .4             | 65                             |
| Sweet potatoes .....  | 20.0           | 55.2           | 1.4            | .6             | 21.9                | .9             | 640                            |
| Spinach .....   |                | 92.3           | 2.1            | .3             | 3.2                 | 2.1            | 110                            |
| Squash .....  | 50.0           | 44.2           | .7             | .2             | 4.5                 | .4             | 105                            |
| Tomatoes .....  |                | 94.3           | .9             | .4             | 3.9                 | .5             | 105                            |
| Turnips .....   | 30.0           | 62.7           | .9             | .1             | 5.7                 | .6             | 125                            |
| Vegetables, canned:   |                |                |                |                |                     |                |                                |
| Peas ( <i>Pisum sativum</i> ), green .....                                  |                | 85.3           | 3.6            | .2             | 9.8                 | 1.1            | 255                            |
| Corn, green .....   |                | 76.1           | 2.8            | 1.2            | 19.0                | .9             | 455                            |
| Tomatoes .....  |                | 94.0           | 1.2            | .2             | 4.0                 | .6             | 105                            |
| Fruits, berries, etc., fresh: <i>b</i>                                      |                |                |                |                |                     |                |                                |
| Apples .....  | 25.0           | 63.3           | .3             | .3             | 10.8                | .3             | 220                            |
| Bananas .....   | 35.0           | 48.9           | .8             | .4             | 14.3                | .6             | 300                            |
| Grapes .....  | 25.0           | 58.0           | 1.0            | 1.2            | 14.4                | .4             | 335                            |
| Lemons .....  | 30.0           | 62.5           | .7             | .5             | 5.9                 | .4             | 145                            |
| Muskmelons .....  | 50.0           | 44.8           | .3             |                | 4.6                 | .3             | 90                             |
| Oranges .....   | 27.0           | 63.4           | .6             | .1             | 8.5                 | .4             | 170                            |
| Pears .....   | 10.0           | 76.0           | .5             | .4             | 12.7                | .4             | 260                            |
| Persimmons, edible portion .....  |                | 66.1           | .8             | .7             | 31.5                | .9             | 630                            |
| Raspberries .....   |                | 85.8           | 1.0            |                | 12.6                | .6             | 255                            |
| Strawberries .....  | 5.0            | 85.9           | .9             | .6             | 7.0                 | .6             | 175                            |
| Watermelons .....   | 59.4           | 37.5           | .2             | .1             | 2.7                 | .1             | 60                             |
| Fruits, dried:  |                |                |                |                |                     |                |                                |
| Apples .....  |                | 28.1           | 1.6            | 2.2            | 66.1                | 2.0            | 1,350                          |
| Apricots .....  |                | 81.4           | .9             |                | 17.3                | .4             | 340                            |
| Dates .....   | 10.0           | 13.8           | 1.9            | 2.5            | 70.6                | 1.2            | 1,450                          |
| Figs .....  |                | 18.8           | 4.3            | .3             | 74.2                | 2.4            | 1,475                          |
| Nuts:   |                |                |                |                |                     |                |                                |
| Almonds .....   | 45.0           | 2.7            | 11.5           | 30.2           | 9.5                 | 1.1            | 1,660                          |
| Beechnuts .....   | 40.8           | 2.3            | 13.0           | 34.0           | 7.8                 | 2.1            | 1,820                          |
| Brazil nuts .....   | 49.6           | 2.6            | 8.6            | 33.7           | 3.5                 | 2.0            | 1,655                          |
| Butternuts .....  | 86.4           | .6             | 3.8            | 8.3            | .5                  | .4             | 430                            |
| Chestnuts, fresh .....  | 16.0           | 37.8           | 5.2            | 4.5            | 35.4                | 1.1            | 945                            |
| Chestnuts, dried .....  | 24.0           | 4.5            | 8.1            | 5.3            | 56.4                | 1.7            | 1,425                          |
| Cocoanuts .....   | c 48.8         | 7.2            | 2.9            | 25.9           | 14.3                | .9             | 1,413                          |
| Cocoanut, prepared .....  |                | 3.5            | 6.3            | 57.4           | 31.5                | 1.3            | 3,125                          |
| Filberts .....  | 52.1           | 1.8            | 7.5            | 31.3           | 6.2                 | 1.1            | 1,575                          |
| Hickory nuts .....  | 62.2           | 1.4            | 5.8            | 25.5           | 4.3                 | .8             | 1,265                          |
| Pecans, polished .....  | 53.2           | 1.4            | 5.2            | 33.3           | 6.2                 | .7             | 1,620                          |
| Peanuts .....   | 24.5           | 6.9            | 19.5           | 29.1           | 18.5                | 1.5            | 1,935                          |
| Pinon ( <i>Pinus edulis</i> ) .....   | 40.6           | 2.0            | 8.7            | 36.8           | 10.2                | 1.7            | 1,905                          |
| Walnuts, California, black .....  | 74.1           | .6             | 7.2            | 14.6           | 3.0                 | .5             | 805                            |
| Walnuts, California, soft-shell .....                                       | 58.1           | 1.0            | 6.9            | 26.6           | 6.8                 | .6             | 1,375                          |
| Raisins .....   | 10.0           | 13.1           | 2.3            | 3.0            | 68.5                | 3.1            | 1,445                          |
| Miscellaneous:  |                |                |                |                |                     |                |                                |
| Chocolate .....   |                | 5.9            | 12.9           | 48.7           | 30.3                | 2.2            | 2,860                          |
| Cocoa, powdered .....   |                | 4.6            | 21.6           | 28.9           | 37.7                | 7.2            | 2,320                          |
| Cereal coffee, infusion (1 part boiled<br>in 20 parts water) <i>d</i> ..... |                | 98.2           | .2             |                | 1.4                 | .2             | 30                             |

*a* Such vegetables as potatoes, squash, beets, etc., have a certain amount of inedible material, skin, seeds, etc. The amount varies with the method of preparing the vegetables, and can not be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinarily prepared.

*b* Fruits contain a certain proportion of inedible materials, as skin, seeds, etc., which are properly classed as refuse. In some fruits, as oranges and prunes, the amount rejected in eating is practically the same as refuse. In others, as apples and pears, more or less of the edible material is ordinarily rejected with the skin and seeds and other inedible portions. The edible material which is thus thrown away, and should properly be classed with the waste, is here classed with the refuse. The figures for refuse here given represent, as nearly as can be ascertained, the quantities ordinarily rejected.

*c* Milk and sbell.

*d* The average of five analyses of cereal coffee grain is: Water 6.2, protein 13.3, fat 3.4, carbohydrates 72.6, and ash 4.5 per cent. Only a portion of the nutrients, however, enter into the infusion. The average in the table represents the available nutrients in the beverage. Infusions of genuine coffee and of tea like the above contain practically no nutrients.

## DIETARY STANDARDS.

Dietary studies have been made in considerable numbers in different countries. The results of such studies and experiments to determine the amount of food required by men engaged in different occupations have resulted in the adoption of dietary standards. Some of these follow :

*Standards for daily dietaries.*

| Character of work to be performed.    | Nutrients.    |               |                     | Fuel value.      |
|---------------------------------------|---------------|---------------|---------------------|------------------|
|                                       | Protein.      | Fat.          | Carbohy-<br>drates. |                  |
| European :                            | <i>Pound.</i> | <i>Pound.</i> | <i>Pounds.</i>      | <i>Calories.</i> |
| Man at moderate work .....            | 0.26          | 0.12          | 1.10                | 3,055            |
| Man at hard work .....                | .32           | .22           | .99                 | 3,370            |
| American :                            |               |               |                     |                  |
| Man without muscular work .....       | .20           | .....         | .....               | 3,000            |
| Man with light muscular work .....    | .22           | .....         | .....               | 3,000            |
| Man with moderate muscular work ..... | .28           | .....         | .....               | 3,500            |
| Man with hard muscular work .....     | .39           | .....         | .....               | 4,500            |

The table of composition of food materials shows the amount of water, protein, fat, carbohydrates, and ash content and the total fuel value per pound for each kind of food named. The protein, fat, and carbohydrates all furnish energy. In addition to furnishing energy, protein forms tissue. Since protein and energy are the essential features of food, dietary standards may be expressed in their simplest form in terms of protein and energy alone.

Observation has shown that as a rule a woman requires less food than a man, and the amount required by children is still less, varying with the age. It is customary to assign certain factors which shall represent the amount of nutrients required by children of different ages and by women as compared with adult man. The various factors which have been adopted are as follows :

*Factors used in calculating meals consumed in dietary studies.*

- One meal of woman equivalent to 0.8 meal of man at moderate muscular labor.
- One meal of boy 14 to 16 years of age, inclusive, equivalent to 0.8 meal of man.
- One meal of girl 14 to 16 years of age, inclusive, equivalent to 0.7 meal of man.
- One meal of child 10 to 13 years of age, inclusive, equivalent to 0.6 meal of man.
- One meal of child 6 to 9 years of age, inclusive, equivalent to 0.5 meal of man.
- One meal of child 2 to 5 years of age, inclusive, equivalent to 0.4 meal of man.
- One meal of child under 2 years of age equivalent to 0.3 meal of man.

These factors are based in part upon experimental data and in part upon arbitrary assumptions. They are subject to revision when experimental evidence shall warrant more definite conclusions.

The plan followed in making dietary studies is, briefly, as follows : Exact account is taken of all the food materials (1) at the beginning



of the study, (2) purchased during the study, and (3) remaining at the end. The difference between the third and the sum of the first and second is taken as representing the amount used. From the figures thus obtained the amount of the different food materials and the amount of the different nutrients furnished by them is calculated. Deducting from this the weights of the nutrients found in the kitchen and table refuse, the amounts actually consumed are obtained. Account is also taken of the meals eaten by different members of the family or groups studied and by visitors, if there are any. From the total food eaten by all the persons during the entire period the amount eaten per man per day may be calculated. In making these calculations due account is taken of the fact that, as stated above, women and children eat less than men performing the same amount of work.

#### METHOD OF CALCULATING DIETARIES.

The following may be taken as an illustration of the way in which the table of composition of food products and the dietary standards may be practically applied. Suppose the family consists of four adults, and that there are on hand or may be readily purchased the following food materials: Oatmeal, milk, sugar, eggs, lamb chops, roast beef, potatoes, sweet potatoes, rice, bread, cake, bananas, tea, and coffee. From these materials menus for three meals might be arranged as follows:

*Breakfast.*—Oatmeal, milk, sugar, lamb chops, bread, butter, and coffee.

*Dinner.*—Roast beef, potatoes (Irish), sweet potatoes, rice pudding, and tea.

*Supper.*—Bread, butter, cake, and bananas.

The amounts required of the several articles of food may be readily approximated by any person experienced in marketing or preparing food for a family. Thus, it may be assumed that four adults would consume for breakfast  $1\frac{1}{2}$  pounds lamb chops, one-half pound oatmeal, one-half pound bread, 6 ounces milk, 2 ounces sugar, and 2 ounces butter. From the table of composition of food materials the nutritive ingredients which these foods furnish may be easily calculated. Thus, if oatmeal contains 16.1 per cent of protein and furnishes 1,860 calories per pound, one-half pound would contain 0.081 pound protein ( $0.5 \times 0.161 = 0.081$  pound) and yield 930 calories ( $0.5 \times 1,860 = 930$ ), and if lamb chops contain 16 per cent protein and furnish 1,130 calories per pound,  $1\frac{1}{2}$  pounds of lamb chops would furnish 0.24 pound protein ( $1.5 \text{ pounds} \times 0.16 = 0.24$  pound) and 1,195 calories ( $1.5 \text{ pounds} \times 1,130 = 1,695$ ) calories. The others may be calculated in the same way.

The assumed quantities of food materials which the four persons

would consume in a day, and the calculated protein content and fuel value, would be as follows:

*Menu for family of four adults for one day.*

| Food materials.             | Weights.       |                | Protein.<br><i>Pound.</i> | Fuel<br>value.<br><i>Calories.</i> |
|-----------------------------|----------------|----------------|---------------------------|------------------------------------|
|                             | <i>Pounds.</i> | <i>Ounces.</i> |                           |                                    |
| <b>BREAKFAST.</b>           |                |                |                           |                                    |
| Oatmeal .....               |                | 8              | 0.081                     | 930                                |
| Milk .....                  |                | 6              | .012                      | 122                                |
| Sugar .....                 |                | 2              |                           | 232                                |
| Lamb chops (from leg) ..... | 1              | 8              | .240                      | 1,695                              |
| Bread .....                 |                | 8              | .046                      | 608                                |
| Butter .....                |                | 2              | .001                      | 451                                |
| Coffee <i>a</i> .....       |                |                | .010                      | 417                                |
| Total .....                 |                |                | .390                      | 4,455                              |
| <b>DINNER.</b>              |                |                |                           |                                    |
| Roast beef (chuck) .....    | 1              | 12             | .277                      | 1,435                              |
| Potatoes .....              |                | 12             | .014                      | 233                                |
| Sweet potatoes .....        |                | 12             | .011                      | 480                                |
| Bread .....                 |                | 6              | .035                      | 456                                |
| Butter .....                |                | 2              | .001                      | 451                                |
| Rice .....                  |                | 4              | .020                      | 408                                |
| Eggs .....                  |                | 4              | .030                      | 160                                |
| Milk .....                  |                | 6              | .012                      | 122                                |
| Sugar .....                 |                | 2              |                           | 232                                |
| Tea .....                   |                |                | .010                      | 410                                |
| Total .....                 |                |                | .410                      | 4,387                              |
| <b>SUPPER.</b>              |                |                |                           |                                    |
| Bread .....                 |                | 12             | .070                      | 912                                |
| Butter .....                |                | 2              | .001                      | 451                                |
| Bananas .....               |                | 12             | .006                      | 225                                |
| Cake .....                  |                | 8              | .032                      | 838                                |
| Total .....                 |                |                | .109                      | 2,426                              |
| Total for 3 meals .....     |                |                | .909                      | 11,268                             |
| Average for 1 person .....  |                |                | .227                      | 2,817                              |

*a* Coffee and tea in themselves have little or no nutritive value. In the menu, allowance is made for the milk or cream and the sugar that would ordinarily be added.

The American dietary standard for a man at moderate muscular work calls for 0.28 pound protein and 3,500 calories. It will be seen that the menu suggested above is insufficient, that is, more food must be supplied. For instance, cheese might be added for dinner, and pork and beans and milk for supper. The amounts of protein and energy which a sufficient quantity of these articles for four persons would supply are shown in the following table:

*Food added to bring the day's menu up to the dietary standard.*

| Food materials.                  | Weights.       |                | Protein.<br><i>Pound.</i> | Fuel<br>value.<br><i>Calories.</i> |
|----------------------------------|----------------|----------------|---------------------------|------------------------------------|
|                                  | <i>Pounds.</i> | <i>Ounces.</i> |                           |                                    |
| Cheese .....                     |                | 4              | 0.069                     | 536                                |
| Beans .....                      |                | 10             | .141                      | 0,005                              |
| Pork .....                       |                | 4              | .005                      | 918                                |
| Milk .....                       | 2              |                | .066                      | 650                                |
| Total amount added to menu ..... |                |                | .281                      | 3,109                              |

These additions would make the total protein 1.190 pounds and

the total fuel value 14,377 calories for four persons, or for one person, 0.298 pound protein and 3,599 calories. (For the sake of simplifying calculation no distinction is made between the amounts required by men and women.) These values are approximately the amounts required by the dietary standard.

Following the above method, the value of any menu chosen may be easily calculated. It should be borne in mind that approximate rather than absolute agreement with the dietary standard is sought. It is not the purpose to furnish a prescription for definite amounts of food materials, but rather to supply the means of judging whether the food habits of families accord in general with what research has shown to be most desirable from a physiological standpoint. If economy is necessary, a study of the tables will show that it is possible to devise menus which will furnish the requisite amounts of nutrients and energy at comparatively low cost.

#### DIGESTIBILITY.

The value of a food is determined not alone by its composition, but also by its digestibility; that is, by the amount of it which the body can retain and utilize as it passes through the digestive tract. The term digestibility, as frequently employed, particularly in popular articles, has several other significations. Thus, to many persons it conveys the idea that a particular food "agrees" with the user, i. e., that it does not cause distress when eaten. The term is also very commonly understood to mean the ease or rapidity of digestion, and one food is often said to be more digestible than another because it is digested in less time. However, the term digestibility is most commonly understood in scientific treatises on the subject to mean thoroughness of digestion. The digestibility of any food may be learned most satisfactorily by experiments with man, although experiments are also made by methods of artificial digestion. In the experiments with man both food and feces are analyzed. Deducting the amounts of the several nutrients in the feces from the total amounts of each nutrient consumed shows how much of each was digested. The results are usually expressed in percentages and spoken of as coefficients of digestibility. From a large number of experiments with man it has been calculated that on an average the different groups into which foods may for convenience be divided have the following coefficients of digestibility:

*Coefficients of digestibility of different groups of food.*

| Foods.                      | Protein.         | Fat.             | Carbohy-<br>drates. | Mineral<br>matters. |
|-----------------------------|------------------|------------------|---------------------|---------------------|
|                             | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i>    | <i>Per cent.</i>    |
| Animal foods .....          | 98               | 97               | 100                 | 75                  |
| Cereals and sugars .....    | 85               | 90               | 98                  | 75                  |
| Vegetables and fruits ..... | 80               | 90               | 95                  | 75                  |

Making use of these figures, the digestible nutrients furnished by any food may be readily calculated. Thus, as shown by the table on composition above, sirloin steak contains 16.5 per cent protein. One and one-half pounds would therefore contain 0.2475 pound protein, or in round numbers, 0.25 pound ( $1.5 \times 165 = 0.2475$ ). As shown by the coefficients of digestibility quoted above, 98 per cent of the protein of animal food is digestible. Therefore, 1.5 pounds sirloin steak would furnish 0.245 pound digestible protein ( $0.25 \times 0.98 = 0.245$ ). The digestibility of the several nutrients in a given quantity of any food may be calculated in a similar way.

Recommended for publication.

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Publication authorized:

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WASHINGTON, D. C., *April 5, 1901.*

