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FOOD AND DIETETICS

AMERICAN SCHOOL of HOME ECONOMICS
CHICAGO, ILLINOIS
U. S. A.

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FOOD AND DIETETICS

BY

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CHICAGO
AMERICAN SCHOOL OF HOME ECONOMICS
1910

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AMERICAN SCHOOL OF HOME ECONOMICS

CHICAGO

January 1, 1907.

Dear Madam:

In the study of the lessons on Food and Dietetics, full use should be made of the many interesting and valuable publications of the United States Department of Agriculture These are divided into the popular bulletins and pamphlets sent free to all in the United States and the more technical bulletins for which a nominal price is charged.

The free publications are included chiefly in the series of Farmers' Bulletins and in Extracts from Year Books, etc. The "for sale" bulletins are issued by the various divisions of the Department of Agriculture, those on food chiefly by the Office of Experiment Stations and the Division of Chemistry.

Any or all of the free publications may be obtained simply by addressing the Department of Agriculture, Washington, D. C. For the "for sale" bulletins coin or money order must be sent to the Superintendent of Documents, Washington, D. C. Postage stamps are not accepted.

The full list of free and "for sale" publications will be sent on request by the Department of Agriculture. A fairly complete list of the publications on food is given in the bibliography, but new bulletins are constantly being published. Their numbers, titles and contents are given in the monthly list of new publications which is sent free on request.

Bulletins of the various state agricultural experiment stations cannot be obtained from the U. S. Department of Agriculture, but summaries are given of the more important of these in the series of Farmers' Bulletins called Experiment Station Work, the contents of which are given in the list of free publications.

Of the "for sale" bulletins, two of the Office of Experiment Stations at least should be sent for--No. 28, American Food Materials, which gives the composition of all ordinary foods, price 5 cents, and No. 129, Dietary Studies in Boston, Springfield, Philadelphia and Chicago, price 10 cents,- interesting in connection with the cost of food. Farmers' Bulletin No. 142, The Nutritive and Economic Value of Food, should be read in connection with Part I.

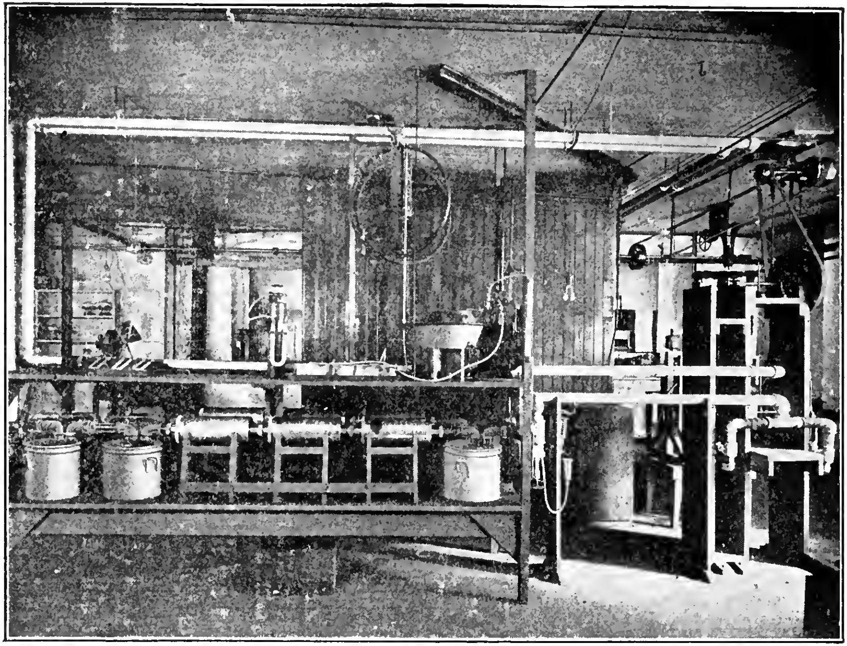
The food problem is a large one and although nutrition by no means depends entirely upon the composition of the food eaten, knowledge of the character and composition of food is fundamental in the selection of a healthful diet. In the last analysis, the food problem must always be an individual one based on conditions and personal peculiarities.

If difficulties or questions arise in connection with this series of lessons, remember that you are always privileged to write to the School for assistance and advice.

Sincerely yours,

W. L. E. Bosquet

Director



GENERAL VIEW OF THE RESPIRATION CALORIMETER, MIDDLETOWN, CONN.
From Year Book U. S. Department of Agriculture, 1904

FOOD AND DIETETICS

THE problems of the household are more difficult to-day than they have ever been, for each advance in science, each modern invention, has brought in its train new responsibilities and new duties. In every department of the administration of the home more knowledge and skill are required than ever before. With the increase of conveniences has come increased care. Standards of living have changed as well, and greater perfection in all household service is demanded of the home-maker. **Problems of To-Day**

We still carry on in the household many of the numerous trades that were formerly a part of the home life, as cooking, cleaning, laundry work, sewing. At the same time more close supervision of the life of the children, mental, moral and physical, is required; more knowledge is needed to control materials if we would have that power over our environment which makes us the masters and not the slaves of our belongings; and the social demands upon time and strength can not be ignored.

If to-day we would lead "the simple life," it must be as a result of determined effort, often in the face of more or less conscious opposition on the part of relatives and friends and of society in general. **The Simple Life**

Essentials and Non-Essentials

Yet a simpler life is not to be attained by ignoring the results of science, and refusing to apply the knowledge made available by the investigator; but rather by making use of every help that will give knowledge of the materials with which we work, that will cultivate the power to distinguish between the essential and the non-essential, and that will give control of the situation.

The Food Problem

The food problem is perhaps the most difficult of all the physical problems that present themselves in the household, partly because it is so vital to the welfare of the family, and partly because it is so inclusive. The food question once meant the providing something palatable and presumably wholesome at a cost within one's means. To-day it implies a knowledge not only of the cost and nutritive value of food materials, their composition and digestibility; but of the balanced ration, the proportion of different food principles necessary for perfect nourishment, and of the way in which this proportion should be varied to suit the needs of the child or of the aged, of the laborer, or of the student. An understanding of the principles involved in the preparation of food is demanded, as well as a knowledge of food adulterations that will insure pure food materials.

The importance of the question can scarcely be exaggerated. Mrs. Ellen H. Richards tells us that "the prosperity of a nation depends upon the health and morals of its citizens; and the health and morals of a people depend mainly upon the food they eat, and the homes they live in. Strong men and women can not be raised on insufficient food; good tempered, temperate, highly moral men can not be expected from a race which eats badly cooked food, irritating to the digestive organs and unsatisfying to the appetite. Wholesome and palatable food is the first step in good morals, and is conducive to ability in business, skill in trade, and healthy tone in literature."

A Means to an End

It is quite true that we may put food in a wrong position, making it an end rather than a means in living. We should eat to live, not live to eat. Yet we must keep in mind that right food, clothing and shelter are the primary conditions of health, and that health is essential to the most complete happiness and to the highest usefulness.

Some one has said that "well dressed men and women, well fed men and women, are still an ethical possibility of the future." However this may be in regard to dress, certainly an age that has devoted so much time and thought to feeding on the stock farm, so much attention to the right nutriment for plants, and that has solved so many difficult problems in these directions, should be able to lay down the principles which govern the diet of human beings.

Importance of the Food Problem

While the food question then is by no means the one thing in housekeeping as it is apparently so often considered, it yet is of real and vital importance; and the housekeeper who desires to make the most of her opportunities to contribute to the extent of her ability to the welfare of her family, should master the principles of diet so far as they are known, should keep an open mind toward new knowledge, and should apply with discretion and intelligence the knowledge now available in this direction.

THE COST OF FOOD

The first practical question that will appeal to the housekeeper in regard to food is its cost. Long before she asks what proportion of carbohydrate, of fat, and of proteid she must provide for her family, the question, "What shall I spend for food?" appeals to her, and indeed she is often forced by absolute necessity to decide the question. Later, "How shall I spend?" will be the important problem.

Proportion of Income for Food

Two main questions are involved. First, What proportion of the family income may go for food? What is the relation of the expenditure for food to that for rent, for clothing, for travel and amusement, for books and education? Second, What is the minimum cost per individual of food sufficient to give necessary nourishment? How much shall this minimum cost be exceeded for the sake of added attractiveness, increased digestibility, or adaptation to individual taste?

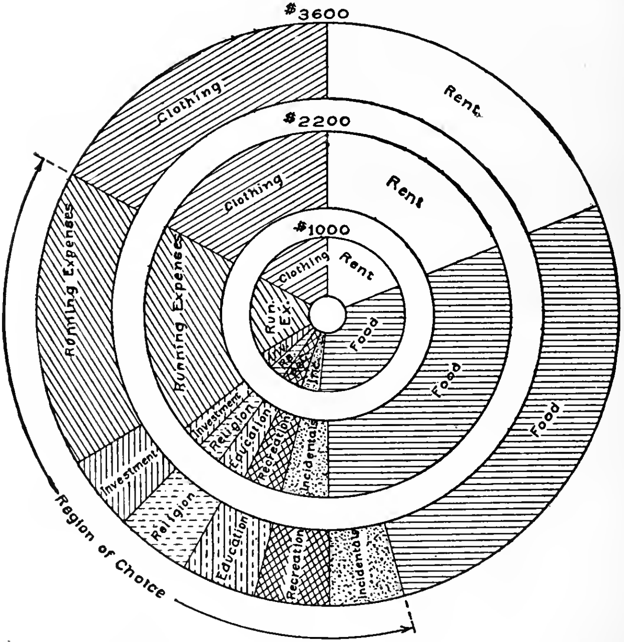
Raw Food Only Part of Cost

Nor is the cost of food a question of raw material alone. The amount of waste must be considered, the cost of the fuel used in cooking, and the cost of service. These often triple the original cost of the food.

Mr. Atkinson has said that half the cost of life is the price of food. This broad statement is true only in the case of the small income. A fairer interpretation of the matter is given by Dr. Engel, who has formulated four laws that in the main seem to hold, both in ideal and actual budgets. As quoted in *The*

DIVISION OF INCOME CHART

Typical Family of Two Adults and Three Children



Running Expenses include Wages, Fuel, Light, Ice, Etc. With $1,000 Income the Children Would be Educated in the Public Schools.

The above chart was adapted from a large colored chart prepared under the direction of Mrs. E. H. Richards for the Mary Lowell Stone Exhibit on Home Economics.

Cost of Living, the first of these laws is "that the proportion between expenditure and nutriment grows in geometric progression in an inverse ratio to well-being; in other words, the higher the income, the smaller is the percentage of the cost of subsistence." That is, while clothing, rent, heating and lighting keep a nearly invariable proportion, whatever the income, the proportion expended for food varies from sixty per cent in an income of three hundred dollars to twenty-five per cent or less in the three thousand dollar income.

Cost per Person per Day

In discussing the amount of money needed for food, it is usual to consider the amount expended for each individual per day. How much is necessary to supply the required nourishment depends upon various factors. The locality will be important. As a rule, country prices are lower than those in the city, while in different sections of the same city there may be wide variation. Eastern prices differ from those of the middle west, and these again from those prevalent in the far west or the south. In institutions where food is purchased in large amounts, the cost is less per person than in the individual household. An absolutely definite statement is, therefore, impossible, but a number of experiments have shown that a sufficient amount of the simplest raw food material may, under favorable circumstances, be furnished for from eight to ten cents a day per person. This implies the absolute exclusion of all but the cheapest materials. Fifteen cents for each person means a less limited choice in raw materials, but the most careful management and the strict denial of anything approaching luxury. For twenty-five cents a day, one may add to the dietary a limited amount of fresh fruit and vegetables in season, coffee and other beverages, a fair supply of milk, and may furnish a satisfactory variety of food, while forty cents per person gives an excellent table with added luxuries, though it will not purchase fruit out of season, such as strawberries in January, nor give an unlimited supply of high priced game and similar delicacies.

Standards

In deciding what one of these standards to adopt, the number of members in the family and the total amount of income must be considered. The typical economic family, on which estimates are made, is one of five members, two adults and three children, or four adults. The real family often has six or eight members, and this additional number must modify the application of economic theories to real life.

True Food Economy

It is not desirable to cut down the expenditure for food to the lowest point at which nutritive food may be obtained if the income justifies a larger expenditure. *Economy does not mean spending a small amount, but expending money in such a way that it may bring in the largest return.*

Cost of Cooking

The cost of cooking modifies the expenditure for raw material. Often a cheap food, requiring long cooking, is in the end more expensive than a higher priced food requiring only a short cooking. This difference is particularly marked in the case of such a fuel as gas. With a coal stove careful planning for the utilization of all the heat may mean only the difference between the wasting of heat and the using of it. For example, the beans baking in the oven while ironing is going on add practically nothing to the amount of fuel used, while the beans baked in the gas oven must have the cost of the gas consumed added to their cost. It is quite possible that a cheap, tough piece of meat might consume so much gas in the long cooking necessary to stew it that its cost would be raised nearly to that of the more expensive cut that it supplanted.

Cost of Labor

Another element in the cost of food is that of the labor consumed in preparation and in service. The time taken to prepare a certain dish must be added to the cost of the raw materials before we can fairly estimate the cost of that dish. It must be remembered, however, that a dish requiring long cooking does not necessarily involve the expenditure of much time in preparation.

In a certain hotel having a large number of guests it was estimated that the extra time required to add a sprig of parsley to each plate of meat served meant the employment of an additional helper for the equivalent of one day a week. In the private family, the difference between a dinner served in three courses, or in four, means an expenditure of additional time that has a definite money value.

Waste of Food

The waste of food must also be considered. This is of two kinds, necessary waste, and needless waste. It is foolish to say, as some have done, that the garbage can might be eliminated from our houses if greater care were taken. The parings of potatoes, the husks of corn, the pods of peas, must always be refuse. In one experiment it was found that because of the cost of service, it was cheaper to allow thick parings of potatoes to be thrown away than to pay for the care that would insure thin parings. On the other hand, the head of a certain institution found that the careful paring of the potato meant the actual saving of a large number of bushels each year. Mrs. Richards says, "It is not food actually eaten that costs so excessively; it is that wasted by poor cooking, by excessive quantity and by purchase out of season when the price is out of all proportion to its value.

Amount Harmony Flavor

"Good judgment as to the amounts to be prepared, as to the harmony of the meal, the blend of flavor; as to the right appetizers; and good humor and cheerful conversation, with the most attractive setting and perfect serving, will cut down the cost of almost any table one-half. Many seem to hold the idea that hospitality requires the setting of a double portion before the guests, and this alone doubles the cost of food in some families."

She says again, "In no other department of household expenditure is there so great an opportunity for the exercise of knowledge and skill with so good results for pocket and health; no item of expense is so fully under individual control."

Economical Cookery

On the other hand, Thudicum, in his *Spirit of Cookery*, refers to "the delusion of economical cookery with scraps costing nothing." He speaks of what is termed "the fearful waste in English kitchens," and says, "When we proceed to investigate the items of the alleged waste, we find them to consist of stale lumps of bread, bacon rind, and bare bones of boiled or roast joints." He quotes with scorn and denial a prominent medical journal which says, "The French cook makes excellent and nutritious soup out of materials which the English housewife throws away as useless; while her pot-au-feu is composed of stray scraps carefully husbanded, which cost her nothing, but which, when skilfully combined, constitute a useful and inexpensive food."

True Cost

Perhaps the truth lies between the two extremes. To set an attractive table costs something in raw food material, in equipment and in service. The snowy table cloth, always spotless, so often suggested in newspaper articles as a substitute for expensive food, means the expenditure of time, money and energy. The soup made from "scraps" involves expenditure of time and fuel, if not of money with which to purchase fresh material. The cost of saving may outweigh the cost of material saved. But that there is much unnecessary waste in the average household can not be denied. Nor is the mere money value of the material wasted the most serious part. The habits of carelessness and extravagance engendered show themselves in a lack of responsibility for material and indifference toward useless expenditure of time and energy as well as money, and in general thoughtlessness.

Conditions Alter Cases How the money to be expended shall be distributed between different food materials must be largely a matter for the individual housekeeper since conditions vary so greatly. As a rule, vegetable foods are cheaper than animal. This may be counter-balanced by the more easy digestibility of the animal food, as we shall see in a later discussion. Whether one food or another is the cheaper source of a particular food principle depends upon the percentage composition and comparative cost of these foods. As is seen in Table I, potatoes at two cents per pound, i. e., 30 cents per peck, cost almost twice as much, so far as actual food value is concerned, as rice at five cents per pound. When rice is ten cents per pound, as it is in many places at present, and potatoes are one cent a pound, conditions are reversed. Sweet potatoes at five cents a pound must be definitely considered as a luxury when white potatoes may be had for one cent at the same place.

TABLE I

Some Important Foods Considered as to Their Nutritive and Economic Values.

	Refuse, per cent.	Water, per cent.	Proteid, per cent.	Fat, per cent.	Carbohydrates, per cent.	Calories, per lb.
Nuts (peanuts, edible portion)	....	9.2	25.8	38.6	24.4	2560
Sugar (granulated)	....	....	....	....	100	1857
Cornmeal (bolted)	....	12.9	8.9	2.2	75.1	1655
Wheat flour (roller process)	....	12.5	11.3	1.1	74.6	1645
Rye flour	....	12.7	7.1	.9	78.5	1630
Rice	....	12.4	7.8	.4	79	1630
Legumes (dried)	....	13.2	22.3	1.8	59.1	1590
Meats (as purchased about)	12	55	16	1.5	....	928
Fish (fresh)	30	45	12	4	....	388
Potatoes	15	67.1	1.8	.1	15.3	325
Milk	....	87	3.3	4	5	325
Bananas	40	44.5	.7	.5	13.7	290
Fruit (apples, grapes, etc.)	25	60	1	.9	12.9	285

Wheat flour at	2	cents	per	pound	furnishes	3000	calories	for	3.6	cents.
Cornmeal at	3	"	"	"	"	"	"	"	5.4	"
Wheat flour at	4	"	"	"	"	"	"	"	7.2	"
Rice at	5	"	"	"	"	"	"	"	9.2	"
Potatoes at	1	"	"	"	"	"	"	"	9	"
Legumes at	8	"	"	"	"	"	"	"	15	"
Milk at	2	"	"	"	"	"	"	"	18	"
Potatoes at	2	"	"	"	"	"	"	"	18	"
Nuts(kernels)at 16 cents			"	"	"	"	"	"	19	"
Cheese (American pale) at 14				"	"	"	"	"	20	"
Fruit at 2 cents per pound					"	"	"	"	21	"
Milk at 3½ (7 cents a qt.)					"	"	"	"	32	"
Beef (medium fat) at 15 cents (15% bone)					"	"	"	"	47	"
Beef (sirloin) at 25 cents per pound					"	"	"	"	69	"
Eggs at 25 cents per dozen					"	"	"	"	115	"

(From *The Cost of Food*, by Mrs. Ellen H. Richards.)

Finding the Cost of Food

The most satisfactory way to get at the cost of food per individual in a family is to keep careful accounts over a considerable period of time, both of the actual expenditure for food, and of the number of meals served. To make an experiment for a definite time, one month for instance, look over the material on hand, estimating as accurately as possible the amounts of flour, of sugar, of spices, etc. At the end of the month, again take account of stock and estimate the value of the materials on hand. Add the difference if there is less, and subtract the difference if there is more, to the amount expended during the month, and the result will be the cost of the food.

The following tables are records of actual expenditure for food. Table II gives the expenditure in two institutions in an eastern city, where, under the direction of an expert, effort was made to provide a sufficient amount of food at the lowest price.

The left-hand table gives the expenditure for food in a house of correction and the right-hand table for that in an orphans' home. In this table it will be noticed that one of the largest expenditures was for milk. The cost for food at the officers' table was about the same in both institutions. Provisions were bought at wholesale prices,

TABLE II

Average Daily Cost of Food Materials per Person in Two Public Institutions in Boston.

	Inmates	Officers	Inmates	Officers
Number of Persons Fed	523	73	333	35
	Cents	Cents	Cents	Cents
Meat and fish (fresh or salt)	4.67	23.13	1.59	19.60
Eggs		1.14		1.29
Cheese		0.26	0.16	0.20
Milk	0.93	3.13	3.75	5.02
Butter and Lard		3.16	0.07	2.97
Flour, cornmeal, crackers	2.22	0.75	1.88	1.19
Oatmeal, hominy, rice	0.46	0.12	0.27	0.35
Peas, Beans	0.26	0.04	0.12	0.11
Tapioca, sago, cornstarch		0.04	0.04	0.08
Sugar	0.62	0.67	0.29	1.27
Dried fruits		0.06		0.24
Potatoes	0.38	0.57	0.17	0.53
Fresh vegetables	0.26	0.48		0.38
Apples	0.02	0.26		0.11
Molasses	0.04	0.04	0.03	0.06
Cost per day per person	9.86	33.85	8.37	33.40

(From Report of Institutions Commissioner of the City of Boston for 1897.)

Experience of College Girls

Table III is a record from the middle west, and is taken directly from the expense account of three college girls who were trying to keep the cost of living as low as possible. There is no pretense to an ideal diet. Probably it was low in proteid, but the girls lived and apparently thrived upon it.

TABLE III

Weekly Expense Account for Food for Three People.

Second Week in October, 1903.	
Navy Beans	.25
Sardines	.05
Butterine	.20
Meal, corn	.20
Apples	.20
Bananas	.10
Bread	.10
Flour	.10
Crackers	.10
Potatoes	.25
Beef	.40
Salt pork	.07
Bread	.20
Butter	.13
Butter	.20
Prunes	.05
Celery	.05
Milk	.51
	$3.16

Third Week in October, 1903.	
Bread	.05
Grapes	.35
Bananas	.15
Raisins	.10
Crackers	.10
Bread	.10
Cheese	.20
Meat	.13
Milk	.51
Meat	.15
Cranberries	.10
Cranberries	.10
Crackers	.10
Oleo	.20
Pork	.05
Bread	.10
Salt	.10
	$2.59

Second Week in April, 1904.	
Bread	.15
Pork, fat	.05
Radishes	.05
Cookies	.15
Grapes	.20
Crackers	.10
Bread	.05
Honey	.12
Beefsteak	.10
Crackers	.20
Bananas	.08
Oranges	.10
Lettuce	.05
Beef, boil	.30
Potatoes	.40
Bread	.05
Strawberries	.10
Bread	.05
Milk	.51
Apple butter	.10
	$2.91

Third Week in April, 1904.	
Soda crackers	.10
Crackers	.10
Can Tomatoes	.10
Ham	.15
Bread	.05
Oranges	.20
Beans	.05
Crackers	.10
Eggs	.18
Flour	.10
Bread	.05
Apple butter	.10
Nuts	.03
Macaroni	.15
Sugar	.25
Blackberries	.20
Beans	.05
Pork steak	.10
Pickles	.10
Hamburg steak	.15
Butter	.25
Milk	.51
	$3.07

Total cost for three people for twenty-eight days $11.83

Average cost for one person for one day 0.141

Liberal Table with High Prices

Table IV shows the expenditure in a summer home in the mountains. In this case no effort was made to reduce expense by excluding articles desired, but true economy was practiced in careful planning of meals and in utilizing all material.

TABLE IV

Expenditure During the Summer of 1903, in a Mountain Town in New England, Some Miles from a Railroad.

	Lbs.	Proteid	Fat	Carbohyd'te
Fish	44.5	5.9345	2.057	....
Meats	83.88	24.259	25.9495	....
Soups	4.	.088	.022	....
Dried Fruit	3.5	.0805	.1065	2.6735
Dairy	343.1	13.616	49.681	14.354
Cereals	28.	2.3775	.3615	19.099
Bakeries	16.	1.352	1.327	10.597
Sugar and starches	151.16	11.680	3.719	116.717
Fruit	87.	.564	.303	11.349
Vegetables	250.5	8.915	3.775	36.06
293 Days (1 person)	1011.64	68.866	87.441	210.8495
Each day per pers'n	3.45 lbs.	106.5 grams	135.17 grams	326.1 grams
		3.76 oz.	4.78 oz.	11.51 oz.

Total cost, $114.14. Cost per day, per person, $0.39.

The number of meals served was 878. This is taken as equivalent to 293 days for one person.

The prices of some of the chief articles of food are given here.

Beef roast....20 cents per pound
Beef steak....28 " " "
Lamb roast...18 " " "
Lamb chops..25 " " "
Veal " ..20 " " "
Chicken.......25 " " "
Fowl..........20 " " "
Halibut.......16 " " "

Salmon.......30 cents per pound
Haddock...... 6 " " "
Potatoes 20 and 25 cents per peck
Cream.........25 cents per quart
Milk.......... 5 " " "
Butter.. ......28 " " pound
Eggs...28 and 30 cents per dozen

The following tables give in detail the weight and composition of the various food used.

Fish

	Lbs.	Prot.	Fat	Carb.
Mackerel	12½	1.275	.525	....
Salmon	4	.612	.356	....
Halibut	6	.918	.264	
Haddock	8¼	.693	.0165	
Dressed Cod	2	.222	.004	
Lobster	1½	.0835	.003	
Blue fish	2¼	.225	.0135	
Cod (salt)	3	.762	.009	
Herring	2	.224	.078	
Sardines	4	.92	.788	
	44.5	5.9345	2.057	....

Meats

	Lbs.	Prot.	Fat	Carb.
Steak	14¼	3.405	1.4535	
Lamb	12¾	7.006	9.799	
Veal	4¾	.954	.357	
Chicken	13⅞	2.984	.346	
Pork (salt)	1½	.106	1.002	
Ham	14¾	2.978	3.304	
Fowl	2½	.482	.407	
Bacon	4½	4.095	2.6685	
Lard	5		5.000	
Sl. Ham	1	.192	.162	
Pot. Ham	1	.095	.1705	
Chicken	1	.128	.014	
Corn beef	4	1.052	.748	
Dried beef	1	.392	.054	
Tongue, Ox	2	.390	.464	
	83.88	24.259	25.9495	

Soup

	Lbs.	Prot.	Fat	Carb.
Julienne	1	.027		....
Tomato	2	.036	.022	....
Corn	1	.025		
	4	.088	.022	

Dried Fruit

	Lbs.	Prot.	Fat	Carb.
Seed raisins	3	.078	.099	2.283
Citron.	½	.0025	.0075	.3905
	3½	.0805	.1065	2.6735

Dairy

	Lbs.	Prot.	Fat	Carb.
Eggs	27.6	3.643	3.312	....
120 qts. milk	240.	7.920	9.60	12.00
19¼ qts. cream	38.5	.962	7.022	1.732
Cheese	3.	.751	.847	.622
Butter	34.	.34	28.9	
	343.1	13.616	49.681	14.354

Cereals

	Lbs.	Prot.	Fat	Carb.
Rice	4½	.126	.004½	1.098
Wheat	4	.484	.072	3.008
Sh. Wheat	1	.105	.014	.779
Farina	1	.11	.014	.763
Corn Meal	12	1.104	.228	9.048
Hominy	3½	.290½	.021	2.765
Rice Fl.	2	.158	.008	1.638
	28	2.377½	.361½	19.099

Bakeries

	Lbs.	Prot.	Fat	Carb.
U. Biscuits	2	.196	.182	1.462
Bread	6	.486	.414	3.252
Gin. Snaps	2	.130	.172	1.52
Van. Cr.	1	.066	.140	.716
Mis. Cookies	2	.134	.192	1.448
Water Cr.	2	.234	.10	1.514
Saltines	1	.106	.127	.685
	16	1.352	1.327	10.597

Sugars and Starches

	Lbs.	Prot.	Fat	Carb.
2 qts. Molasses	6	.144		4.158
Sugar	40			40.
1 gal. Syrup	8			11.016
Maccaroni	1	.402	.027	2.223
S. D. Flour	70	7.70	.63	42.08
F. M. Flour	15	2.07	.285	10.785
Rye Flour	3	.204	.027	2.361
Spaghetti	2	.242	.008	1.526
Honey	2	.008	....	1.624
Chocolate	2½	.322	1.217	.657
Almonds	1⅔	.588	1.525	.287
	151⅙	11.680	3.719	116.717

Fruit

	Lbs.	Prot.	Fat	Carb.
Oranges	3	.024	.006	.348
Lemons	6	.06	.024	.510
Currants	1	.015	....	.128
Raspberries	1	.017	.01	.126
Melons (12)	12	.036	....	.552
5 doz. peaches	7	.05	....	.03
Apples	25	.100	.125	3.550
Plums	2	.02	....	.402
Bananas	1½	.019	.009	.55
Box berries	1	.017	.01	.126
Grapes	5	.065	.08	.960
3 pears	½	.003	.002	.071
2 pineapples	4	.016	.012	.388
3 canteloupes	3	.009		.138
Canned peaches	4	.028	.004	.432
Pears	1	.003	.003	.180
Cherries	4	.044	.004	.844
Qr. Mar	2	.012	.002	1.690
Quince	2	.014	.002	.216
Currants	2	.012	.012	.108
	87	.564	.305	11.349

Vegetables

	Lbs.	Prot.	Fat	Carb.
Sweet Pot.	31	.93	.656	13.051
Beets	30	.480	.03	2.910
Potatoes	82½	2.062	.26	5.430
Peas	29	2.03	1.18	4.901
Beans	5	.115	.15	.370
Squashes	2	.028	.01	.180
Cabbage	10	.160	.30	.560
Tomatoes	20	.18	.08	.780
Carrots	2	.022	.008	.186
Olives	1	.008	.202	.08
Mushrooms	2	.07	.008	.136
Baked beans	20	1.38	.800	3.920
Asparagus Tips	10	.210	.330	.220
Corn	1	.031	.011	.197
Split Peas	4	.984	.04	2.480
Dried beans	1	.225	.015	.659
	250.5	8.915	4.08	36.060

A Typical Investigation

As an example of fairly attractive menus with low priced foods, the following extract from Bulletin No. 129 of the Office of Experiment Station, U. S. Department of Agriculture, by Miss Bertha M. Terrill, may be of interest:

"In February, 1902, the students of the Bible Normal College, situated then in Springfield, Mass., voted to save a sum of money, which they desired to raise for a special object, by reducing the cost of their table board. They had been paying $3 per week for table board at the time, or very nearly 43 cents per person per day, which of course included the cost of fuel, preparation, and service, estimated to be 10.6 cents per person per day. Learning that it has been found possible to provide a balanced and nourishing diet for 10 cents per man per day for the raw food, they entered eagerly into an experiment with a diet to cost that amount for food materials only, the cost of preparation, etc., to remain the same as before, making the total cost of the daily food as served 20.6 cents per person, or 22.4 cents less than their ordinary diet. There were 30 students interested in this project, and it was planned to continue the investigation three days, as this would suffice to save the $20 desired." * *

The menus for the different days covered by the study were as follows:

SATURDAY, FEBRUARY 8.

Breakfast.—Oatmeal and top of milk, fish cakes, toast (with a little butter), prunes, milk and cereal coffee.

Dinner.—Beef soup, croutons, beans (baked with pork), brown bread, apricot shortcake.

Supper.—Sandwiches (cheese and jelly), white and graham bread (no butter), sliced bananas, milk.

SUNDAY, FEBRUARY 9.

Breakfast.—Corn-meal mush and top of milk, baked beans, buns, milk and cereal coffee.

Dinner.—Split-pea soup and crackers (crisped), potted beef, brown sauce, baked potatoes, bread, rice with milk and sugar.

Supper.—Brown-bread sandwiches (with a little butter), white-bread sandwiches with date and peanut filling without butter, cocoa, popcorn salted.

MONDAY, FEBRUARY 10.

Breakfast.—Oatmeal with top of milk, cream toast, cereal coffee.

Dinner.—Baked-bean soup. crisp crackers, Hamburg steak balls, brown sauce, hominy, turnip, peanuts and dates.

Supper.—Potato and beet salad, gingerbread, cheese, bread, milk.

TUESDAY, FEBRUARY 11.

Breakfast.—Wheat breakfast food and dates, creamed codfish muffins (with little butter), milk and cereal coffee.

Dinner.—Beef Stew with biscuits, bread pudding, bread.

Supper.—Scalloped meat and potato, bread (with butter), prunes chocolate candy "fudge."

WEDNESDAY, FEBRUARY 12.

Breakfast.—Oatmeal with top of milk, hash, corn cake, milk and cereal coffee.

Dinner.—Vegetable soup, croutons, baked stuffed beef's heart, brown sauce, rice, cornstarch blanc mange, caramel sauce.

Supper.—Potato and celery salad, white and graham bread, fried corn-meal mush, sirup,

THURSDAY, FEBRUARY 13.

Breakfast.—Corn-meal mush with top of milk, hashed meat on toast, milk and cereal coffee.

Dinner.—Salt salmon, drawn butter sauce, baked potatoes, parsnips, bread, evaporated apple shortcake.

Supper.—Cold sliced beef's heart, creamed potatoes, cocoa, bread (white and graham), ginger snaps.

The Family

"The family in this experiment consisted of 30 students—26 women and 4 men—ranging in age from 25 to 45 years. Considering the 4 men as equivalent to 5 women as regards food consumption, the family for six days was equivalent to 186 women for one day.

Cost of Food

"The cost of the diet, 9.4 cents per woman per day, was just within the limit set, but the quantities of nutrients and energy (75 grams of protein and 2,243 calories) were somewhat smaller than was intended.

"The low cost of the diet in this experiment was made possible by the selection of simple and inexpensive food materials and by reducing the quantities of some foods commonly used rather abundantly, as meat and butter. Most of the students felt quite satisfied with the food. The curtailing of the amount of butter served at the table was considered the greatest deprivation; a small pat, about half the customary size, being served to each where butter is indicated with bread on the menu.

Economy and Nourishment

"The importance from the standpoint of economy of selecting foods which are nourishing rather than those having a low food value but which please the palate and add to the attractiveness of the diet, is illustrated by a dietary study made of a family in New Jersey in which it was found that $2.16 was expended in three weeks for oranges and $3 for celery, making a total of $5.16 for these two articles, which together furnished only 150 grams of protein and 6,445 calories of energy. During the same period $5.16 was also expended for cereal foods and sugars, which supplied 3,375 grams of protein and 184,185 calories of energy, or about twenty-five times the amount furnished by the oranges and celery. Of course, the sum expended for these articles was not excessive and they undoubtedly helped to make the diet palatable and pleasing, a by no means unimportant consideration, but it is evident that they were not economical sources of nutritive material.

Dainty Serving

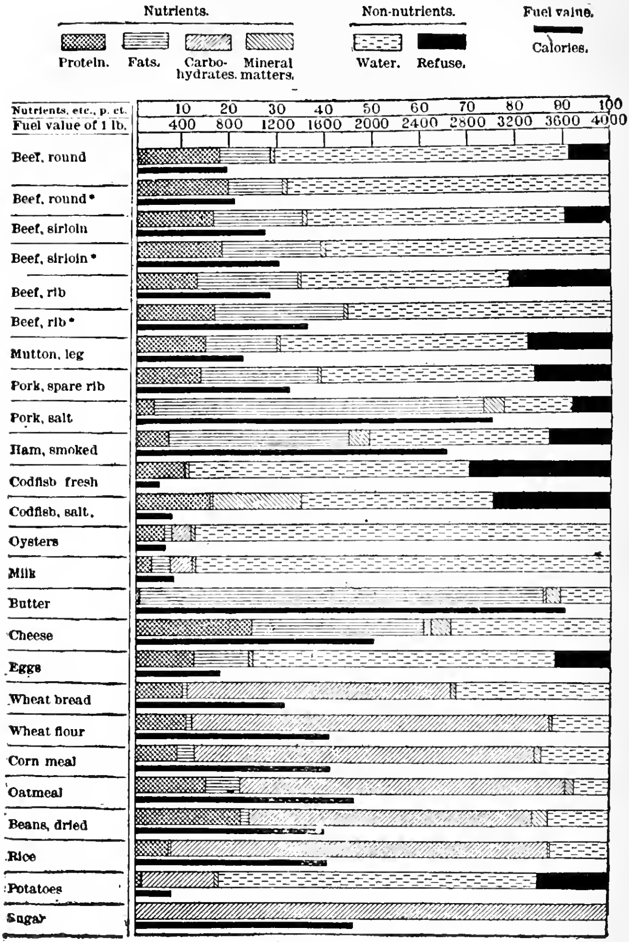
"In the present investigation it was found to be well worth while to use special care in arranging the dishes for serving, that they might be as appetizing in appearance as possible. Much care was also observed in avoiding waste both by careful preparation and by the use of all 'left overs.'"

In the following table is given the details of cost, weight and nutritive value of the food used in this investigation.

Weights and Cost of Food and Nutrients

Food consumed during the entire study (6 days).		Cost, nutrients, and fuel value per woman per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Dols.*	*Cts.*	*Gms.*	*Gms.*	*Gms.*	*Calories.*
Beef: Hearts, 11 lb., 38c.; round, 10.5 lb., $1.05; rump, 10 lb., 80c.: shank, fore, 3 lb.; brisket (stew), 7.25 lb., 50c	2.73	1.5	15	19	......	229
Pork: Bacon, 2 lb., 30c.; salt pork, 2 lb., 18c.; lard, 1 lb., 12c.	.60	.3	1	8	......	75
Fish: Cod, salt, 4 lb., 42c.; salmon, salt, 5 lb., 40c	.82	.4	5	2	......	38
Eggs, 1 lb., 33c	.33	.2	......	......	......	......
Butter, 9 lb., $2.25	2.25	1.2	......	19	......	169
Cheese, 2 lb., 30c	.30	.2	1	2	......	22
Milk, 210 lb., $2.70	2.70	1.4	17	20	26	350
Total animal food	9.73	5.2	39	70	26	883
VEGETABLE FOOD.						
Cereals: Corn meal, 10 lb., 29c.; pop corn, 1 lb., 5c.; hominy, 1.44 lb., 5c.; oatmeal, 4.5 lb., 15c.; rice, 4 lb., 28c.; graham flour, 10 lb., 25c.; white flour, 66 lb., $1.55; crackers, Boston, 0.75 lb., 4c	2.66	1.4	27	4	178	856
Sugars, starches, etc.: Sugar, granulated, 20 lb., $1; molasses, 2.33 lb., 36c.; cornstarch, 0.33 lb., 2c.; cocoa, 1 lb., 17c.; chocolate, 0.12 lb., 5c	1.60	.9	1	1	54	229
Vegetables: Beans, lima, 2 lb., 18c.; beans, pea, 2.44 lb., 10c.; beets, 1.25 lb., 4c.; cabbage, 5 lb., 10c.; carrots, 1.25 lb., 2c.; celery, 2.06 lb., 10c.; parsnips, 4.69 lb., 15c.; peas, split, 1.69 lb., 13c.; potatoes, 80 lb., $1.47; turnips, 5.5 lb., 7c	2.36	1.3	7	1	41	201
Fruits, nuts, etc.: Apricots, 1.5 lb., 17c.; bananas, 7 lb., 30c.; dates, 2 lb., 12c.; prunes, 2 lb., 18c.; raisins, 0.25 lb., 2c.; peanuts, 2 lb., 25c.; crab-apple jelly, 0.2 lb., 3c	1.07	.6	1	2	13	74
Total vegetable food	7.69	4.2	36	8	286	1,360
Total food	17.42	9.4	75	78	312	2,243

Chart of Composition of Foods

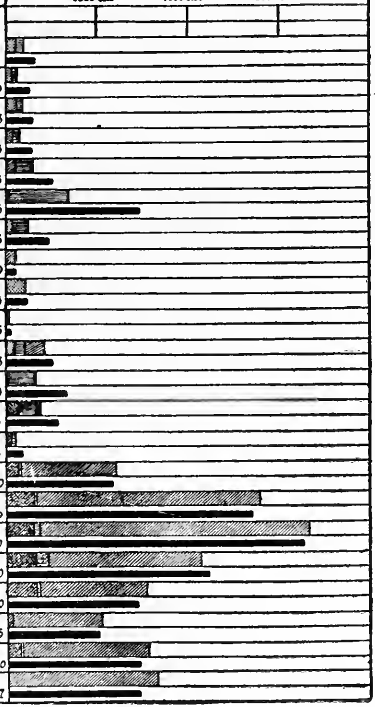


* Without bone.

Chart of Pecuniary Economy of Food

Protein. Fats. Carbohydrates Fuel Values

FOOD MATERIALS	Price per pound (Cents)	Ten cents will buy (Lbs.)	Pounds of nutrients and calories of fuel value in 10 cents worth. (1 lb 2000 Cal; 2 lbs 4000 Cal; 3 lbs 6000 Cal)
Beef, round	14	.71	
Beef, sirloin	20	.50	
Beef, shoulder	12	.83	
Mutton, leg	16	.63	
Pork, loin	12	.83	
Pork, salt, fat	12	.83	
Ham, smoked	18	.56	
Codfish, fresh, dressed	10	1.00	
Codfish, salted	7	1.43	
Oysters, 35 cts per quart	18	.56	
Milk, 6 cents quart	3	3.33	
Butter	25	.40	
Cheese	16	.63	
Eggs, 24 cents dozen	16	.63	
Wheat bread	5	2.00	
Wheat flour	3	3.33	
Corn meal	2½	4.00	
Oat meal	4	2.50	
Beans, white, dried	5	2.00	
Rice	8	1.25	
Potatoes, 60 cents bushel	1	10.00	
Sugar	6	1.67	



From Farmers' Bulletin, No. 142.

Composition

It is impossible to decide intelligently how the money available for food shall be distributed among different food materials without understanding something of the composition of these food materials, and of the relation of food to the needs of the body. Experience has taught us many things, but the accumulation of experience needs interpretation by definite scientific knowledge. Until lately this knowledge was in the hands of only a few, and even then in so indefinite a form that it was not available for the housekeeper, no matter how well trained, and hardly for an educated physician.

Much progress has been made, but even to-day the housekeeper is often a little slow in availing herself of the knowledge she needs. This is partly because of the common feeling that what our fathers and mothers knew is enough for us, and partly because so much of the information is still locked up in more or less technical books, and the ordinary housekeeper, even though she be well educated, has not the key. It is to furnish the key to some of this knowledge that this series of lessons is written.

Function of Food

We all know in a general way that food nourishes us and makes us strong. But when we try to interpret this general idea into specific terms we find that we do not realize its meaning. Nothing is in the strict sense a food unless it performs at least one of three functions, (1) that of building the body, (2) furnishing heat, and (3) giving power to work.

Building Foods

The first function of food, that of building the body, is exercised not only in the growing child, where the material that can be transformed into bones and muscles, blood and nerve tissue, must be furnished by food, but in the adult, since even after growth has ceased, the constant waste of the body tissue must be repaired by food. So far as this function is concerned, the composition of the body must determine to a great extent the kind of material that may be used as food. It is easy to see that the body can be built only by foods containing the same elements, and that the proportion of these elements must bear some relation to their proportion in the body. It is reasonable to expect that the elements are combined in food in a way similar to that in which they are combined in the body

Composition of the Body

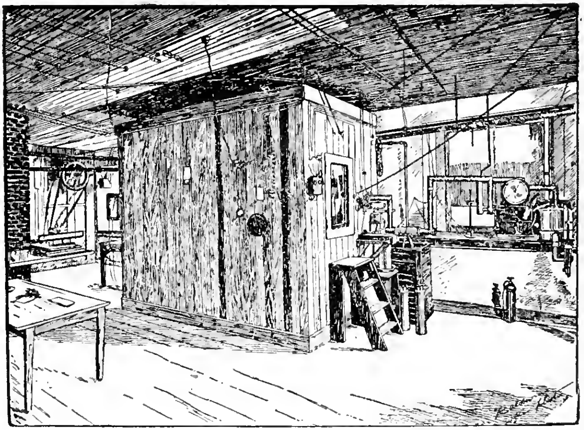
The body of a man of average weight has been estimated to contain the following amounts of the various combinations known as the proximate principles:

Water	108 lbs.
Mineral matter	11.00
Proteid	29.75
Fat	5.00
Carbohydrates	.25
Total	154.00

It will be judged from this that so far as the organic food principles proteid, carbohydrate and fat are concerned, proteid holds the chief place as a tissue former.

Fuel and Energy Foods

Not only must the body have its actual material furnished by the food, but from this also must be derived its energy.



ATWATER'S RESPIRATION CALORIMETER.

A Man Lives in the "Box" for Days and the Actual Heat and Energy Obtained from the Food Consumed is Determined. (See page 52.)

The two forms of energy with which we are especially concerned in our study of the body are heat and power to work.

Heat

Heat is required to maintain the body temperature necessary in order that the processes of life may be carried on.

Work

The work performed may be considered as of two kinds, internal and external. The internal work is that used in maintaining the different functions of the body itself. The beating of the heart, breathing, the absorption of food, all require the expenditure of energy; this internal work requires a large portion of the available power. As in all machines, energy is lost in the form of radiant heat, but the body is considered an efficient machine because a larger proportion of energy is available for external work than in most engines constructed by man.

External Work Variable

The amount of energy required for external work is a variable factor, and the work to be done is consequently important in determining the amount of food necessary.

Source of Energy

So far as present knowledge goes, we may say that the energy of the body is derived from the oxidation (or combustion) of food that takes place in the tissues of the body. The process is undoubtedly a complex one, far from the simple union of the food with the air we breathe, and probably implies the actual building of the food into body substance, but we are concerned chiefly with the final result rather than the process by which it is reached.

Potential Energy

All combustible substances have what is known as potential energy. This might be defined as stored-up energy. It implies that energy from some exterior source has been used in producing the substance in its present form. For instance, heat from the sun has been utilized in the formation of the starch or proteid in the plant, and this energy is again set free in the oxidation or the decomposition of the substance.

Potential energy may perhaps be most easily understood by thinking of one form of it, energy of position. A weight lifted to a height has by virtue of its place a certain amount of *potential energy.* The fall of the weight from its position will convert its potential energy into active or *kinetic energy* by which work is accomplished.

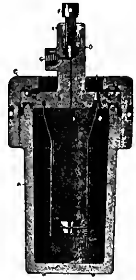
The waste materials of the body have little or no potential energy, and the outgo of the body differs in this important respect from its income. If the food taken in is only partially oxidized, the waste material still contains some energy, and this potential energy must be substracted from that of the income in order to find the amount available for the use of the body.

Unit of Heat and Energy

The value of a food to produce heat and mechanical energy is measured by the amount of heat that may be produced by it, and the unit of measure is the calorie. A calorie is the amount of heat required to raise about one pound of water four degrees Fahrenheit, or, accurately, the amount of heat required to raise one kilogram of water one degree centigrade. This is the large calorie, and it is sometimes written with a capital *C* to distinguish it from the small calorie. The small calorie has a value one-thousandth as great. The term used in this paper means the large calorie.

It has been found that there is an exact quantitative relation between heat and work, expressed by the term *mechanical equivalent of heat.* Experiments have shown that about 778 foot-pounds of work are consumed in heating one pound of water one degree Fahrenheit, or 1400 foot-pounds in heating the same amount of water one degree Centigrade. In other words, the same amount of energy would be expended in heating a pound (about one pint) of water one degree Fahrenheit, as in raising a weight of 778 pounds one foot, or a weight of one pound 778 feet. By the same calculations a calorie is equivalent to 3,087 foot-pounds. The calorie then is used as a convenient measure *not only of quantity of heat, but of mechanical energy, or power to work.*

Mechanical Equivalent of Heat



The "Bomb" of a Bomb Calorimeter.

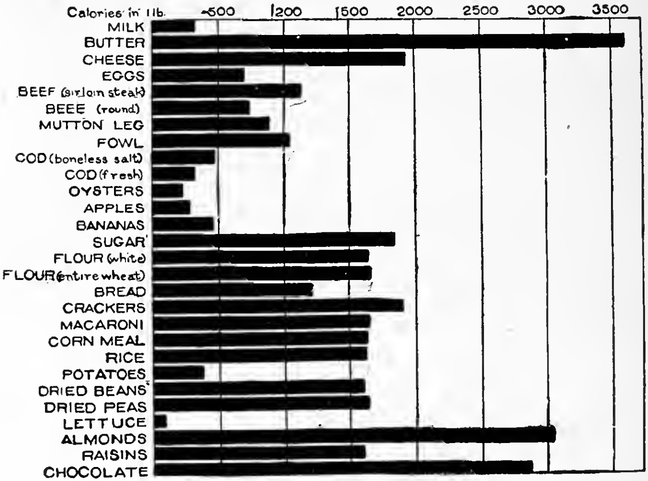
One gram of proteid has been found to yield 4.1 calories; a gram of carbohydrate yields the same amount, while a gram of fat yields 9.3 calories. Or more than twice as much heat can be obtained from a given amount of fat as from the same amount of either proteid or carbohydrate.

Bomb Calorimeter

The number of calories any particular food will yield theoretically is determined by the use of the bomb calorimeter. A portion of food of a given weight is enclosed in an iron shell or "bomb," which is then immersed in a given amount of water and the temperature of the water taken. By means of an electric spark the contents of the bomb are ignited and burned, and the temperature of the water is again taken at the end of the combustion. For instance, if the burning of one gram of meat raised the temperature of one kilogram (about two pounds) of water seven degrees Centigrade, that amount of meat would be said to yield seven calories.

CHART OF HEAT AND ENERGY

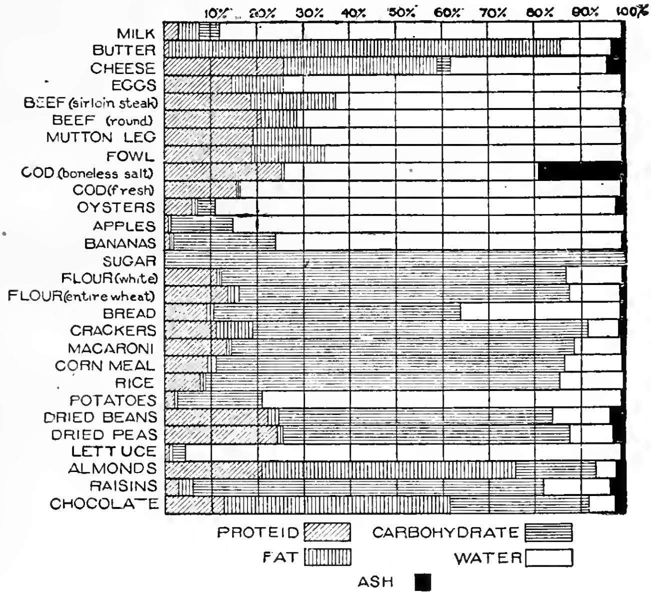
Values in Calories of some Common Foods



The chart given shows the number of calories yielded by several different foods.

Digestibility There is one factor that is often not sufficiently considered in determining the amount of energy obtainable from food. A food may yield excellent results in the calorimeter and yet be of little service in the body because of its lack of digestibility. It is

CHART OF COMPOSITION OF FOODS
Percentage of Nutrients of Edible Portion, i. e., Without Bone, etc.



by no means the food we eat but the food we *assimilate* that nourishes us. The portion of food that is really absorbed by the body differs greatly under different conditions and with different food materials. Many careful experiments have been made of late, and more will be made to determine the amount assimilated in different cases. This element of digestibility is frequently not taken into account, and the value of a food is estimated wholly from its chemical composition.

Some reasons for this are the great difficulty in determining the digestibility of a food, the fact that this digestibility may vary from time to time according to the condition of the body, and the fact that the personal equation enters largely into the matter.

Digestibility of Food

The accompanying tables showing the comparative digestibility of some common foods are therefore merely a general statement, and represent average results.

Table of Digestibility and Fuel Value per Pound of Nutrients in Different Groups of Food Materials. (Atwater.)

Kind of food.	Protein.		Fat.		Carbohydr'ts	
	Digestibility.	Fuel value per pound.	Digestibility.	Fuel value per pound.	Digestibility.	Fuel value per pound.
	Per cent.	Calories.	Per cent	Calories.	Per cent.	Calories.
Meats and fish	97	1.940	95	4.040	98	1.730
Eggs	97	1.980	95	4.090	98	1,730
Dairy products	97	1.940	95	3.990	98	1,730
Animal food (of mixed diet)	97	1.940	95	4,050	98	1,730
Cereals	85	1.750	90	3,800	98	1,860
Legumes (dried)	78	1.570	90	3,800	97	1,810
Sugars	......	....	......	....	98	1,750
Starches	......	....	......	....	98	1,860
Vegetables	83	1,410	90	3,800	95	1,800
Fruits	85	1,520	90	3,800	90	1,630
Vegetable foods (of mix'd diet)	84	1.840	90	3.800	97	1,820
Total food (of mixed diet)	92	1.820	95	4.050	97	1,820

Table of Comparative Digestibility, Commencing with the Most Digestible and Ending with the Least Digestible of Meats and Other Common Animal Food.

Oysters.
Soft-cooked eggs.
Sweetbread.
White fish, boiled or broiled, such as bluefish, shad, red snapper, weakfish, smelt.
Chicken, boiled or broiled.
Lean roast beef or beefsteak.
Eggs, scrambled, omelette.
Mutton, roasted or boiled.
Squab, partridge.
Bacon.
Roast fowl, chicken, capon, turkey.
Tripe, brains, liver.
Roast lamb,
Chops, mutton or lamb
Corned beef.
Veal.
Ham.
Duck, snipe, venison, rabbit, and other game.
Salmon, mackerel, herring.
Roast goose.
Lobsters and crabs.
Pork.
Smoked, dried, or pickled fish and meats in general.

(*From W. Gilman Thompson.*)

Fuel Value in the Body

It should be noticed that the fuel value obtained *in the body* from the various classes of foods is somewhat less than the theoretical amount mentioned on page 35, because they are not completely digested and assimilated nor completely oxidized in the body. The following values are used in the U. S. Government reports as representing average conditions:

Proteid, fuel value, 4 calories per gram, or 1,820 calories per pound.
Fats, fuel value, 8.9 calories per gram, or 4,040 calories per pound.
Carbohydrates, fuel value, 4 calories per gram, or 1,820 calories per pound.

Fuel and Energy Foods

The foods that are particularly useful in furnishing heat and energy for the body, the carbohydrates and fats, are frequently called the fuel foods, although proteid can act as fuel just as readily as can these. Since the proteids, however, have a more important function and are most expensive, the other foods are used as *proteid sparers.* The amount of these fuel foods that is to be taken depends not upon the amounts present in the body, but upon the amount of heat and energy to be produced.

The Body and An Engine

The comparison is frequently made between the body and an engine, the food representing the fuel, the air taken in through the lungs representing the draft, the waste matters of the body corresponding to the smoke and ashes from the engine fire. In many ways this is a helpful comparison, but we need to keep in mind the essential differences between the human body and the mechanical engine as well as their likeness. Combustion in the body is much slower than in the machine, and is therefore not accompanied by light, though by the oxidation of the same amount of fuel the same total amount of heat is produced. Oxidation in the body takes place not in one central cavity, but in every tissue, and, most important of all, the fuel furnished the body probably becomes part of its own substance before it is oxidized. Moreover if it is not sufficient in amount the waste of tissue proceeds faster than its repair, and there is a constant loss of body substance.

FOOD PRINCIPLES

In this and other series of lessons we have already discussed the food principles to some extent. Let us consider them now somewhat more in detail.

PROTEIDS

Different Proteids

The proteids are more difficult to understand than the other food principles because different members of the class seem at first sight to have little in common. A few simple experiments that will isolate some typical proteids in a more or less pure state will serve to give a clearer image.

Gluten

To a quarter of a cup of flour add very slowly a tablespoon of water and stir it until the flour is completely moistened, then work the dough in the hands until it becomes smooth and elastic, and finally wash it under cold water until fresh water added no longer grows milky. This will take from fifteen to twenty minutes. If a little iodine is at hand add a drop. If no blue color appears the starch is all washed out. There will be left in the hands a sticky, elastic mass, called gluten. Save part of this for comparison with other proteids and bake the rest in a hot oven.

Casein

Add a little acid, such as lemon or vinegar, to some milk, and heat it gently. Wash the curd thus formed in order to separate it from the whey. The curd is chiefly composed of casein.

With a knife scrape a piece of lean meat until the tender muscle fibre is separated from the firm white

Myosin connective tissue. The fibre represents one of the chief proteids of meat, called myosin. Beside the gluten, the casein, and the myosin, put the white of an egg, and you have before you the four chief representatives of the proteids of our food.

Legumin If we could add to them legumin, the proteid found in peas, beans, and other members of the pulse family, we should have a fifth important member of the class.

If we compare these substances, we shall find that although at first they seem very different, they yet have certain properties in common. All, for instance, to a greater or less extent, show the elasticity and tenacity that is so marked in gluten; all of them are toughened by a high temperature; and all when dried may be ground to powder similar in texture and appearance.

Composition of Proteids These physical likenesses, however, would hardly be sufficient to place these substances in one group. It is only when we consider the chemical composition of each and the function that each has in the body that we are justified in classing them together as proteids. Proteids are substances containing the elements carbon, hydrogen, oxygen, nitrogen, sulphur and frequently phosphorus. They alone of the food principles are able to supply nitrogen, one of the essential elements in all living things, whether animal or vegetable, and one that we are forced to obtain from our food, since, although we are surrounded by an atmosphere that is nearly four-fifths nitrogen, we cannot utilize it in this form.

Gelatin

Beside the true proteids, there are certain other substances which also contain nitrogen, but which are classed separately because they cannot alone supply the nitrogen needed by the body, though they can replace part of the proteid in the diet, and perform its function. Gelatin is one of the best known of these substances. They are called gelatinoids or albuminoids. Ossein, of which bone is largely composed, keratin, the horny material present in the hair and in the horns and hoofs of animals, collagen, forming the greater part of the connective tissue of meat, are all representatives of the same class of substances. All these named may be changed into gelatin by boiling.

Extractives

Certain other nitrogenous substances called extractives, are present in some foods. These may help give the flavor to meat. They form the chief ingredient of the extracts of beef on the market; and it is these that give the chief value to beef tea and to clear soup. The extractives act as stimulants rather than as true foods since they neither build tissue nor act as fuel, but they seem to play some role in digestion.

Nomenclature

The proteids, gelatinoids, and extractives, are sometimes classed together under the general name of protein. This is the usage of the United States Government pamphlets. The nomenclature applied to the nitrogenous substances is very confusing, since each author seems to have adopted his own. Albuminoid, for instance, is sometimes used to designate the true proteids, and sometimes is applied to the gelatinoids. Proteid is sometimes used in a much more limited sense than we have given to it, including only certain classes of the substances ordinarily designated by the term.

In studying the subject, therefore, one must first of all ascertain the writer's use of terms.

CARBOHYDRATES

Composition

Grains of Potato Starch.

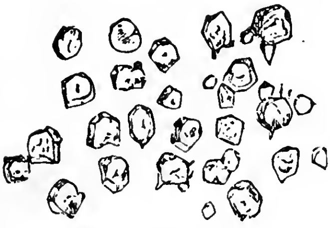
The carbohydrates are so called because they are composed of the elements carbon, hydrogen and oxygen, the last two in the proportion in which they are found in water. This last statement, although it is generally made in defining carbohydrates, is not strictly true, since a few of the less common members of the class are found to vary somewhat from this proportion.

The principal carbohydrates may be classed in three groups. The following table shows the chief members of these different groups, so far as our food is concerned.

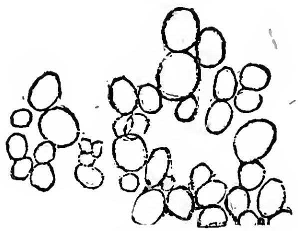
Classification of Carbohydrates

Starch (or Amylose) Group.	*Cane Sugar (or Sucrose) Group.*	*Grape Sugar (or Glucose) Group.*
$C_6 H_{10} O_{5n}$	$C_{12} H_{22} O_{11}$	$C_6 H_{12} O_6$
Starch	Cane Sugar (Sucrose)	Grape Sugar (Dextrose)
Dextrin	Malt Sugar (Maltose)	Fruit Sugar (Levulose)
Cellulose	Milk Sugar (Lactose)	
Gums		
Glycogen		

That the second and third groups bear a definite



Corn Starch.



Rice Starch.

(From *Hygiene*, by Parks.)

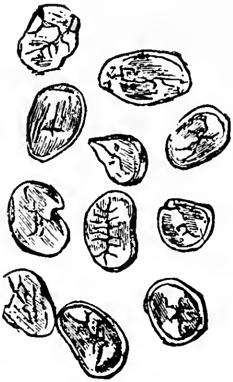
chemical relation to the first may be seen by a comparison of their formulae.

Starch

Starch is the most important of the carbohydrates from the standpoint of food. It is familiar to us all as the fine, white, glistening powder of "corn starch" and of laundry starch. We may easily, by washing it, obtain it also from grated potatoes and from flour. Starch is found only in the vegetable kingdom, and is manufactured by green plants and stored in different parts of the plant in the form of tiny grains lying within the plant cells.

Structure of Starch

The structure of these grains has been very hard to determine because of their minuteness. It was thought for a long time that they were composed of a cellulose envelope enclosing the true starch, and that by the action of water and heat these grains swelled and the cellulose envelope burst.



Bean Starch.

A later theory was that the starch grain was built up in alternate layers of starch cellulose and starch granulose.

The late work of a German botanist, Meyer, seems to show that the grains are in the form of sphero-crystals, each made up of many tiny particles. These radiate from a center, and at the same time are arranged in concentric layers. The particles are of two kinds called by Meyer alpha-amylose and beta-amylose. These may be compared to the starch cellulose and starch granulose of the older theory. Upon the application of heat and moisture the beta-amylose swells and becomes gelatinous, forming a solution. The alpha-amylose is affected only by a temperature much above the boiling point, or by long continued heating.

Starch Grains

The starch grains in different plants differ much in form, size and general appearance, as shown in the illustrations. The relation of the difference in structure to digestibility is not well determined.

Dextrin is a substance having the same general composition as starch, but unlike it in some of its properties. It is chiefly important to us in that it is an intermediate product of the change of starch into sugar. **Dextrin**

Glycogen is the form in which carbohydrate is stored in the body until it is needed for use. It is

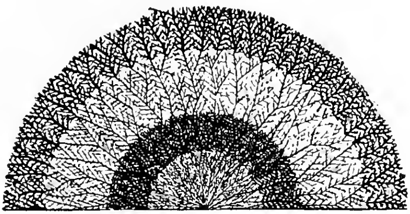


Diagram Representing the Supposed Structure of a Sphero-Crystal of Starch, Showing Radial and Concentric Arrangement.
From A. Meyer.

found chiefly in the liver and is sometimes called animal starch.

Cellulose is so slightly digested that we do not put it in the list of human foods, yet it is important from two standpoints. First, it gives the necessary bulk to food; and second, it so encloses the nutrients in vegetables and fruits that it must be definitely considered in cookery. **Cellulose**

Allied to the gums are the pectose and pectin that are concerned in the making of jelly from fruit juice. The gelatinous substance obtained from Irish moss also belongs in this class. The sugars will be discussed under the special foods.

FATS

Composition

The fats, like the carbohydrates, are composed of carbon, hydrogen and oxygen, but with these elements in very different proportions from that in which they exist in the carbohydrates. There is a much larger proportion of carbon with less oxygen than in starch and sugar, and this accounts for the readiness with which they burn and the intense heat that we get from them. They are of both animal and vegetable origin. Those which are liquid at ordinary temperature we often speak of as oils.

Water and Mineral Matter

In discussing the value of a food we commonly consider only the organic principles. Although water is absolutely necessary it is so easily supplied and so abundant that we do not have to consider whether or not it is present in our food as we purchase it. This is not true of mineral matter to so great an extent, but it is largely so, except in the case of growing children. The mineral matter will, as a rule, take care of itself if we provide the other substances needed.

Nutrient Ratio

By food value or nutritive value we ordinarily mean the amount of organic nutrients present in the food. In determining the importance of any particular food, we consider not only the total amount of the nutrients present, but the relation that the proteid bears to the other nutrients. This is often called the *nutrient ratio*. The nutrient ratio of potatoes, for example, containing two per cent of proteid and eighteen of starch, is 1 to 9. In reckoning this ratio, fat is changed into its starch equivalent, that is, one part of fat is considered equal to two and a quarter of starch.

Classification of Foods

The following classification of the food principles may help to fix in the mind their relationship.

Nutritive Ingredients (or Nutrients) of Food

Organic..	Nitrogenous......	Proteids, e.g., albumin, casein, gluten, etc.
		Gelatinoids, e.g., gelatine, etc.
		Extractives.
	Non-nitrogeneous	Carbohydrates, e.g., sugar, starch.
		Fats.
Inorganic..	Mineral matters.	
	Water	

Use of Food Principles in the Body

Proteid.................. e.g., white (albumen) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc.	Forms tissue....................	All serve as fuel to yield energy in the forms of heat and muscular power
Fats.................. e.g., fat of meat, butter, olive oil, oils of corn and wheat, etc.	Are used or stored as fat........	
Carbohydrates.......... e.g., sugar, starch, etc.	Are used or transformed into fat.	
Mineral matters (ash).. e.g., phosphates of lime, potash, soda, etc.	Share in forming bone, assist in digestion, etc.	

Amount of Food Required

In addition to a knowledge of food constituents, of the proportion of which these exist in our food, and of the use of food in the body, we need to know the amount of food necessary to supply our daily needs under different conditions. Many factors will influence not only the total amount of food that we need, but also the proportions in which we shall use the proteids, the carbohydrates and the fats. The flesh weight of the body is important in deciding the amount of proteid (that is, the muscle weight, not the total weight of the body) since the greater the flesh weight the greater the nitrogenous waste. The shape of the person, whether tall or thin, or short and plump, influences the amount of fuel food required, since the amount of surface exposed affects the loss of heat. The degree of activity has an important influence upon the amount of all the food principles. Variations in climate to a certain extent affect the amount of heat to be produced in the body, and occupation also has an important influence.

Food for Different Ages

The age of the individual is, within certain limits, one of the greatest factors. The growing child needs a large amount of building material, while the old person needs distinctly to lessen the tissue building foods. The accompanying diagram gives an idea of the way in which these proportions vary with different ages. It will be seen that the proportion of proteid is much greater in comparison with other food materials in the case of the child than of the adult. The total amount of food is also greater in proportion to body weight in the child than in the adult. Although not shown in the table, mineral salts are needed in large proportion in the child's diet, while they may well be cut down in the diet of the old. The amount of food needed increases rapidly from birth to about four

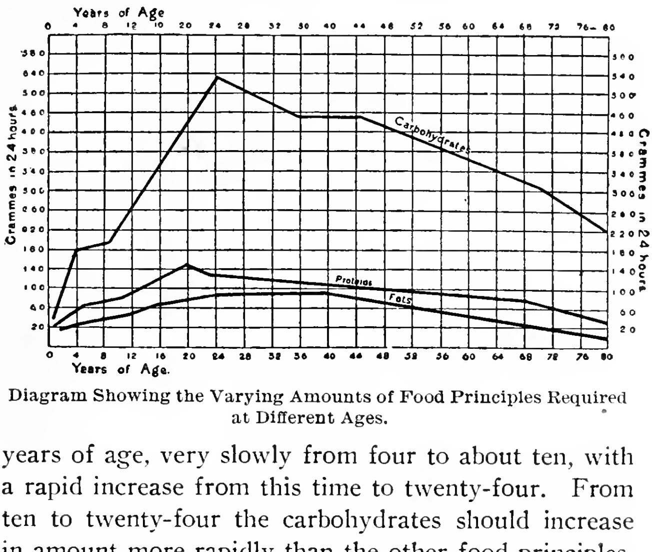


Diagram Showing the Varying Amounts of Food Principles Required at Different Ages.

years of age, very slowly from four to about ten, with a rapid increase from this time to twenty-four. From ten to twenty-four the carbohydrates should increase in amount more rapidly than the other food principles.

Nutrient Ratio

To put in terms of the nutrient ratio the difference between the diet of the child and that of the adult—in the adult diet the ratio is about 1:5.3; in the diet of the child, 1:4.3.

Standard Dietaries

These statements are of course true only approximately, yet one familiar with children must recognize in them a fair generalization from the facts.

The proportions of the different food principles needed daily constitute the dietary, and dietary standards have been made up taking into account as far as possible these different conditions. These dietaries are sometimes called experimental, and sometimes statistical, according to the method used in formulating them. An experimental dietary is the result of careful observations of the effect of different proportions of food nutrients upon an individual under determined conditions. The statistical dietary is the outcome of the study of the actual ration of large numbers of people. Each of these has its drawbacks. In the first case it is difficult to decide how far the result is due to individual idiosyncrasy, and a large number of experiments must be tried before the personal factor can be eliminated. In the second case it is hard to determine whether some variation in the diet might not produce better results.

Experimental Dietaries

An example of the first method of formulating dietaries is that of Professor Atwater's respiration calorimeter, sometimes called "the man in a box," described in one of the government pamphlets. A small room was constructed in the laboratory with flues arranged to bring in fresh air and to carry off the products of respiration. Each of these flues was arranged so that the temperature and composition of the air entering and going out might be determined. A man lived in this room for several days at a time, his food being given to him by means of slides in a double wall. A sample of each food given was analyzed and a determination of the number of calories yielded by it made by means of the bomb calorimeter. All food taken was carefully weighed, and the excreta of the body were analyzed so that an accurate estimate could be made of the total income and outgo of the body. See illustration on page 32.

Statistical Dietaries

Many statistical dietaries have been taken, some of the most valuable being those of the German army. Experiments have been made there as to the effect of the addition of certain articles of food to the diet, and the conclusions have been of much value. Similar dietary studies have been made at many schools and universities.

From a careful comparison of dietaries made up in these two ways certain standards have been determined upon. The American standards vary in some important points, notably in the amount of fat used, from those of Europe. Some of these dietaries are given here.

Standard Dietaries

Voit	Proteid Grams	Fat Grams	Carbohydrat's Grams	Total Grams	Calories
Woman at moderate work (German)	92	44	400	536	2425
Man at moderate work (German)	118	56	500	674	3055
Man at hard work (German)	145	100	450	695	3370
Playfair.					
Man with moderate exercise (English)	119	51	531	701	3140
Active laborer (English)	156	71	568	795	3630
Hard-worked laborer (English)	185	71	568	824	3750
Atwater.					
Woman with light exercise (American)	80	80	300	460	2300
Man with light exercise (American)	100	100	360	560	2815
Man at moderate work (American)	125	125	450	700	3520
Man at hard work (American)	150	150	500	800	4060

There are twenty-eight and thirty-four hundredths grams (28.34) in one ounce. A man at moderate work requires, therefore, according to the American standard, about four and one-half ounces of proteid, four and one-half ounces of fat, and nearly a pound of carbohydrate daily.

Chittenden's Experiments

The dietary standards that we have been considering are those that have been accepted generally since work of this kind was first begun. Some late experiments conducted at Yale University by Professor Chittenden and others, indicate that a much smaller amount of food, especially of proteid, may better serve the purposes of the body, than the larger amounts indicated in these standards. The experiments were carried out upon men representing three different classes of individuals. The first class was composed chiefly of professors and instructors. The second represented the moderate worker. The third class were trained athletes. The experiments covered a period of five months, and the proteid taken daily varied from about thirty-five to fifty grams per day, while the total number of calories yielded was from twenty-five to twenty-eight hundred a day. The general conclusion drawn from these experiments is that under ordinary conditions of life, with an ordinary amount of work, bodily health and vigor are maintained as well, if not better, on a minimum proteid diet than on the amount given in the generally accepted standards.

Dr. Folin's Experiments

Some careful experiments and analyses recently made by the physiological chemist, Dr. Otto Folin, at the McLean Hospital, Waverly, Mass., indicate that about twenty grams of proteid represents the actual daily proteid wastes of an average sized man under ordinary conditions. That is, only about three-fourths of an ounce of proteid material is necessary per day in an adult to rebuild the nitrogenous tissue of the body that wears away through use.*

Such radical differences from standards found by long experience to give good results in health and strength must be considered very carefully before being accepted. But in this as in many other ways, we may be obliged to revolutionize our ideas of food.

Amount of Food to Furnish Required Proteid

We must not fail to distinguish between the amount of proteid required and the amount of food containing proteid. If, for example, meat be supplied containing

*See Report of the Lake Placid Conference on Home Economics, 1905, and American Journal of Physiology, March, 1905.

18 per cent of proteid (a fair average), a little more than a pound and a half of the meat will be required to furnish the four and a half ounces of proteid. Bread containing 9 per cent of proteid would be required to the amount of three pounds. Nearly two pounds and a quarter of eggs, with 13.1 per cent of proteid, or about eighteen eggs, would be necessary to supply four and a half ounces of pure proteid.

Example for Practice

Taking the percentage composition from the accompanying table, calculate the amount of milk that would be required daily to furnish four and a half ounces proteid. How much potato would be required? How much corn meal?

Calculations

Calculations: From the table, milk is found to contain 3.3% of proteid or 1 oz. contains .033 oz. protein. To furnish 4.5 ozs. would require

$$4.5 \div .033 = 136+$$

As a pound contains 16 ozs., 136 oz.=8½ lbs. A pint of milk weighs about 1 lb., so about 4¼ quarts would be required to provide 4.5 ozs. of proteid.

Potatoes *as purchased* contain 1.8% proteid.

$$4.5 \div .018 = 250$$

$$250 \text{ oz.} = 15 \text{ lbs. (aprox.)}$$

A bushel of potatoes weighs about 60 lbs., consequently about one peck of potatoes would be required.

Corn meal contains 8.9% proteid and by the same calculations 3 lbs. 2 ozs. will be found to contain 4.5 ozs. of proteid.

Balanced Ration

It is by no means a matter of indifference whether the proteid be derived from any one of these food materials, or from a mixture of different ones. The other food ingredients present must be taken into account. For example, the three pounds of bread

Composition of the Edible Portion of Some Common Foods

	Ash, per cent.	Water, per cent.	Proteid, per cent.	Fat, per cent.	Carbohydrates, per cent.	Calories, per lb.
Milk	0.7	87.0	3.3	4.0	5.0	325
Butter	3.0	11.0	1.0	85.0	....	3,605
Cheese	3.8	34.0	25.9	33.7	2.4	1,950
Eggs	1.0	73.7	13.4	10.5	....	720
Beef (sirloin)	1.0	61.3	19.0	19.1	....	1,155
Beef (round)	1.1	65.5	20.3	13.6	....	950
Mutton (leg)	1.0	63.2	18.7	17.5	....	1,085
Fowl	1.0	63.7	19.3	16.3	....	1,045
Cod (boneless salt)	19.0	55.0	27.3	0.3	....	490
Cod (fresh)	0.9	82.5	16.7	0.3	....	325
Oysters	1.1	88.3	6.0	1.3	3.3	230
Apples	0.3	84.6	0.4	0.5	13.0	290
Bananas	0.5	75.3	1.3	0.6	21.0	460
Sugar	....	....	....	....	100.0	1,857
Flour (white)	0.5	12.0	11.4	1.0	75.1	1,650
Flour (entire wheat)	1.0	11.4	13.8	1.9	71.9	1,675
Bread	1.1	35.3	9.2	1.3	53.1	1,215
Crackers	1.8	6.8	10.7	8.8	71.9	1,905
Macaroni	1.3	10.3	13.4	0.9	74.1	1,665
Corn meal	1.0	12.5	9.2	1.9	75.4	1,655
Rice	0.4	12.3	7.8	0.3	79.0	1,630
Potatoes	1.0	78.0	2.2	0.1	18.4	385
Dried Beans	3.5	12.6	22.5	1.8	59.6	1,605
Dried Peas	2.9	9.5	24.6	1.0	62.0	1,655
Lettuce	0.9	94.7	1.2	0.3	2.9	90
Almonds	2.0	4.8	21.0	54.9	17.3	3,030
Raisins	2.3	14.6	2.6	3.3	76.1	1,605
Chocolate	2.2	5.9	12.9	48.7	30.3	2,860

(See pages 36 and 37 for charts giving graphic representation of these foods.)

would furnish also more than a pound and a half of carbohydrates, a great excess of the required amount. The meat would vary in fat, but estimating the per cent as twenty, the pound and a half would yield four and eight-tenths ounces, more than would be required for the day. The quantities used of these different foods must then be so adjusted that the nutrients will be in approximately the right proportion. The deciding upon these different quantities from the percentage composition of the food is the essential point in calculating dietaries.

Practical Use of Dietaries

The question will probably come to each one—of how much practical use for the everyday housekeeper is this study of dietaries. In the first place, it would mean the expenditure of a great deal of time if one should undertake to determine each day's rations in this way. In the next place, it is impossible to know the actual composition of the food that we eat, except in a few cases. We may be fairly sure of the composition of the egg, but when meat varies in proteid from 12 per cent to 22 per cent as it does according to the Atwater analyses, how are we to determine the composition of the particular cut that we are using to-day? Moreover, even if our meal were prepared so that the exact proportions of nutrients were furnished, it is quite possible that one member of the family might eat too large a proportion of the proteids and another too much of the carbohydrates.

Another element of uncertainty lies in the difference in composition between cooked and uncooked food. Rice, for example, according to the tables, contains 79 per cent of carbohydrate and 7.8 per cent of proteid. But if you will weigh a cup of rice before it is cooked, and the same rice after it is cooked, you will find that it has gained perhaps four times its original weight. In other words, a quarter of a pound of cooked rice will only furnish about a fourth as much nutrient as a quarter of a pound of rice without the added water. Often we can allow for this difference in the calculation of our dietary; but sometimes we know too little about the changes which take place in cooking to do this. Finally, even if we know exactly what we eat we do not know what we assimilate. Is there, then, any use in the dietary standard?

Variation from Standard

In two ways it is of great service. In the first place, it is a standard by which we may test our diet if we extend our experiment over a sufficiently long period. At the beginning of a month let us take account of stock, estimate the amount of food materials on hand, and then keep careful account for a month of all food brought into the house; at the end of the month we will again estimate what we have on hand and in this way ascertain the amount of raw material used. Table IV, with the details which follow, gives an example of a carefully calculated dietary. The composition of the various foods was taken from Bulletin No. 28 of the office of Experiment Stations, U. S. Department of Agriculture.* If, on calculating the food value of the different materials, we find that for the

* "The Chemical Composition of American Food Materials" which may be obtained by sending five cents *in coin* to the U. S. Department of Agriculture, Office of Experiment Stations, Washington, D. C.

number of persons served we have a distinct variation from the standard diet, we can legitimately conclude that there is something wrong. If, for example, we find that the amount of proteid calculated in our food materials is twice as much as that supposed to be required, we shall conclude that either our families must be using a much larger amount of proteid than would be conducive to the best health, or there must be much unnecessary waste, and in either case, an investigation would be needed.

Errors in Dietaries

Another way in which the dietary standard is of especial service, is in enabling us to judge what error in diet is responsible for some particular weakness or peculiarity in any member of the family. A girl of fourteen may be unusually thin or may appear languid and tired, and everything point to improper feeding as the cause. The first thing to do in this case would be to see whether the child's diet were deficient in any one of the three nutrients, and if so bring the diet up to the standard. In dealing with abnormal conditions, then, or with large masses of people, or with diet over an extended length of time, the dietary standards may be applied to great advantage. It is not necessary to apply it strictly to each individual at each meal.

The calculation of a few dietaries is very useful in giving us a definite idea of the general composition of foods, and so making it easier to estimate the amount of different nutrients which we are providing at ordinary meals, without the tediousness of reckoning each meal in detail.

In such calculations the following factors are used to reduce the results to the standard of one man at moderate work.

Factors used by the U. S. Department of Agriculture in Calculating Meals Consumed in Dietary Studies.

Factors

Man at hard muscular work requires 1.2 the food of a man at moderately active muscular work.
Man with light muscular work and and boy 15-16 years old require 0.9 the food of a man at moderately active muscular work.
Man at sedentary occupation, woman at moderately active work, boy 13-14, and girl 15-16 years old require 0.8 the food of a man at moderately active muscular work.
Woman at light work, boy 12, and girl 13-14 years old require 0.7 the food of a man at moderately active muscular work.
Boy 10-11 and girl 10-12 years old require 0.6 the food of a man at moderately active muscular work.
Child 6-9 years old requires 0.5 the food of a man at moderately active muscular work.
Child 2-5 years old requires 0.4 the food of a man at moderately active muscular work.
Child under 2 years old requires 0.3 the food of a man at moderately active muscular work.

Home Studies

In making dietary studies all food used should be weighed, but the following data may be of use for approximate home calculation:

1 measuring cup = ½ pint.
16 tablespoons = 1 cup.
3 teaspoons = 1 tablespoon.

A cup of water weighs about 8.3 oz., of milk 8.6 oz., of cream 8.4 oz., of butter 8.4 oz., of lard 7.5 oz., of sugar 8 oz., and a tablespoonful of the foregoing weighs about 0.5 oz. A cup of meal weighs 5 oz., of sifted flour 4 oz., of oatmeal 2.7 oz., of cream of wheat 6 oz. A cubic inch of meat or butter weighs about 0.5 oz. An egg without shell weighs 1.6 oz. A slice of bread ½ in. thick weighs 1 oz., a heaping teaspoonful of sugar 0.4 oz.

Since the foregoing was written, Professor Irving Fisher of Yale University has devised a comparatively simple method of calculating individual dietaries. His method is given in full in Bulletin No. 13, "Food Values," of the A. S. H. E, and in the supplement to this series of lessons. Before going further it is well to become familiar with this method.

Instead of starting with the percentage composition by weight of foods, the basis is percentage by "food units" or fuel and energy value, or in other words, by calories. This does away with the varying amounts of water contained in food which, while absolutely necessary, has no fuel value and the method places the fats on the same basis as the carbohydrates and proteins.

A table is given showing the average food units required for men, women and children, based on Professor Chittenden's standards.

After becoming familiar with this method, the approximate total food value of one's daily diet may be reckoned mentally and the proportion of the three chief food principles may be obtained with but little figuring.

Note the additional work required by this method in connection with Question 21 of this lesson p. 217.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

FOOD AND DIETETICS

PART I

Read Carefully. The Department of Agriculture Bulletin No. 142, "The Nutritive and Economic Value of Food," should be studied in connection with this lesson. *Make your answers full and complete.*

1. What to-day is included in the food problem?
2. What factors affect the proportion of the income spent for food?
3. At current prices in your locality, give a list of foods you would provide for a day's ration at 20 cents per person for raw food material. At 30 cents. At 40 cents.
4. To what extent can waste in food be eliminated?
5. How do animal and vegetable foods compare in cost?
6. Which would be the cheaper source of proteid, beefsteak at 25 cents per pound, milk at 8 cents per quart, bread at six cents per pound, corn meal at 4 cents per pound? Give details of calculations.
7. How is the heat and energy of the body produced?
8. What is meant by the term calorie? How is it that mechanical energy can be measured by this unit?
9. How does the amount of heat produced by proteid compare with that obtainable from an equal amount of starch? With that from an equal amount of fat?

10. What relation has digestibility to food value?
11. What are the five food principles? Give their functions. Which of the food principles is most important?
12. What is meant by proteid? Name the most common representatives of the class found in food.
13. If possible, perform the experiments in separating some of the proteids as described and report.
14. How does gelatine differ from the true proteids? How may it be obtained?
15. What is the most important carbohydrate from the standpoint of food? What is its source?
16. How do fats differ from carbohydrates?
17. What is meant by food value? By nutrient ratio?
18. How are dietary standards determined?
19. What factors affect the amount and proportion of food needed?
20. Of what practical value to the housekeeper are dietary standards?
21. Calculate the amount of proteid, carbohydrate, and fat in your own diet for one day as nearly as you can. Give details of calculation.
22. What questions have come to you in the study of this lesson?

Note. Question 21 is optional. After completing the test sign your full name.

FOOD AND DIETETICS

PART II

SPECIAL FOOD STUFFS

Animal and Vegetable Food Stuffs

In the selection of foods one of the questions that will come up will be that of the relative value of animal and vegetable foods. An increasing number of people are confining their diet largely, if not exclusively, to vegetable products, while others add to these such animal substances as do not imply the taking of life, such as milk and eggs. Is a mixed diet essential for health? Or may we at will choose exclusively from the animal or the vegetable kingdom?

Distinction

Certain broad distinctions between animal and vegetable food will immediately present themselves. Speaking generally, animal foods are richer in nitrogenous matter, while vegetable foods are the chief source of carbohydrates. This becomes much more evident if we compare the two in a dry condition. Milk, for instance, makes a poor showing in proteid as compared with dried peas and lentils, or even with rice. But if we take the total solids of the milk as a basis of comparison, eliminating the 87 per cent of water, the case is quite otherwise. This is the fair method, for the dried peas and rice absorb many times their weight of water in the process of cooking, so that the analysis of the raw material is quite different from that of the cooked food.

Hutchison gives the following composition of a few typical dried foods:

One hundred parts of dried lean beef contain 89 parts of proteid.

One hundred parts of dried fat beef contain 51 parts of proteid.

One hundred parts of dried pea flour contain 27 parts of proteid.

One hundred parts of dried wheat contain 16 parts of proteid.

One hundred parts of dried rice contain 7 parts of proteid.

To this we may add:

One hundred parts of dried milk contain 25 parts of proteid.

Carbohydrates

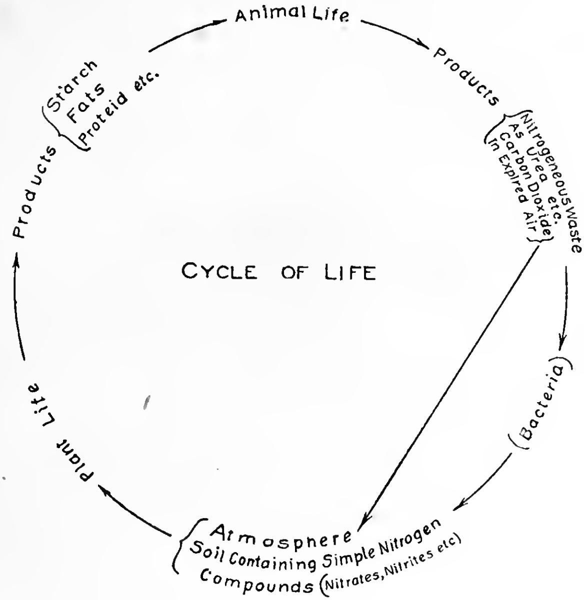
On the other hand we find our carbohydrates almost wholly in the vegetable kingdom. Milk is the only important exception to this. In milk, dried, we find 38 parts of carbohydrate to 100 of the total solids.

Comparative Cost

Another difference between animal and vegetable food is found in their comparative cost. Animal food as a rule is much more expensive than vegetable. This is not difficult to understand when we remember that our animal food has been put through a further process of manufacture than the vegetable food. If the grain raised, instead of going directly to man as food, is used to feed cattle, and these in turn are slaughtered to furnish nourishment for human beings, the process necessarily adds to the cost of the food. This process, as well as the fact that plants are in general *builders* of material, while animals *break down* the complex compounds built up by the vegetables, is graphically shown by the accompanying diagram.

The same intermediate process which adds to the cost of food increases also its digestibility, though the less complete absorption by the system of vegetable

Digestibility



than of animal proteid seems to lie in the fact that in the plant the proteid is enclosed within cellulose walls and ordinary processes of cooking do not always free it, rather than in any difference in the proteids themselves.

In deciding from which kingdom we shall choose

Source of Proteid

our diet, we consider almost wholly the proteid. As we have seen, carbohydrates must necessarily be obtained chiefly from vegetable sources, and it seems to be a matter of indifference whether the fat of the diet is of animal or vegetable origin. With the addition of milk, butter, cheese, and eggs, it is not difficult with care to provide a satisfactory dietary without the use of meat.

Vegetarian Diet

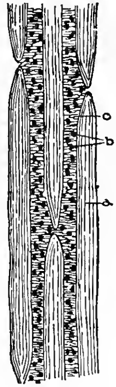
The case is different when vegetables form the only source of food supplies. Because of the great excess of carbohydrates and the presence of indigestible matter in the form of cellulose, a great bulk of food must be taken in order to get the necessary proteid. As a matter of fact, nearly all purely vegetarian diets are deficient in proteid. The extra cost of the animal proteid is justified by its availability since it may be obtained without an excess of other substances and since it is easily assimilated.

MEAT

In the ordinary family the greater part of the proteid diet is probably furnished by meat, so that a knowledge of the composition and nutritive value of this article of food is important. The structure of the

Structure

meat may be best seen if one with a sharp knife scrapes a small piece of meat, thus separating the muscle fibre from the white connective tissue. Under the microscope the muscle fibre is seen to consist of bundles of smaller fibres held together by delicate connective tissue in which fat cells are imbedded. These muscle fibres vary in length in different kinds of meat, and the length of fibre probably plays some part in the digestibility of the meat—the short fibre meats being the more digestible.



FIBRE OF MEAT.

a Fibre
b Fat
c Connecting tissue

The toughness or tenderness of meat depends partly upon the muscle fibres and partly upon the connective tissue, though as a rule the same conditions that have made the connective tissue tough and strong will have had a similar though less effect upon the muscle fibre. In general the muscles that are most used or most exposed to wind and weather will be both tougher and richer in flavor than those not so exposed. The young animal will, of course, have more delicate tissues and less toughened fibres than the older or harder worked animal.

Composition

The composition of different pieces of meat, even from the same animal, differs greatly, the proteid of beef, for instance, varying all the way from twelve per cent to twenty-one, according to the cut of meat and to the feeding of the animal from which it is obtained.

Proteids of Meat

The proteids of meat include a number of different substances, the chief of which are fibrin, myosin and albumin. After the animal is killed the myosin coagulates, thus causing the hardening of the muscle, known as rigor mortis. In this condition the meat is very tough, and the hanging of meat is practiced in order to give time for the disappearance of this rigor by the re-solution of the myosin.

Albumen

The presence of albumin in the meat can be easily shown by soaking a small portion of the meat in water for a few minutes, and then heating this water. The albumin dissolves in the water and coagulates upon heating just as white of egg would do under similar conditions. The scum that forms in the water when a piece of meat is boiled, is largely this same albumin. Beside the true proteids, gelatine may be obtained from meat in varying quantities. The connective tissue upon boiling becomes gelatine, and it is due to this as well as to the gelatine obtained from the bones that water in which meat has been cooked so often sets into a jelly. The color of meat is due largely to the same substance that gives the color to blood, haemoglobin.

Flavor

Its flavor depends chiefly upon the nitrogenous substances called extractives, though the characteristic taste of pork and mutton is caused partly by the fats they contain. These extractives have no real food value, but act as stimulants.

Fat of Meat

The fat in meat varies even more in amount than the proteid; beef, as purchased, containing from five and eight-tenths per cent to more than forty per cent.

Even in meat that appears lean much fat is present lying between the muscle fibres. This may be seen upon heating the meat in water, when globules of fat appear from even the leanest meat. The solidity of the fat is due chiefly to the stearin that is present.

Water

The amount of water in meat varies very much. A lean cut of beef may have as much as seventy-five per cent of water, while a fat piece might not contain more than fifty per cent. In general the more fat the less water there is present, so that in buying it is economy to select meat that is moderately fat.

Factors in Digestibility

From the standpoint of digestibility, meat is an excellent food. It is among the most easily digested of the proteid foods. As a rule raw meat is more digestible than cooked, and rarely cooked meat more digestible than that which is well done. The cooking of meat has its value not in adding to the digestibility but in developing flavor, so that the meat becomes more palatable; and in rendering it more safe, by destroying certain parasites that are sometimes present in raw meat, particularly in pork, and bacteria that under certain circumstances may cause dangerous decomposition.

There is much difference in the digestibility of different meats. Pork is ranked among the less digestible meats, since it requires a longer time for complete digestion than do other varieties. This is probably due to the large amount of fat closely combined with the muscle fibres. Bacon fat, on the other hand, from its different form, is generally found to be easily digested.

Mutton and beef stand equally well in this respect. As has been suggested before, short fibred meats are in general more easily digested than long fibred ones, yet veal is an exception to this. Hutchison explains this by suggesting that the fibres of veal easily elude the teeth on mastication, and that the comparatively insipid character of the veal fails to excite a free flow of gastric juice. It would seem that this absence of extractives would be the more important factor.

Effects of Cooking

How far the cooking of meat alters its chemical composition is not wholly determined. Some interesting experiments at the University of Illinois have taught us much about the losses that take place in the cooking. It is shown that in whatever way meat is cooked, there is much loss of weight, amounting either in boiling or in roasting to a fourth or even a third of the original weight. This loss is partially proteid and fat, but consists still more largely of water. The loss of water appears to be caused partly, at least, by the hardening and consequent contraction of the muscle fibre, the water being mechanically forced out.

Losses in Boiling

An interesting experiment has been tried in regard to the effect of salt in preventing or accelerating the losses in meat. A salt solution was prepared, having the same density as that of the juices of the meat, and a piece of meat was boiled in this. It was found that a very small amount of the juices of the meat were lost in the water and practically none of the salt penetrated into the interior of the meat. The conclusion drawn was that very little interchange of the water and the meat juices could take place unless the medium in which the meat was cooked was either less or more dense than the meat juices themselves.

Cost of Meat

Meat does not form a cheap source of proteid food, but the cost can be lessened very much by care in selecting the cheaper cuts. As a rule these cheaper parts need longer cooking than the more expensive tender cuts, and, as has been suggested before, the fuel must be taken into account in estimating their cost. Where the cheapness of the meat is not counter-balanced by the additional expense of the fuel a great variety and a satisfactory diet may be obtained with only the occasional use of the more expensive portions. As has been said, the nutritive value of the cheaper parts is as great as that of the more tender portions.

Soups and Broths

The nutritive value of meat soups, broths and extracts has been much discussed. Often in estimating this value too little allowance has been made for the method used in preparation. A clear soup contains a very small amount of real food. Its value lies in the

Extractives

extractives that give it flavor, and in the small amount of gelatin that it contains, and in its power to stimulate the flow of the gastric juices, and so whet the appetite rather than satisfy it. The meat from which such a soup has been made still contains a large portion of its nutritive value, and although because of its lack of flavor it cannot be used as it is, it may be made palatable and attractive by the addition of spice or seasoning, or by its combination with a small portion of fresh meat. Unless large quantities of soup are made, it ought to be possible, in the ordinary household, to utilize the soup meat in some way.

Extracts of Meat

The commercial extracts of meat are similar to clear soup in that they contain practically nothing but the extractives. A more nutritious broth may be made if the meat, cut in small pieces, is allowed to soak for some time in cold water and then is heated to a low temperature, not above 180 degrees Fahrenheit, and kept at this point for some hours. Toward the end of the process the broth may be brought to the boiling point for a few minutes in order to dissolve all the gelatin possible. The brown flecks of albumin that form must be served in the broth and not be strained out. Even made in this way, the value of the broth is small compared with that of meat, but it is much greater than that of the clear soup.

Beef Juice

Raw beef juice is valuable as a food. If the beef be cut small, and thoroughly pressed, a much larger amount of proteid is obtained than by any other treatment. The round of beef, very slightly broiled and pressed, may yield as much as seven per cent of proteid and four per cent of extractives.

FISH

Nutritive Value and Digestibility

One of the most natural substitutes for meat is fish. Its nutritive value is much like that of meat, although it contains a somewhat smaller proportion of proteid. It also has the advantage of being as a rule easily digested, and so is particularly adapted to the needs of a person of sedentary habits. It is probably this fact that has given rise to the false idea that fish is a particularly good brain food. As a matter of fact, it is no more a brain food than meat or eggs or any other proteid food. The cost of fish is generally less than that of meat, so that it furnishes a cheap source of the necessary proteid. The value of fish depends, however, upon nearness to the source of supply much more than does that of meat, since fish deteriorates rapidly upon keeping.

Classification of Fish

For food purposes we may divide fish into white and fat fish; or we may take Hutchison's classification of, (1) fish with more than five per cent of fat, such as eels, salmon and herring; (2) fish with from two to five per cent of fat, as halibut and mackerel; and (3) fish with less than two per cent, such as cod and haddock. Fish with a small amount of fat is more easily digested than the more oily variety. Beside the proteid and fat in the fish, we obtain a certain amount of gelatine. The sturgeon furnishes isinglass, a very pure variety of this substance.

Cost of Fish

In estimating the cost of fish, allowance must be made for the large amount of waste so that the price per pound tells by no means the whole story of its value from an economic standpoint. The following analysis by Miss Williams shows the waste in cooked fish as served at the table, and also the amount of nutrient present.

Composition of Fish

Fish	Part analyzed	Per cent Waste. Bones, etc.	Per cent Gelatin	Per cent Water	Per cent Nutrients
Sardines ..	Whole	4.91	....	42.17	52.92
Salmon ...	Section	5 99	0.53	61 06	32.02
Trout......	Whole	8.23	0.55	67.12	24.10
Eels........	Heads removed.....	11.66	1.09	53.29	33.96
Mackerel..	Whole...............	10.51	0.25	65.21	24.03
Cod.	Section	15.99	0.43	63.78	19.79
Salt cod...	Section	6.13	0.33	67.68	25.85
Haddock ..	Whole	35.10	0.80	46.46	17.64
Whiting...	Whole	21.50	0.86	61.29	16.35
Turbot	Anterior and head..	31.20	0.59	53.09	15.12
Halibut....	Section	6.84	0.03	69.35	23.78
Plaice	Flesh	....	....	79.85	20.14
Soles	Whole	22.02	0.74	61.18	12.06
Oysters....	Shell contents......	....	....	77.71	22.29
Smelts.....	Whole	18.86	0.38	65.20	15.56

Variety in Diet

Fish, beside being an economical source of nitrogenous substances, has much value in satisfying the demand for variety in food. Any lack in nutrients is frequently supplied by the sauces with which it is served, and by the fat used if it is fried. It would seem to be an error from the standpoint of food values to serve a rich sauce with a fish like salmon that already contains a high proportion of proteid and a large amount of fat, but an egg sauce served with a light fish like cod or haddock has its justification, not only in the additional flavor imparted, but in the additional food value.

Shell Fish

Oysters may be taken as a good type of the various shell fish that we use. The analysis of oysters shows a composition somewhat similar to that of milk, although they are higher in nitrogen and lower in fat than milk.

Average Composition of Oysters. (Langworthy.)

(Exclusive of liquid.)

Water	88.3
Nitrogenous substances	6.1
Fat	1.4
Carbohydrates	3.3
Salts	1.9

Comparative Cost

When milk is seven cents a quart and oysters are twenty-five, the amount of food material purchased for a given amount differs greatly in the two. When oysters are fifty cents a quart they must be distinctly regarded as a luxury, used for the purpose of providing variety, and not as a valuable source of food. Oysters are one of the few animal foods that contain a large amount of carbohydrates. These are present in the liver of the oyster in the form of glycogen.

Digestibility

The oyster is especially easy of digestion, but this digestibility is lessened by cooking. This is particularly true when the oyster is overcooked. An objection to the use of the raw oyster is that during the so-called fattening of the oyster, that is done in shallow water, it may become contaminated with typhoid germs derived from sewage. Some noted epidemics have been traced to this source. This simply means that greater care should be taken in the supervision of such a food supply in order that it may be protected from such possible contamination.

Clams Lobsters

Of other shell fish commonly used, clams have a similar composition to that of oysters, but contain a tougher muscle, while lobsters and crabs are generally considered somewhat indigestible because of the firmness and compactness of their fibre. The difficulty here seems partially at least to be the failure to properly masticate the flesh, as is true in so many other cases, and also the difficulty of obtaining the food in an absolutely fresh condition.

Dried and Smoked Fish

Dried and smoked fish deserve a place in the diet for the sake of variety, and because, since the water has been eliminated, a large amount of food material is obtained for a small amount of money. The use of certain varieties of canned fish has become general. Salmon is perhaps the most satisfactory of these. Special care should be taken in using canned fish to remove it immediately from the can after it is opened, and to use it within a short time. Fish that has been frozen should be cooked immediately after thawing, since it decomposes much more rapidly than fish which has not been frozen.

Cooking

Fish, particularly some varieties, such as cod, occasionally contains parasites, but these are destroyed by thorough cooking. It is essential that *all* fish used should be thoroughly cooked, although this does not mean that it should be cooked at a high temperature. A temperature of from 180 to 200 degrees Fahrenheit continued long enough to coagulate the proteid and render the fish opaque instead of clear, gives far more satisfactory results than boiling.

As in other cooking of flesh, this principle is apparently violated when fish is cooked in a hot oven, or fried, but as a matter of fact, the violation is only true so far as the outside layers are concerned, and this sacrifice is made in order to keep the shape of the fish and to develop the flavor.

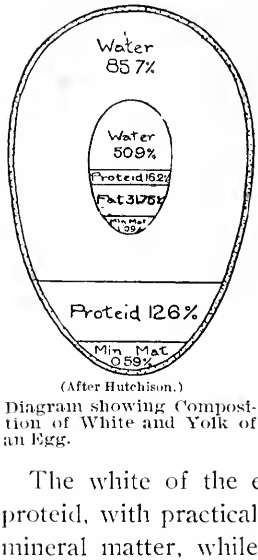
Comparative Costs of Protein and Energy as Furnished by a Number of Food Materials at Certain Prices

Kind of Food Material.	Price per pound.	Cost of protein per pound.	Cost of energy per 1000 calories.
	Cents.		
Codfish	10	$0.94	$0.49
Codfish steaks	12	.71	.36
Bluefish	12	1.22	.59
Halibut	18	1.18	.38
Cod, salt	7	.44	.22
Mackeral, salt	10	.68	.11
Salmon, canned	12	.55	.13
Oysters, "solids" (30 cents per quart)	15	2.50	.65
Oysters, "solids" (60 cents per quart)	30	5.00	1.30
Beef, sirloin	25	1.53	.26
Do	20	1.23	.21
Beef, round	14	.77	.16
Beef, stew meat	5	.36	.07
Beef, dried "chipped"	25	.97	.32
Mutton chops (loin)	20	1.54	.14
Mutton leg	22	1.48	.25
Pork roast (loin)	12	.85	.09
Pork, smoked ham	22	1.65	.13
Milk (7 cents per quart)	3½	1.06	.11
Milk (6 cents per quart)	3	.91	.09
Lobster	18	3.05	1.24
Wheat flour	3	.27	.02
Corn meal	2	.22	.01
Potatoes (90 cents per bushel)	1½	.88	.05
Potatoes (45 cents per bushel)	¾	.44	.02
Cabbage	2½	1.79	.20
Corn, canned	10	3.57	.22
Apples	1½	5.00	.07
Bananas	7	8.75	.22
Strawberries	7	7.00	.38

From *Fish as Food*

EGGS

One of the most general substitutes for meat is the egg. One would at first thought expect eggs to be of much the same composition as milk, since each fur- **Composition** nishes food for the growing animal, but when the different conditions are considered, the reason for the variation in this respect is readily seen. The egg must contain a large amount of nourishment in the most compact form. It must furnish all the materials necessary for growth, but it does not need to provide for activity to the extent that milk does. Consequently we find the carbohydrates wholly absent, and a much larger proportion of solid material than is present in milk. The solids are in the form of proteids, fourteen and eight-tenths per cent; fat, ten and a half per cent; and mineral salts, one per cent. This refers to the edible part only.



(After Hutchison.)
Diagram showing Composition of White and Yolk of an Egg.

White and Yolk The white of the egg contains twelve per cent of proteid, with practically no fat and a small amount of mineral matter, while the yolk has sixteen and two-tenths per cent of proteid and almost thirty-two per cent of fat.

The greater part of the mineral salts are also in the yolk, although the sulphur that causes the blackening of the silver spoon with which we eat our egg is chiefly in the white.

While eggs form a valuable meat substitute, it is difficult to use them wholly in the place of meat, since it takes so many eggs to equal a pound of meat. From eight to nine eggs constitute a pound. If the eggs have the composition given and meat contains eighteen per cent proteid, it would require about twelve eggs to furnish as much proteid as one pound of meat; and one who would have no difficulty in eating half a pound of beefsteak at a meal, would not wish to eat an equal weight of eggs.

Eggs like meat need to be supplemented by carbohydrate material. Bread and eggs furnish a satisfactory combination as well as bread and meat. Raw eggs are usually considered more easily digested than cooked eggs, although some experiments show that the cooked egg leaves the stomach in a shorter time than the uncooked. This is explained by the statement that the raw egg is digested largely in the intestine. Its failure to excite the secretion of gastric juice in the stomach makes it possible to use raw eggs in the diet when the stomach requires rest.

Digestibility

Hard cooked eggs take a longer time to digest than those lightly cooked, but from recent government experiments they seem to differ little in the completeness with which they are digested, an egg boiled three minutes having 8.3 per cent of its nitrogen undigested at the end of five hours; one boiled for five minutes having 3.9 per cent undigested, and one boiled for twenty minutes having 4.2 per cent remaining. Eggs cooked at 180 degrees Fahrenheit for five and ten minutes respectively were totally digested in five hours. Possibly the rapidity of the digestion of the hard cooked egg may depend on the fineness of mastication.

Cost

Whether eggs are to be used freely depends largely upon their price. Eggs at fifteen cents a dozen may be so used, while at fifty cents a dozen they can not be regarded as an economical source of food.

MILK

Milk is often called a perfect food. This is true, however, only in a limited sense. Hutchison gives five tests of a perfect food.

Tests of a Perfect Food

First, such a food must contain all the nutritive constituents required by the body; proteids, fats, carbohydrates, mineral matter and water.

Second, it must contain these in their proper relative proportions.

Third, it must contain, in a moderate compass, the total amount of nourishment required daily.

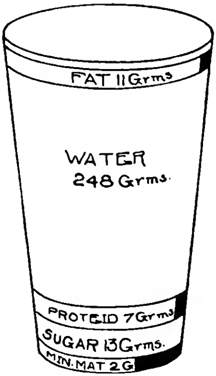
Fourth, the nutritive elements must be capable of easy absorption, and yet leave a certain bulk of unabsorbed matter to act as intestinal balance.

Fifth, it must be obtainable at a moderate cost.

Of these tests milk meets only the first perfectly. It contains the two proteids, casein and albumen. It contains the fat so familiar to us in the form of cream and butter. The carbohydrates are represented in it by milk sugar or lactose. The mineral salts are particularly valuable, and consists chiefly of calcium compounds, including calcium phosphate.

Proportions of Nutrients

When we come to the second test, we find a different condition. An average sample of milk contains 87 per cent of water, three and three-tenths per cent proteid, four per cent fat, and five per cent carbohydrate, with seven-tenths of one per cent mineral matter. This proportion is of course right for the young animal, who demands a large proportion of muscle-building food, but it is far from a desirable proportion for the adult.



(After Hutchison.)
Composition of a Glass of Milk.

Nutrient Ratio

Remembering that the nutrient ratio is about one to five, or to put it in another form, that the adult requires approximately five times as much carbohydrate (or its equivalent) as proteid, we see that milk must be supplemented by some food containing a large proportion of carbohydrate before it can adequately supply the needs of the adult. As a matter of fact, experience has taught us to use with milk such a food as bread, thus supplying the needed starchy material.

The third condition is not met better than the second. At least four quarts of milk a day would be necessary for the complete nutrition of a healthy man doing a moderate amount of muscular work. Milk also is lacking in the bulk of unabsorbed matter that it leaves.

Cost

The fifth condition may or may not be fulfilled. In the city the price of milk is too high for it to be an economical source of food if used exclusively. On the other hand in the country the price of milk is often so low that this condition might be fulfilled.

A comparison of the food value obtained from one pound (a pint) of milk and from that of a similar weight of some common article of food, is given, with the cost of each at prices taken from two different sections of the country:

Comparative Food Value of Milk

1 lb. of milk	furnishes	.033 lbs. proteid	.04 lbs. fat	.05 lbs. carbohydrate
1 " " sirloin steak	"	.165 " "	.161 " "	no "
1 " " eggs (8 eggs)	"	.131 " "	.093 " "	no "
1 " " bread	"	.092 " "	.013 " "	.531lbs. "
1 " " potatoes (one 60th bu.)	"	.018 " "	.001 " "	.147 " "

From milk at (.04 per qt. or .02 per lb.)	1 lb. of	proteid	costs	$ .60
" " " (.07 " " " .035 " ")	1 " "	"	"	1.06
" sirloin steak at .18 a lb.	1 " "	"	"	1.09
" " " " .25 "	1 " "	"	"	1.52
" eggs at (.15 per doz. or .10 per lb.)	1 " "	"	"	.76
" " " (.36 " " " .24 " ")	1 " "	"	"	1.83
" bread at .05 per lb.	1 " "	"	"	.54
" " " .08 " "	1 " "	"	"	.87
" potatoes at .60 per bu. or .01 per lb.	1 " "	"	"	.56
" " " $1.20 " " " .02 " "	1 " "	"	"	1.11

In addition to the proteid, the money invested would have purchased, in the case of milk more than a pound of fat and of sugar; in that of meat an equal amount of fat; in the case of bread more than five pounds of starch; in that of potatoes nearly seven pounds of starch; while three-fourths of a pound of fat would be furnished by the eggs.

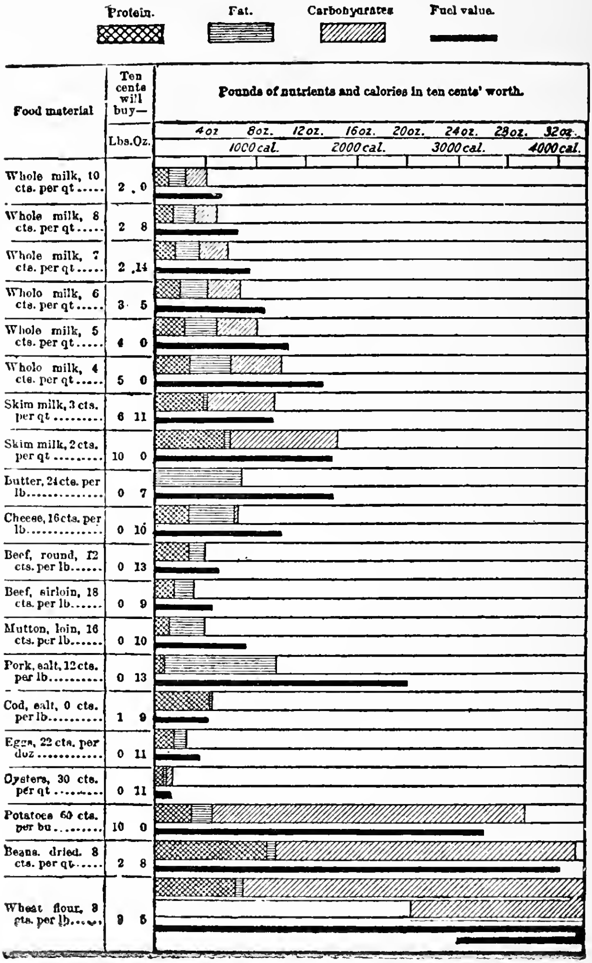
A Food Not a Beverage

Even at city prices milk might well be substituted to a certain extent for other proteid foods. The habit of many people of using milk simply as a beverage in addition to the food required, is perhaps responsible for the fact that many people find milk indigestible; the difficulty lies not with the milk but with the over-abundance of food. An experiment was tried at the Maine Agricultural College on the effect of a limited and an unlimited amount of milk at the University boarding house. These experiments are reported in the Government Bulletin called Milk as Food, and the following conclusions are drawn:

An Economical Food

"First, the dietaries in which milk was more abundantly supplied was somewhat less costly than the others, and at the same time was fully as acceptable. Second, the increased consumption of milk had the effect of materially increasing the proportion of protein in the diet. Third, 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. Fourth, 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 food."

Chart of the Pecuniary Economy of Milk and Other Foods at Given Prices



We may conclude that while it would not be economical to obtain our total food supply from milk, it is good economy to use it freely in connection with other foods to furnish part of the proteid of the diet.

Digestibility

The digestibility of milk varies very much with the method in which it is taken. If a small amount of liquid rennet or of the junket tablets so commonly found in the market, be added to a portion of warm milk, a thick clot forms. This is similar to the process that takes place in the stomach after milk has been swallowed. Milk properly, then, so far as its digestion is concerned, is a solid rather than a liquid food. Its digestibility depends largely upon the way in which this clot is formed. If the milk be swallowed rapidly, so that the rennin acts upon a large mass at once, one large clot is formed. If, on the other hand, the milk be sipped slowly, or eaten from a spoon, the action is slower and the curd is broken.

Addition to Milk

The same result in a more marked degree is obtained by the addition of certain substances, such as lime-water, to the milk; or by the mixing of the milk with bread, as is done in eating bread and milk. Some people who cannot use milk in its ordinary form have found that they could digest it without difficulty if a cracker were rolled into fine crumbs and stirred into the milk. The digestive juices that would act slowly upon a large mass of curd, act readily upon the same amount when it is broken into small clots.

Boiled milk has generally been considered less diges-

Boiled Milk

tible than uncooked milk, but some experiments seem to contradict this. The experiment station bulletin states that when cow's milk has been boiled before it is taken into the stomach it is likely to be precipitated in a more floculent form. Hutchison says that it has been found in the case of infants and calves that sterilized milk which has been kept at or above the boiling point for more than an hour is absorbed quite as well as milk which has merely been boiled in the usual way, and he concludes that boiling does not appreciably diminish the digestibility of milk.

On the other hand, the government bulletin states; after acknowledging that the results of experiments upon the subject are conflicting, that "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 there are persons who cannot take fresh milk with comfort but with whom boiled milk agrees very well."

In this case as in many others we must wait for a larger number of experiments to be made before we can make very dogmatic statements.

Buttermilk Koumiss Skim-milk

Buttermilk is considered an especially digestible form of milk, while koumiss or fermented milk is of still greater value in this respect. Skim-milk deserves more general use than it has, since the proteid of the milk nearly all remains in this, and it is for the proteids that we especially value the milk. Where skim milk is sold at a low price, it is economy to use it freely in cooking, supplying the needed fat in a less expensive form than cream.

The Composition of Milk

Casein

The composition of milk has already been stated in a general way. If we examine it more in detail, we find that the proteids of milk consist chiefly of two: casein or, as it is sometimes called, caseinogen. This forms about three per cent of the total of the milk. It is held in solution more or less completely by the salts of lime present in the milk. When acid is added to the milk, or it becomes sour, this casein is precipitated. When rennet is added the casein is coagulated and is changed in chemical composition. The scum that forms upon heated milk is chiefly casein.

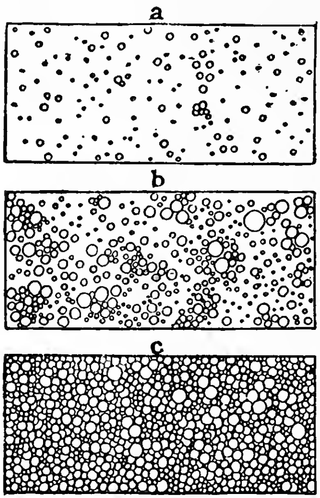
Lact-Albumen

The other proteid present in milk is lact-albumen. This coagulates when the milk is heated for a long time. It is present in much smaller amount than the casein, forming only about one-seventh of the total proteid of the milk.

Milk Sugar

The sugar of the milk, forming between four and five per cent, is called lactose or milk sugar. It has two important characteristics. It lacks the sweetness usually associated with the name of sugar, having only a very slight sweet flavor, and it is considered the most digestible form of sugar, apparently fermenting in the stomach or intestines with much less ease than do other sugars. For both of these reasons it is particularly suitable for the use of infants or invalids. The commercial article is obtained from milk, and is sold in the form of a fine white powder looking not unlike pulverized sugar. Aside from its use as a food it is extensively used in the preparation of pills.

Fats



Fat Globules of Milk Magnified 200 Times.

a Skim Milk. *b* Whole Milk. *c* Cream.

The fat of milk is present in the form of an emulsion. If one looks at a drop of milk through the microscope one sees a large number of tiny fat globules. That the fat is so finely divided is a factor in its digestibility, though fat derived from milk, either in the form of cream or butter, is also considered particularly digestible.

Mineral Matter

The mineral matter of milk consists largely of potash and lime salts, and of these salts the phosphates are the most abundant. These are important, not only in the building of bone tissue, but also, as has been suggested before, in holding the casein in solution.

Water forms about 87 per cent of milk, and its chief use in this form is in holding other materials in solution. To compare milk with other foods, we should properly think of the solid ingredients alone, since the water has no more food value than water in any other form. **Water**

Milk readily undergoes many changes, some of them harmless and some more or less harmful. The most common change is that of souring. Bacteria present in the milk act upon the sugar and change it into lactic acid. After a certain amount of this acid has been produced, the growth of the bacteria is stopped, and no further change in the sugar takes place, though undoubtedly certain other changes take place both in the fat and in the proteid. **Souring**

There is no evidence that sour milk is unwholesome. The objection to it seems to be chiefly one of taste. Its use in cooking produces good results, and many prefer it for some purposes to sweet milk since it seems to produce a more tender product than does the sweet milk. On the other hand, milk may under the action of certain bacteria produce most harmful products, and poisoning from these ptomaines is not uncommon where milk has been handled in an uncleanly manner and has been poorly cared for. A more serious danger from milk is that owing to the excellent food it furnishes for almost all bacteria, it is frequently a carrier of disease. Disease germs that in water would not multiply and would probably live only for a short **Use of Sour Milk** time, multiply abundantly in milk. It is because of the possibility of the presence of these harmful bacteria, rather than from any danger from sour milk, that we guard our milk supply carefully. Each hour that elapses between the milking of the cow and the use of the milk by the consumer, increases the number of bacteria present. One cubic centimeter of milk frequently contains from 400,000 to several million bacteria.

Pure Milk

Efforts to guard the milk supply have been directed in two ways. The sterilization or pasteurization of all milk is often recommended; but a more satisfactory method would seem to be the insuring of cleanly conditions upon the dairy farm where the milk is produced. The next essential after cleanliness is that the milk should be cooled rapidly when first milked, since the lower temperature makes the fluid less favorable for the growth of germs.

Care of Milk

In the household milk should be kept in perfectly clean vessels, and should be loosely, not tightly, covered, in order that there may be access of air to it, since the absence of fresh air favors the growth of certain putrefactive organisms. The entirely open vessel is only allowable in perfectly clean surroundings, not only free from dust, but with no strong flavoring substance near from which odors could be absorbed.

Condensed Milk

One form in which we often get milk is that of evaporated or condensed milk. This is simply milk from which most of the water has been removed, and which has been made sterile by heating to a high temperature. It has usually been sweetened, and the sugar acts as a preservative. While it is a convenient form for use when fresh milk is not obtainable, its large amount of sugar renders it somewhat undesirable as a common article of diet, and also makes it unfit for many cooking purposes.

Milk Powder

There is being put upon the market now milk powder that seems to consist chiefly of the curd of the milk dried and ground. With the addition of water it forms a very fair substitute for milk.

Adulteration

Milk is perhaps more often adulterated than any other common article of diet. The most common form of adulteration is that of skimming or removing part of the cream. This can easily be detected, because it increases the specific gravity of the milk. To counterbalance this, water, which is slightly lighter than milk, is added in such proportion that the twice adulterated milk gives the same test as if it had not been tampered with at all.

Another adulteration that is sometimes practiced is that of adding coloring matter to the milk. This is usually done in order to conceal the blueness of the milk, when it has been watered.

Preservatives

Preservatives are frequently used. Of these boric acid is probably the least harmful, though some authorities contend that formaldehyde in the minute quantities in which it is used has no physiological effect. A milk that will stand in a warm place for some hours and show no tendency to sour is open to the suspicion of having been treated in some such way. Ordinary cooking soda is sometimes added to neutralize the acidity that may be present because of the age of the milk. Salicylic and benzoic acids are sometimes found, while formaldehyde is used most of all.

MILK PRODUCTS

Butter The importance of milk is hardly greater than that of its two chief products, butter and cheese. Butter consists chiefly of the fat of the milk with a small amount of water, of caseïn and of salt, with sometimes a little milk sugar. The average amount of fat contained is 82 per cent. The fats which are present may be put into two classes: Those derived from the so-called "fixed" fatty acids, and those from the volatile fatty acids. The fixed fatty acids are present in the form of stearin, the chief ingredient in beef fat, and of palmitin and olein. The amount of the volatile acids present differentiate butter from most of the other fats that we commonly use as food. The flavor of butter is produced apparently by the action of bacteria upon the cream, the different flavor of butter at different times of the year coming largely from differences in the kind and amount of bacteria that find their way into the milk. The "ripening" of the cream is often induced by artificial cultures of the proper bacteria. Many buttermakers abroad and in some sections of our own country, depend entirely upon these bacterial cultures for the production of their butter flavor.

Changes

The rancidity of butter may be produced by changes taking place in the casein that is present, or from a decomposition of the fats themselves. Cooking lessens the digestibility of butter as it does that of other fats, probably because of the decomposition that takes place when fats are subjected to a high temperature, and the consequent freeing of irritating fatty acids.

Adulteration

The adulteration of butter consists chiefly in a substitution of other substances, either in whole or in part, for the butter fat, or of an inferior and "doctored" article. The coloring of butter is almost universal, but it is so generally accepted that it can hardly be classed as an adulteration, although it surely shows a false standard in foods when we insist upon buying a deep yellow compound colored with annatto or some other foreign material instead of the delicate straw-colored substance that most natural uncolored butter is.

Renovated Butter

The substitutions spoken of are chiefly either what is called renovated butter, or oleomargarine. Renovated butter is made by taking different lots of stale or rancid butter, melting it, allowing the curd to settle, and re-churning the fat with a small amount of milk. The product is certainly better than the rancid butter, but it cannot compare in flavor and in wholesomeness with fresh butter, and certainly should not be sold as such.

Butterine

Oleomargarine, or butterine, is made by clarifying the fat of beef and churning it in milk. It differs from butter in its composition in that it contains practically no curd, and is lacking in the volatile fatty acids that are present in the butter and characteristic of it. It is a cheaper product than butter, and the temptation to put it upon the market under the name of butter has consequently been great. There is absolutely no reason, however, why, sold under its own name, it should not be a very general article of use. There seems nothing to show that it is materially less digestible than butter itself; it does not grow rancid with the ease that butter does, and it is made in a perfectly cleanly and wholesome way, certainly so far as the best quality of it is concerned. Even if it is artificially colored, this is no worse than is true of butter. The difference in taste between it and butter is rather in an absence of the aroma that we find in the best butter, than in any disagreeable flavor present. Indeed, although each person thinks to the contrary in regard to himself, few people are able to distinguish it from butter by taste. It may be used in almost every way as a butter substitute. It is perfectly satisfactory to use in the making of sauces or upon vegetables or meat. It does not make so light a cake as butter, and is not satisfactory for this purpose, except that in a plain cake it may be substituted for part of the butter; and it cannot be used in candy making as, for some reason, it fails to combine with the other materials and always separates out upon cooling. Since it is so much cheaper than butter it would be well to use it as a substitute for part of the more expensive material.

The present law in regard to it has lessened its sale to a great extent since it can no longer be artificially colored, but it is certainly only prejudice that prevents our accepting a pure white fat instead of a bright yellow one.

Cheese

Cheese, so far as nutritive value is concerned, stands almost at the head of our list of foods. Since it is made from the curd of the milk, and the water has largely been disposed of in the whey, while the fat is carried down with the curd, we have the most important part of the milk solids in a condensed form. The composition of the different varieties of cheese varies to quite an extent, but in a rough way we may say that cheese is one-third proteid, one-third fat and one-third water. Mineral salts are abundant as well, while a small amount of milk sugar is sometimes present.

Cheese Making

Cheese is prepared by the addition of rennet to milk. Coloring matter is generally added, and salt. After the curd has set, it is cut in small pieces and the whey allowed to drain off. The curd is then put into a press and allowed to remain for a few hours. After this the real curing or ripening of the cheese begins, and this process is allowed to go on for months in order to develop the flavor. This flavor is produced by the action of bacteria, different varieties of bacteria giving us the different flavors of the various kinds of cheese.

Digestibility

While there is no question as to the nutritive value of cheese, there is more doubt as to its digestibility. In many countries cheese is used largely as a substitute for meat, and wherever it can be digested this is certainly a rational thing. Some people who have delicate digestions have no difficulty in digesting cheese, while others find it an extremely indigestible food. One difficulty seems to be that the cheese is frequently not chewed enough, and the digestive organs have to cope with lumps of the material.

Effects of Cooking

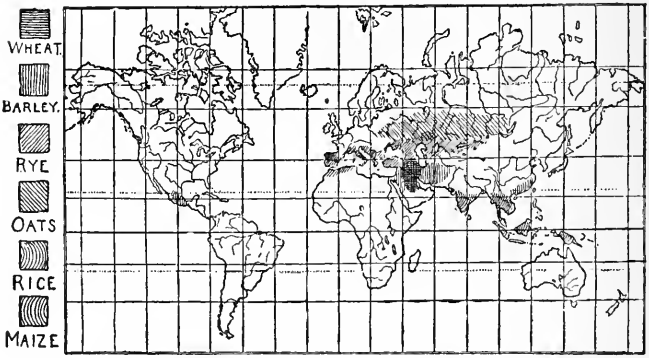
Cheese generally proves more digestible if it is finely divided and mixed with some starchy material like bread crumbs or macaroni. Another factor in its digestibility is the temperature at which it is cooked. Like all proteid foods, it is toughened and hardened by a high temperature. This is very evident in the case of such a dish as a Welsh rarebit, where over-cooking produces a tough, stringy, most indigestible mass. In combining cheese with such a dish as macaroni it is well not to allow the cheese to be at the bottom or the top of the dish, but to protect it from the high temperature by putting it between the layers of starchy material.

Matthieu Williams, in his chemistry of cookery, suggests the use of a little bicarbonate of potash, the old-fashioned salaratus, to make the cheese more soluble and therefore more digestible. Sometimes after the cheese has become tough from the action of too high a temperature, it may be again made soft by the addition of this substance, or of baking soda. Hutchison suggests that the disagreeable effect that cheese has upon some people may be due to small quantities of fatty acids produced in the process of ripening. The philosophy of the use of cheese at the end of a dinner seems to be that the cheese in small quantities aids the digestion of other foods, even though it is not always easily digested itself. Wherever, then, cheese can be used and digested without difficulty, it forms an excellent article of food, one that should be used more freely than is done at present.

CEREALS AND THEIR PRODUCTS

Importance

The most important of all our vegetable foods are without doubt cereals. Not only do they contain a large amount of nutriment, chiefly, but by no means wholly, in the form of carbohydrates, but their areas of growth are widely distributed, and their power of adaptation to different climates and conditions is usually great. This alone would render them exceedingly



PROBABLE NATIVE HOME OF THE GRAINS.

(From *Corn Plants* By Fredric LeRoy Sargent.)

important as food for the human race. Of them all wheat is undoubtedly the most important from its wide distribution and its power of adaptation to different conditions. Rice follows closely in importance, while corn, oats, rye, barley and millet each have an important place in the food of the world. The home of the cereals seems for the most part to have been Central Asia, nearly all, except rice and corn, originating there. Corn is supposed to have originated in Mexico. From these centers their production has spread through all parts of the world.

Composition

A comparison of the composition of some of the different cereals in forms commonly used is given in the following table:

Composition of Cereals.

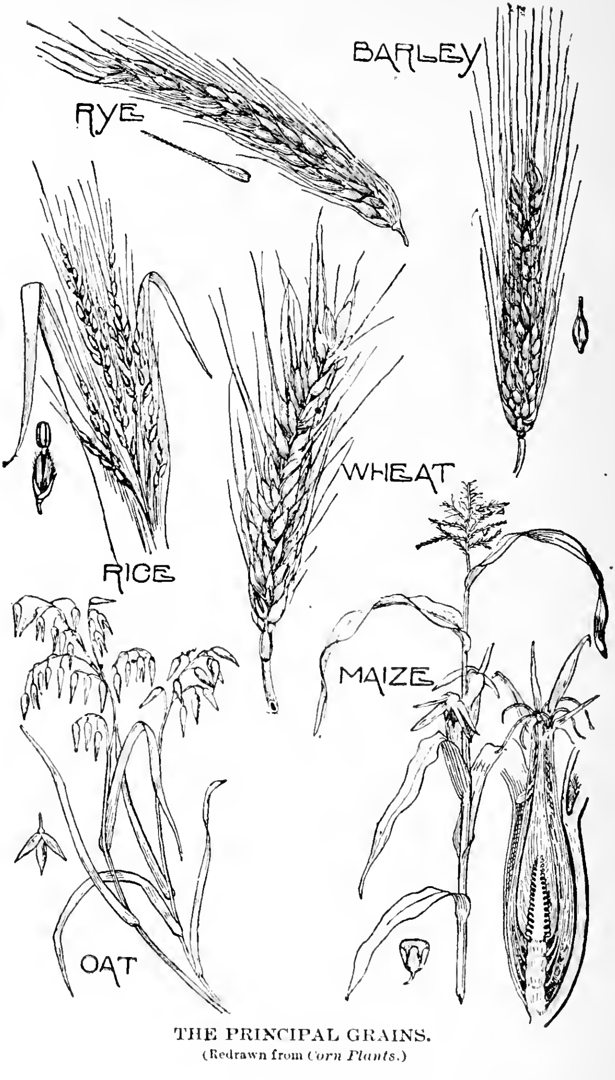
	Per Cent of Water.	Per Cent of Proteid.	Per Cent of Carbo-hydrate.	Per Cent of Fat.
Wheat flour (entire)	11.4	13.8	71.9	1.9
Cornmeal	12.5	9.2	75.4	1.9
Oatmeal	7.3	16.1	67.5	7.2
Rye flour	12.9	6.8	78.7	.9
Barley meal and flour	11.9	10.5	72.8	2.2
Barley (pearled)	11.5	8.5	77.8	1.1
Rice	12.3	8.	79.	.3

Wheat

Wheat derives its special importance from the fact that it will grow in so many different climates and under so many varying conditions. It may be sown either in the fall or in the spring, and receives its name of winter or spring wheat, according to the time of the planting. Many varieties are found, such as red wheat and white wheat, hard and soft wheat.

Varieties

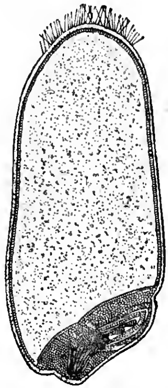
The hard wheats contain a larger proportion of gluten, and therefore a smaller proportion of starch than do the soft wheats. Wheat from which macaroni is manufactured, is an exceedingly hard variety. Successful attempts have been made within a few years to grow macaroni wheats in this country, and much of it is now produced in Dakota. Though hard wheat is



THE PRINCIPAL GRAINS.
(Redrawn from *Corn Plants.*)

used chiefly for making pastes like macaroni, excellent bread can be made from it also, as is shown by experiments made at the So. Dakota Agricultural College.

Winter wheats as a rule are softer than spring wheats. So-called pastry flour is made from the softer wheats. Much of our bread flour is now made from mixtures of winter and spring wheat, and great care is exercised in the combining of these in order to keep an even standard.



Section of a Grain of Wheat.
From a Maine Exp. Station Bulletin.

Flour

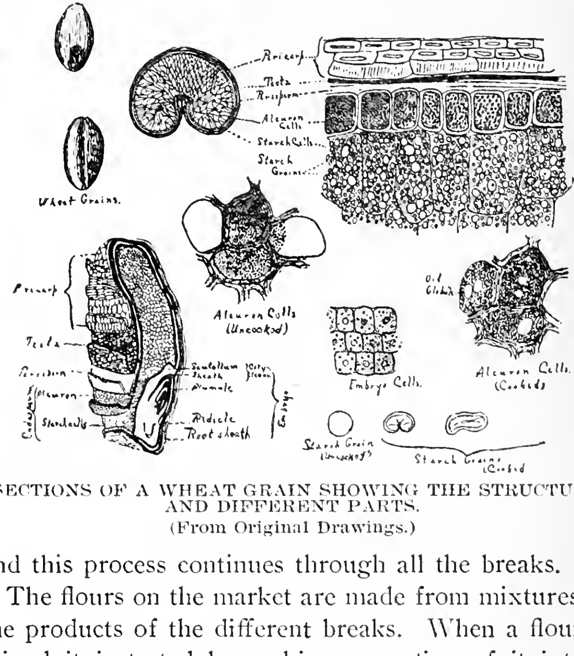
The process of manufacturing flour is carried out differently by different manufacturers, so far as its details are concerned, but the main features are the same. The wheat as it comes to the mill is first of all cleaned, by screening to get rid of any large foreign substances that may be present in it, and by "scouring" to get rid of the fine dirt that may adhere. The next process is that known as breaking. The wheat is cut by corrugated iron rollers provided for the purpose. There are generally five breaks in all. Each "break" is put through a number of siftings. The meshes of the bolting cloth through which this sifting is done are graduated in size, and the products accordingly vary in

Bolting

fineness. The finest particles are called the dustings,

Scalping

the coarsest are the scalpings, while between these are the middlings,—germ, medium and fine. The scalpings from the first break undergo a second breaking and are again separated by sifting as in the first break,



SECTIONS OF A WHEAT GRAIN SHOWING THE STRUCTURE AND DIFFERENT PARTS.
(From Original Drawings.)

and this process continues through all the breaks.

Mixing and Testing

The flours on the market are made from mixtures of the products of the different breaks. When a flour is mixed it is tested by making a portion of it into a small loaf and baking it, and comparing this loaf with that made from some standard flour. The scalpings from the last break constitute the bran. This is almost wholly cellulose and is therefore not digestible by human beings, but much of the so-called Graham flour on the market is simply a mixture of white flour with some of this bran. True Graham flour is really wheat meal made by grinding the entire kernel.

Whole Wheat Flour

So-called whole wheat flour contains the inner portion of the bran only. The cellulose is very finely divided, so that it is less irritating to the digestive organs than the bran in Graham flour.

There is little difficulty today in obtaining good flour, but the different brands vary in composition, and so do different lots of the same brand, in spite of the effort to keep them constant. This means that a different treatment must be used. It is well, then, in the household, to experiment a few times with a new lot of flour before condemning it as poor and returning it.

Standards

Some false standards have been set up in regard to flour. The best bread flour is not pure white, but yellowish in tint. It readily retains the impression of the fingers, if a little is pressed together in the hand. It always has a slightly gritty feeling, while pastry flour is much smoother and more velvety to the touch.

Breakfast Foods

Within a few years the use of cereals as breakfast foods has become general. We have now not only the standard meals, which have been used for a long time, but a multitude of patent preparations as well. The Maine agricultural experiment station found that of fifty varieties of cereals purchased in the market, only about twenty had been on sale for more than three years. Many of these are only new in name, or differ very slightly from those before used. Within a short time there has been added to our list of breakfast cereals many that claim to be predigested foods, and some that make absurd claims with regard to their wonderful food value, while others stand for what they are, without pretence.

Probably there is comparatively little to choose between different preparations of the same grain, so far as their chemical composition goes. The analysis of the uncooked food, however, by no means represents the composition of the cereal as we eat it. An analysis of boiled oatmeal, for instance, gave: Water, 84.5 per cent; protein, 2.8 per cent; carbohydrate, 11.5 per cent; fat, 5 per cent. Comparing this with the analysis of oatmeal given on p. 99, we find only about one-sixth the per cent of nutritive material, with a corresponding increase of water. A cereal that would absorb a greater weight of water would show still greater variation.

Digestibility of Cereals

The digestibility of the cereals is influenced by the coarseness of the particles. The coarser foods are highly desirable in many cases, especially where a sluggishness of the intestines exists, and in other cases are very irritating to the delicate lining of stomach and intestine. Individual needs must determine the use of each.

Most of the cereals, even those that are steam

Time of Cooking

cooked, need much more cooking than is ordinarily given them in order to sufficiently hydrate the starch. Of the foods supposed to be ready to eat, it is difficult to speak definitely, for lack of careful experimentation. In most of them a certain proportion of the starch has been converted into dextrin and sugar. Two questions arise in regard to this. Has the starch been sufficiently changed so that it no longer is indigestible as uncooked starch; and is it desirable to have the starch digested? There seems to be a tendency in our modern life to depend too largely upon predigested foods, particularly in the case of children. This means a tendency toward the lessening of the power to digest. It is certainly a question whether it is not best to take our starch undigested but in such a form that it can be easily acted upon by the digestive juices, rather than to have the work done outside the body.

BREAD

History

Bread was one of the earliest foods of man. That it was used long before history was written, the discoveries of modern times have shown us. In Switzerland, in the lake dwellings of prehistoric times, there have been found not only stones for grinding meal and baking bread, but even bread itself, in the form of round cakes. The first mention of bread in literature is in Genesis, in the words of Abraham to the angels, "I will fetch a morsel of bread." The Egyptians knew the art of breadmaking, and baked loaves and cakes in great variety of form and flavor. One ancient Greek writer names sixty-two kinds of bread in use; and in Rome there were many bakeries, where not only was the baking of bread done, but the grain was pounded and sifted, to prepare it for use.

Kinds of Bread

In our own day bread is found in a great variety of forms, many of them characteristic of certain nations; familiar examples are the black bread of Germany, the oat cakes of Scotland, the hard rye cakes of northern Sweden, baked only twice in the year, and the passover cakes or unleavened bread of the Jews.

Bread forms the staple food of a large section of the human race, and is often the only means of subsistence of the very poor. Mr. Goodfellow, in some investigations made in London, found that in the worst districts fifteen per cent of the children ate only bread for the twenty-one meals of the week, while forty per cent more had other food only two or three times a week.

Good Bread

It is essential that so universal a food should be nutritious, palatable, and digestible. To fulfil these conditions, the flour used must be rich in nutriment; the bread must be light and porous, that as large a surface as possible may be exposed to the digestive juices; and the cooking must develop the flavor, and render the food materials assimilable to the greatest possible extent. The necessary ingredients of bread are flour of some variety and liquid for moistening it. Salt for flavoring is required by almost every one, and to most of us the term bread implies some agent for lightening the dough.

Wheat Bread

Wheat is the flour most commonly employed not only because of its widespread growth but because of the presence in it of the proteid called gluten, or more strictly speaking, of the proteids that upon the addition of water form gluten. Gluten is an important aid in the making of bread light in that being an elastic tenacious substance it retains the gas as it is formed in the dough. In the process of cooking, the gluten hardens and thus enables the loaf to retain its shape. This function of gluten may be compared to that of soap in the water from which soap bubbles are blown.

If some gluten be prepared from flour, as in the experiment on page 41, and baked, the value of this substance in lightening the dough will be appreciated.

Other Breads Of the other cereals, rye makes the lightest bread as its proteids form with water a sticky substance not so elastic or tenacious as the gluten of the wheat, but sufficiently so as to retain much gas. Corn flour, however, makes only a flat and crumbly loaf unless egg be added to increase the elasticity of the dough.

The most desirable bread flour is one rich in gluten.

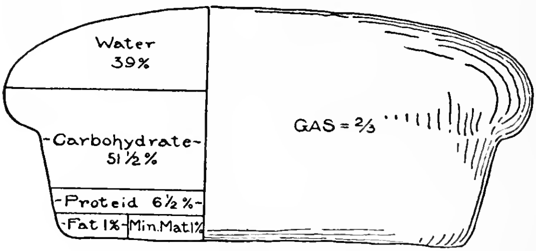


DIAGRAM SHOWING COMPOSITION OF A LOAF OF BREAD.
(After Hutchison.)

Even very hard macaroni wheat may be made into excellent bread as has been shown at the South Dakota Agricultural Experiment Station. If a flour poor in gluten and rich in starch is to be used a stiffer dough must be made than with the opposite conditions. In spite of the efforts of the manufacturers to maintain a constant standard in flour each barrel varies somewhat, and slightly different treatment may be needed.

Leavening Agents Many different agents for lightening the dough have been used at various times. The ancient leaven was made by allowing flour and water to stand in a warm place till it fermented. Part of this dough was used to start the fermentation in a new mixture of flour and water. In some sections of our own country "salt rising" bread is commonly used. In England aerated bread, made by forcing carbon dioxide under pressure into the dough, has been advocated and used to some extent.

Yeast Bread

The most common method of lightening the loaf, in this country at least, is by means of yeast. Yeast comes into the household in three forms, that of liquid yeast, compressed, and dried yeast. The last is most often used by those too far from the source of supply to obtain compressed yeast in good condition. It makes satisfactory bread, but the process is a long one, as time must be allowed for the dry yeast to take up water and renew its life processes. Liquid, or home brewed yeast, prepared usually from potato with the water from a few hops, frequently with the addition of sugar and flour, and the whole fermented by means of the addition of a "pitching" yeast, is much less used than formerly. Aside from the trouble of preparation, it is open to the disadvantage of usually containing many bacteria and wild yeasts. Many think, however, that the fine texture and delicious flavor of old fashioned home made bread was due in part to the use of this yeast.

Compressed Yeast

Compressed yeast is a by product of the distillery or the brewery. It is skimmed from the top of the fermenting liquor, is washed, strained, mixed with a small amount of starch and pressed into large cakes. At the distributing centers it is cut and wrapped in foil and sold for one or two cents, according to locality. It is, on the whole, the most satisfactory yeast to use in bread making, though it is rarely, if ever, free from the bacteria that cause the souring of bread when conditions are right for their growth.

Chemical Process

The changes that take place in the process of bread-making are largely those of fermentation. Some of the starch of the flour is changed to sugar, and the sugar is broken up into alcohol and carbon dioxide. If the fermentation goes too far the alcohol is changed to acetic and other acids and the bread becomes sour. Yeast is not the sole agent working; bacteria and not yeast are responsible for the souring, while the change of starch into sugar is probably accomplished by bacteria or some enzyme (ferment) present in the flour.

Chemical changes, such as the change of some of the starch into dextrin and some of the sugar into caramel, which takes place especially in the crust of the bread, are caused by the heat of the oven, while the same agent is responsible for the driving off of the alcohol and carbon dioxide present.

Methods of Making

A few years ago bread was almost invariably made by what is called the long process. A small amount of yeast was used and the bread was allowed to rise over night. Now more often the bread is set in the morning and the whole process is carried through in six hours.

The advantage of the latter method is that it makes it possible to watch the process and regulate the temperature more carefully than can be done if the bread is set at night. As temperature is an important factor in the growth of the yeast, too low a temperature hindering its growth, and too high a temperature favoring the growth of the acid producing bacteria, this is a distinct advantage. The most favorable range of temperature is from 75 degrees to 90 degrees F.

On the other hand, the long process produces a loaf of a texture preferred by many, and some experiments tend to show that it may be slightly more digestible.

Graham and Whole Wheat Bread

There has been discussion for many years over the comparative value of graham, whole wheat and white bread. Several years ago graham bread was urged upon every one as the only satisfactory bread. After a time the conclusion was reached that the coarse particles of the graham flour were too irritating to the intestinal wall, and its use was discouraged except where this very irritation was desirable, as in case of constipation. Then came the era of whole wheat bread, showing like the graham a high percent of nutriment. At one time it seemed to be considered almost a crime to use any other bread than this. The presence of phosphates in larger amount than in white flour and the higher proportion of proteid seemed a sufficient reason for encouraging its use by every one.

The latest government investigations have proved

White Bread More Nutritious

that this was a false assumption. While from the chemical standpoint it is true, from the physiological one it is not. Less of the material of whole wheat bread is available for use in the body, or in other words, a larger proportion is excreted in the feces than in white bread, so that whole wheat is not superior to white bread in *real nutritive value*. It is hurried through the intestines more quickly and thus given less chance for absorption than is true of the white bread. The phosphates are so closely attached to the outer cellulose wall that they probably do not furnish any more material to the body than is obtained from bread made of white flour.

Combinations with Bread

Although bread contains a fair proportion of proteid, about 9.2 per cent, it has too little proteid, too little fat, and too large an amount of starch to form in itself a perfect food. Instinctively we supplement it with these lacking ingredients. We use butter on our bread, we eat bread with meat, or we combine it with milk. In either case we are supplementing it admirably. Eggs, too, contain the lacking fat and proteid. Nuts eaten with bread and cheese so much used in many countries have scientific sanction.

Good bread is one of the cheapest, most nutritious, most easily and completely digested of all foods and well deserves its title the "Staff of Life."

SUGAR AS FOOD

Consumption

Mrs. Abel, in the government pamphlet Sugar as Food, calls attention to the fact that the consumption of sugar is everywhere increasing. In England eighty-six pounds per capita and in the United States sixty-four pounds per capita were consumed in the year 1895. This means simply the sugar that is manufactured in this form, and does not include that taken in the form of various fruits and vegetables.

The desire for sugar seems to be universal, and the fact that children always crave it would seem to be an indication that it is needed in their diet. On the other hand, we must remember that the manufacture of sugar is comparatively a late matter, and that earlier, a hundred years or so ago, people got along without it except as naturally present in their foods.

Concentrated Food

In using sugar it must be remembered that it is a highly concentrated food, and that it is therefore not to be used in such large quantities as would be right in the case of foods containing a large amount of water. It seems best fitted for assimilation by the body when it is diluted or used with other foods that give it the necessary bulk. It is also an error to use sugar, as is so often done, with other foods in such a way or in so large an amount as to disguise the natural flavor of these foods.

One of the advantages of sugar is that it passes quickly into the circulation, so that the energy obtained from it is available in a very short period. It is particularly fitted for food in cases of exhaustion.

The bad effects of sugar are ascribed by Mrs. Abel to its use in too great quantity. Three or four ounces a day can be disposed of by the healthy adult with impunity. It has generally been thought that sugar is injurious to the teeth, but this also is denied. Any bad effects of this kind are due not to sugar in the diet, but to the allowing particles of sweet food to re- for acid fermentation and possible injury to the teeth.

Sources of Sugar

The source of most of the sugar used until a few years ago was the sugar cane. Now over half of the sugar used in the world is obtained from the sugar beet. In 1904, only about 10 per cent of the sugar used in the United States came from the sugar beet. There has been an impression that beet root sugar is less satisfactory for many purposes than the cane sugar, but it is identical chemically. It may be true in some cases that the beet root sugar has not been completely purified, and that these impurities give an odor to the sugar upon boiling, and possibly affect some of its uses; but the properly prepared sugar may be used in every way that sugar from the sugar cane may; indeed, it is impossible to distinguish between them.

Glucose

Another sugar of which we hear a good deal is glucose. This has been made much of as an adulterant, particularly of candy. There is, however, no reason to think that glucose is less digestible or less easily assimilated than cane sugar. Indeed, it is more nearly ready for assimilation. When we boil sugar for any length of time in the presence of an acid, we change a certain amount of the sugar into glucose. Candy that will stretch we may be sure contains at least some of its sugar in this form. If glucose is pure and properly prepared there is no reason to fear it as an adulterant of candy. The cheap coloring matter and flavors that are used in some of the cheap candies are more to be feared, since some of them are harmful.

It is possible that since glucose goes so rapidly into circulation it may overload the system more readily than would plain sugar, and it is more easily fermented.

Maple Sugar

Maple sugar, regarded as a delicacy, is simply cane sugar plus the flavoring matters found in the maple tree. Milk sugar is generally considered the most easily digested form of sugar and it less easily undergoes fermentation.

Powdered Sugar

Cane sugar is on the market in various forms. Ordinary powdered sugar is, of course, the same substance as granulated sugar, but more finely ground. This is often considered adulterated because it is less sweet than the granulated form, but the lack of sweetness is due to the finely divided condition. A very simple test will serve to show the presence of adulterants since these would probably be either some form of porcelain clay, or starch. If the sugar dissolves in water neither of these can be present.

The brown sugars that we use are simply cane sugar that has not been decolorized, or has been only partially so treated.

Molasses

Molasses formerly was obtained as a bi-product in the manufacture of sugar, and was the part of the sugar-cane juice that would not crystallize, containing a large per cent of glucose. With modern methods of work and with the coming in of beet sugar, whose molasses has such a strong flavor that it cannot be put upon the market, a manufactured molasses came into use. The commercial molasses of the present day is frequently glucose, prepared from starch, colored and flavored with a small amount of molasses from the sugar factories. Sometimes the light molasses has been bleached, and the bleaching agents, unless completely removed, may be injurious. Sorghum molasses is also used in some sections.

Effect on Diet of Use of Sugar

One comparison in regard to the addition of sugar to the diet may be interesting. In the case of milk, it has been found that an addition of this in any large amount to the diet means a corresponding decrease in the amount of other foods used. This seems not to be true of sugar. When sugar is furnished freely in abundance, it does not decrease the use of other foods, but sometimes by adding to the flavor of these actually increases thier consumption. On the other hand, the desire for sugar often marks an inadequate diet.

FOOD AND DIETETICS

PART II

Read Carefully. The following U. S. Government Bulletins should be read in connection with this lesson: No. 34, Meat Composition and Cooking; No. 85, Fish as Food; No. 128, Eggs and their Use as Food; No. 74, Milk as Food; No. 112, Bread and the Principles of Bread Making; No. 93, Sugar as Food. These may be obtained free by addressing the Department of Agriculture, Washington, D. C. Place your name and address on the first sheet of the test. Leave space between answers. *Make your answers full and complete.*

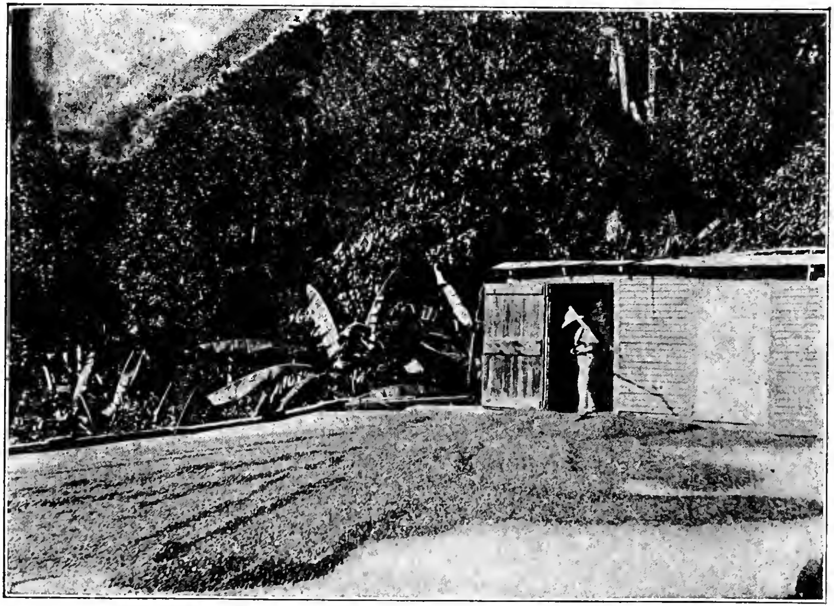
1. What is the relative value of animal and vegetable foods?
2. What are the chief nutrient ingredients of meat? How may the presence of some of these be shown? What reasons are there for cooking meat?
3. Compare clear soup, beef broth, and beef juice as to their nutritive value.
4. What meat substitutes may be used in the daily diet, and how does their value compare with that of meat?
5. In what ways does milk satisfy the requirements of a perfect food? How does it fail?
6. What is the approximate composition of milk? Under what conditions is its free use economical?
7. Give the composition of butter. How does cooking affect its digestibility?
8. What is renovated butter? How may oleomargarine be used and how does it compare with butter in wholesomeness?
9. Describe the process of cheese making.

10. What is the food value of cheese? With what foods should it be combined?
11. What can you say of the value of the cereals as food?
12. If scales are available weigh out a portion of rice (about 1/4 cup), boil, and weigh again. If the scales are not at hand, measure the rice carefully, before and after cooking. How does the composition of the cooked rice differ from that of the uncooked? Repeat the experiment with a potato and compare results.
13. Why is wheat so extensively used? What is its especial value in bread making?
14. What are the chief steps in the manufacture of flour?
15. What are the tests for a good flour? Why is a flour high in gluten desirable for bread?
16. What are the characteristics of good bread?
17. Compare the nutritive value of whole wheat and white bread. When is graham bread valuable?
18. What kinds of yeast are in common use? What are the advantages and disadvantages of each?
19. State the chief changes that take place in the process of bread making and baking.
20. What is the value of sugar as food? How does beet sugar differ from that obtained from the cane? What can you say of the adulteration of sugar?
21. Ask one or more questions on this lesson.

Note.—After completing the test, sign your full name.

FOOD AND DIETETICS

PART III



DRYING COFFEE IF PORTO RICO
From Bulletin No. 25, Division of Botany, U. S. Department of Agriculture

FOOD AND DIETETICS

PART III

VEGETABLES

An increasing importance is coming to be attached to the use of vegetables and fruits in the diet. Not only vegetarians but many others have found from experience that it is possible to live largely upon vegetable food, while those who use meat freely lay great stress upon the vegetable accompaniments whether in the form of salads or of cooked vegetables.

Botannical Classification

A study of vegetables from the standpoint of botany would imply their classification according to the parts of the plant used; whether leaf, as in the case of lettuce, cabbage, spinach; stem, as in celery, asparagus, potato (a tuber, or underground stem); root, as in beet, carrot and sweet potato; flower, as cauliflower; or fruit, as squash, cucumber, tomato.

Flavor Classification

From the standpoint of cookery the most important classification is that of *strong flavored* and *sweet flavored* vegetables, since this modifies our method of cooking; right methods leading us to retain all the juices of the latter as far as possible, while we legitimately discard part of the extract of the former. For example, green peas and string beans, young carrots, and squash, should be cooked in a small amount of water, or have the water in which they are cooked concentrated at the end so that it may all be served with the vegetable; while in the case of onions we may well use a large portion of water, and throw it away. It is true that in this latter case we may lose valuable salts and some nutriment, but these we sacrifice for the sake of improved flavor.

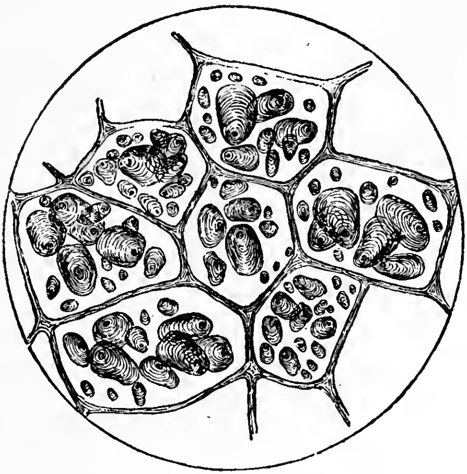
Nutritive Classification

From the standpoint of diet a better classification would be into *nutritive vegetables* and *flavor vegetables.* With the latter we should include those that contain mineral salts, but have little food value. Of this class, lettuce, spinach, cabbage, tomato and cucumber are types; while rice, potatoes, peas, beans and lentils furnish examples of the former. Many vegetables will be on the border line between the two.

The composition of vegetables varies in general from that of animal foods in that here we have the carbohydrates largely represented. The chief carbohydrates of vegetables are starch, sugar, and cellulose of various types.

Cellulose of Vegetables

The fact that cellulose forms the framework of the plant and that it is within cellulose walls that the starch as well as the proteid of the plant are contained, is important in two ways. While cellulose is only slightly digested by human beings (only so little of it in young and tender plants really serving as a food that the amount may be neglected), it does have a more or less important function in furnishing the required bulk of food. If one undertakes to live wholly upon a vegetable diet, this bulk generally becomes too great; on the other hand, one of the objections to an exclusively animal diet is in the absence of bulk. Since the digestive juices do not act upon cellulose to any extent, and the nutritive portions of the vegetables are enclosed within walls of this sub-

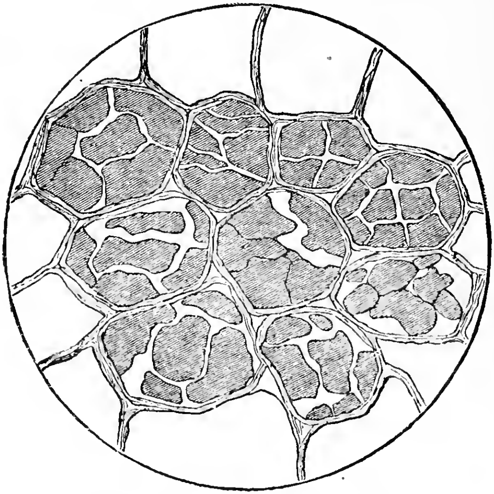


STARCH OF A POTATO ENCLOSED IN CELULOSE CELLS.

stance, the province of cooking is to so change the cell wall that the nutritive materials may be set free, or the digestive juices penetrate to them.

Effect of Cooking on Cellulose

We usually speak of softening the cellulose by means of cooking. Apparently what we really do is to dissolve the intercellular substances that bind the walls together, and thus make it possible for the cell walls to be mechanically ruptured, either in the process of cookery or by the pressure exerted in the mouth. Part at least of this intercellular substance belongs to the pectin group that causes the jelling of fruit juices.



SWELLING OF THE STARCH.

Hydration of the Starch

The first process in rendering the starch of the vegetable digestible is one of hydration. It is important, therefore, that an abundance of water be present when starch is cooked. Some vegetables like the potato contain so much water that the necessary amount for the starch is supplied within the vegetable itself. The grains and other dry vegetables need to have a large amount supplied. The swelling of the starch grains upon hydration is probably an important agent in the rupturing of the cellulose cell wall already referred to.

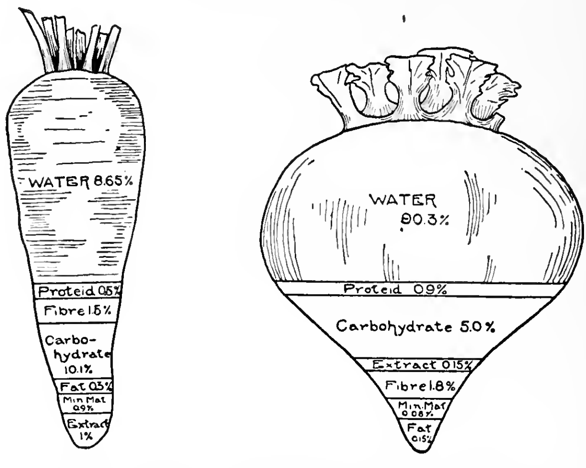
THE CELL WALLS RUPTURED.

Sugar in Vegetables

Sugar is the soluble carbohydrate of the vegetable, as starch is the insoluble form in which this nutriment is stored. Some vegetables, such as carrots, show large amounts of sugar, while starch is absent from this part of the plant. Other typical vegetables containing a large amount of sugar are beets, parsnips, artichokes, sweet potato. Onions, cabbage, and some varieties of peas, string beans, squash and sweet corn all contain a fair amount.

Starchy Vegetables

Vegetables containing a large amount of starch are

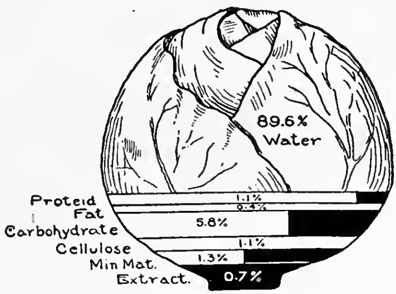


COMPOSITION OF THE CARROT AND TURNIP.
(After Hutchison)

represented by potato, sweet potato, rice, peas, beans and lentils. Some vegetables containing a large amount of cellulose are squash, potato, beet, celery, cabbage.

Proteid of Vegetables

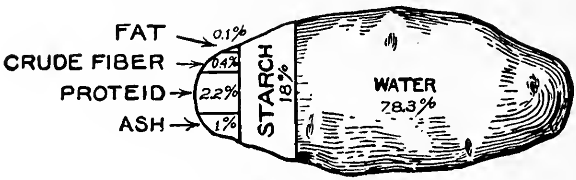
As a rule, we do not look to the vegetable world for our main supply of proteid, yet some of our vegetables, notably the legumes, do contain an abundant supply of this food principle. Whether this is as available for use in the body as the proteid in meat is often questioned. With ordinary cooking processes it evidently is not, but with long continued heat the matter is different. That there is no inherent difference between vegetable and animal proteid, so far as



COMPOSITION OF THE CABBAGE.
Blackened portions represent amount dissolved in cooking.

Digestibility of Vegetable Proteid

its digestibility is concerned, would seem to be indicated by the fact that when the vegetable is finely divided, as in the case of some of the vegetable meals, it is absorbed to a greater extent than in its ordinary form. It is said, for instance, that when lentils are soaked and boiled until soft, 60 per cent of their proteid is absorbed, while in the lentil meal 90 per cent is utilized by the body. No careful experiments have been made to see what proportion of the boiled lentils would have been absorbed if the cooking had been continued for several hours. There is every reason, however, to think that the percentage would be increased. Anyone who has compared dry peas or beans cooked two hours, or until they have just become soft, with those cooked from eight to twelve hours will realize the difference in the result.



COMPOSITION OF THE POTATO.

The Potato

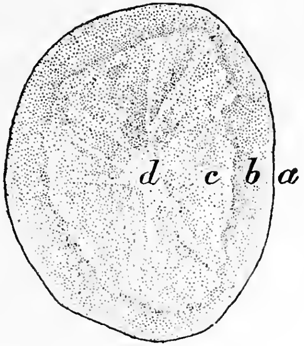
Among the vegetables, the potato, in this country at least, is the most generally used. It has of late been decried as having no food value. This is far from true. It has, of course, a small amount of proteid, some of which is lost in the process of cooking. Its mineral salts are less in amount than in many vegetables, and are partially lost in the cooking. Its chief value as food lies in the starch it contains, and in the fact that its very absence of strong flavor makes it acceptable day after day.

Salts of Vegetables

Vegetables should be in our diet not only for their food value but for their mineral salts as well. The bad effect of the failure to use a certain proportion of vegetables and fruits, has long been known. Scurvy has usually been attributed to this error in diet, while it is quite possible that some minor disorders of the digestion are attributable to the same cause. Cabbage, lettuce, celery, onion, spinach and the different leaves used as greens find their value almost wholly in the presence of mineral salts.

Mushrooms

Mushrooms have often been considered of great value, from the proteid they contain, but it seems certain now that this value has been much exaggerated,



SECTION OF A POTATO.

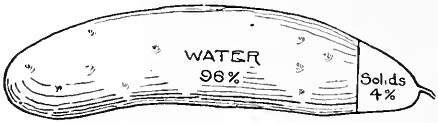
a—Outer Skin. *b*—Inner Skin or Fibro-vascular Layer. *c*—Flesh. *d*—Inner Flesh.

and that the reason for using them as articles of food lies in their pleasant flavor and the variety they give, rather than in the amount of nutriment they furnish the system.

Digestibility of Vegetables

The digestibility of different vegetables must always be difficult to ascertain, so far as any one individual is concerned. Not only the presence of cellulose, but of acids, as in the tomato, of nitrogeneous substances, such as asparagin found in asparagus, and of volatile flavors, as in the onion, all affect this question.

There has been within a few years a great gain in the abundance and variety of vegetables available. Formerly in winter choice was confined to cabbage,



COMPOSITION OF THE CUCUMBER.

turnip, squash, onions and a few others. Now a visit to the market of a large city, even at the least promising time of year, shows an overwhelming variety of fresh vegetables. If we add to these the numerous canned vegetables of excellent quality available (and these are increasing in variety constantly) and the dried vegetables, like the peas, beans and mushrooms even, that are obtainable, we have no excuse for limiting our diet so far as vegetables are concerned.

True economy will consist not in cutting down the supply but in choosing fresh vegetables at the time when each is most abundant and therefore cheapest, and presumably at its best, and in supplementing these by the judicious use of the canned or dried product, not forgetting the ordinary winter vegetables.

Average Composition of Vegetables

Name	Refuse	Percentage Composition of Edible Portion						
		Water	*Carbohydrates	Fiber	Nitrogenous	Fats	Ash	†Calories, per lb.
Beans, dried	......	12.6	55.2	4.4	22.5	1.8	3.5	1,605
Beans, string	7.0	89.2	5.5	1.9	2.3	.3	.8	195
Peas, dried	......	9.5	57.5	4.5	24.6	1.0	2.9	1,655
Peas, green	45.0	74.6	15.2	1.7	7.0	.5	1.0	465
Potatoes	20.0	78.3	18.0	.4	2.2	.1	1.0	385
Sweet Potatoes	20.0	69.0	26.1	1.3	1.8	.7	1.1	570
Sweet Corn	61.0	75.4	19.2	.5	3.1	1.1	.7	470
Parsnips	20.0	83.0	11.0	2.5	1.6	.5	1.4	300
Carrots	20.0	88.2	8.2	1.1	1.1	.4	1.0	210
Beets	20.0	87.5	8.8	.9	1.6	.1	1.1	215
Turnips	30.0	89.6	6.8	1.3	1.3	.2	.8	185
Onions	10.0	87.6	9.1	.8	1.6	.3	.6	225
Cabbage	15.0	91.5	4.5	1.1	1.6	.3	1.0	145
Spinach	......	92.3	2.3	.9	2.1	.3	2.1	110
Squash	50.0	88.3	8.2	.8	1.4	.5	.8	215
Tomatoes	......	94.3	3.3	.8	.9	.4	.5	105
Lettuce	15.0	94.7	2.2	.9	1.2	.3	.7	90
Celery	20.0	94.5	2.3	1.0	1.1	.1	1.0	85
Cucumbers	15.0	95.4	2.4	.5	.8	.2	.7	80

*Not including fiber.
†Including fiber and thus higher than fuel value available in the body.

The substances grouped under carbohydrates in the above table are chiefly starch, sugar and pectose bodies. Church states that turnips contain no starch or sugar, only pectose, but one of the analyses of the Department of Agriculture showed one sample to contain over 4% of sugar. The carrot contains sugar and pectose, but no starch; parsnips, sugar, starch and pectose. The nitrogenous matter is only in part proteid; in potatoes about 57%; in carrots, onions, cabbage, cucumbers, lettuce, about one-half.

Classification of Fruits

Fruits may, like vegetables, be classified as *flavor* fruits and *food* fruits, and again these two classes will run together so that we shall have difficulty in deciding where certain ones belong. The apple, the orange, the strawberry, although all having a certain food value, are used so largely for their flavor and to give variety, that these may well be put under the head of the flavor fruits. Bananas form, perhaps, the best common example of the food fruits. Bread fruit, so largely used in the tropics, is another representative of this class.

Dietetic Value

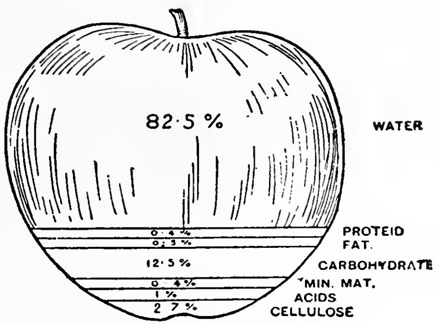
From a dietetic standpoint the most important function of fruits is that of furnishing mineral salts and organic acids to the body. The potash salts are considered especially important. Some fruits, like the pineapple, contain ferments that are said to be aids to digestion. Fruits are generally laxative in effect,—apples, figs, prunes, peaches and berries are particularly effective in this respect, especially if taken between meals or at the beginning of a meal.

Nutritive Value

Their chief nutritive value is given to fruits by the carbohydrate group. This is largely in the form of sugar, while the remainder consists chiefly of vegetable gums, among which may be included the "pectin bodies" that give to fruits their power to form jelly. Starch may be present in unripe fruits, but disappears as the fruit ripens. Bananas, as we use them, contain a small amount of starch. Of fresh fruits very few contain more than one per cent of nitrogenous matter, not all of which is proteid.

Dried Fruits

Dried fruits may be without question put under the food fruits, dates containing sixty-six per cent of carbohydrate, prunes approximately the same amount, figs about sixty-three per cent, while raisins furnish seventy-five per cent. Raisins in this respect stand almost at the head of the list of concentrated foods since they furnish so much nutriment in so small a



COMPOSITION OF AN APPLE.
(After Hutchison.)

bulk. When fresh fruits are not obtainable dried fruits may well take their place. These are usually less expensive than fresh fruits, and properly cooked go far to make up for the absence of the fresh varieties.

Canned Fruits

Canned fruits are increasingly used, and many who formerly thought it necessary to put up large amounts of fruit at home, are now purchasing those canned on a commercial scale. Whether this is a wise thing or not depends on the amount of fruit available for the housekeeper at a low cost, the price of sugar, and the time and strength at her disposal. Often the fruit commercially canned is really superior to that prepared at home for the reason that the canning is done where the fruit is easily obtainable in its freshest and most perfect condition. When canned fruit is as reasonable in cost as it is at present, the housekeeper should certainly be very sure that her time cannot be used to better advantage before she undertakes to prepare quantities of fruit at home.

Perhaps no article of diet has increased in use during the last few years so rapidly as fruits. Not only the most hardy, but the more perishable varieties, including berries, are by improved methods of transportation, by the use of refrigerator cars and by increased areas of cultivation made available through a longer season, and at greater distances from the source of supply than ever before. The fruit industries, including the cultivation of the fruit, the great canning and drying establishments, and the transportation of the product, have become of immense importance in the commercial world.

New Varieties

New varieties of fruit produced by careful selection and cross fertilization are constantly appearing. Some of the most important changes that have been induced by cultivation have been the lessening of the proportion of cellulose, the production of seedless varieties, the increase in size and the development of fine flavors.

PICKING AND DRYING RAISINS IN CALIFORNIA
From Year Book U. S. Department of Agriculture, 1904

As in the case of vegetables, the digestibility of fruits is largely an individual matter. Bananas may be eaten freely by many, even by children, while others fail to digest even a small portion. Strawberries, generally considered easily digested, are actual poison to some people. The chief benefit of a table of digestibility is as a guide for experimentation. In feeding a child, for instance, one would try first the fruits considered most digestible.

Digestibility of Fruits

Aside from the personal equation, ease in mastication is one of the important elements in the digestion of fruits, as in the case of other foods. The banana, for instance, easily slips down the throat in large pieces; the blueberry can be swallowed whole, while such a fruit as the apple is naturally more thoroughly masticated, for ease in swallowing, and the orange almost falls apart of itself.

The difference in the digestibility of ripe and unripe fruits is generally attributed to the larger proportion of cellulose in the latter; this and the excess of acids in unripe varieties is held responsible for their ill effects.

Gilman Thomson gives among the commoner fruits easy of digestion: grapes, oranges, lemons, cooked apples, figs, peaches, strawberries and raspberries; while he classifies as somewhat less digestible: melons, prunes, raw apples, pears, apricots, bananas and fresh currants. Dried currants and citron he considers "wholly indigestible," while he gives as the most useful fruits for invalids: lemons, oranges, baked apples, stewed prunes, grapes, banana meal.

Young children and those of delicate digestion should avoid all skin and seeds of fruit.

Average Composition of Fruits

	Refuse	Percentage Composition of Edible Portion						
		Water	*Corbohydrates	Fiber	Nitrogenous	Fats	Ash	†Calories, per lb.
Bananas	35.	75.3	21.0	1.0	1.3	.6	.8	460
Grapes	25.	77.4	14.9	4.3	1.3	1.6	.5	450
Plums	5.	78.4	20.1	?	1.0	......	.5	395
Cherries	5.	80.9	16.5	.2	1.0	.8	.6	365
Huckle berries	......	81.9	16.6	?	.6	.6	.3	345
Apples	25.	84.6	13.0	1.2	.4	.5	.3	290
Pears	10.	84.4	11.4	2.7	.6	5	.4	295
Black berries	......	86.3	8.4	2.5	1.3	1.0	.5	270
Apricots	6.	85.0	13.4	?	1.1	......	.5	270
Peaches	6.	85.0	10.5	?	.5	......	.6	......
Oranges	27.	86.9	11.6	?	.8	.2	.5	240
Raspberries (red)	?	85.8	9.7	2.9	1.0	......	.6	255
Cranberries	......	88.9	8.4	1.5	.4	.6	.2	215
Lemons	30.	89.3	7.4	1.1	1.0	.7	.5	205
Pineapple	......	89.3	9.3	.4	.4	.3	3	200
Muskmellon	50.	89.5	7.2	2.1	.6	......	.6	185
Strawberries	5.	90.4	6.0	1.4	1.0	.6	.6	180
Watermelon	60.	92.4	6.7	?	.4	.2	.3	140

* Not including fiber.
† Including fiber.

The carbohydrates of fruits are chiefly in the form of sugar. Nearly all contain pectin bodies and these are most abundant in unripe fruit. The acids of the fruits are here included under the carbohydrates. Apples, pears and peaches contain malic acid; lemons and oranges, citric acid; grapes, tartaric acid; rhubarb, oxalic acid, etc.

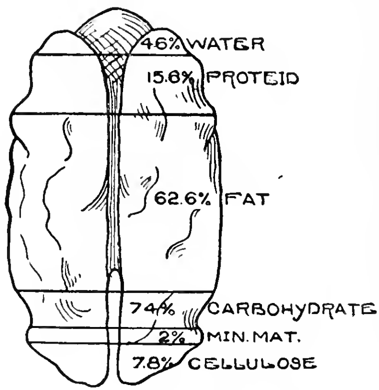
Average Composition of Dried Fruits

	Refuse	Percentage Composition of Edible Portion: Water	*Carbohydrate	Nitrogenous	Fats	Ash	*Calories, per lb.
Dates	10.0	15.4	78.4	2.1	2.8	1.3	1,615
Raisins	10.0	14.6	76.1	2.6	3.3	3.4	1,605
Currants	......	17.2	74.2	2.4	1.7	4.5	1,495
Figs	......	18.8	74.2	4.3	.3	2.4	1,475
Prunes	15.0	22.3	73.3	2.1	......	2.3	1,400
Apples	......	28.1	66.1	1.6	2.2	2.1	1,350
Apricots	......	29.4	62.5	4.7	1.0	2.4	1,290

* Including fiber.

Nutritive Value

The form of fruits that we know as nuts has a very different place in diet from that of the ordinary fruit. We find here foods having a nutritive value that compares favorably with that of the most nutritious substances. Almond kernels for instance contain twenty-one per cent of proteid, fifty-four of fat, and seventeen



COMPOSITION OF AN ENGLISH WALNUT.

of carbohydrates, while peanuts are richer still in proteid and also contain a large amount of fat. Indeed, nuts often may well be substituted for meat, and have the advantage that they supply at the same time a certain amount of carbohydrates. Some nuts, as chestnuts, are very rich in the latter. The table given is taken from the experiment station bulletin, *Nuts as Food*, and shows the composition of some of the most common nuts.

Average Composition of Nuts

	Refuse	Percentage Composition of Edible Portion					
		Water	Protein	Fat	Carbohydrates including Fiber	Ash	Calories, per lb
Almonds	47.0	4.9	21.4	54.4	16.8	2.5	2,895
Brazil Nuts	49.4	4.7	17.4	65.0	9.6	3.3	3,120
Filberts	52.1	5.4	16.5	64.0	11.7	2.4	3,100
Hickory Nuts	62.2	3.7	15.4	67.4	11.4	2.1	3,345
Pecans	50.1	3.4	12.1	70.3	12.2	1.6	3,300
Walnuts	58.8	3.4	18.2	60.7	16.0	1.7	3,075
Chestnuts (fresh)	15.7	43.4	6.4	6.0	42.8	1.4	1,140
Butternuts	86.4	4.5	27.9	61.2	3.4	3.0	3,370
Cocoanuts	34.7	13.0	6.6	56.2	22.6	1.6	2,805
Cocoanut, shredded	......	3.5	6.3	57.4	31.5	1.3	3,125
Pistachio.	......	4.2	22.6	54.5	15.6	3.1	3,250
Peanuts	27.0	7.4	29.8	43.5	17.1	2.2	2,610
Roasted Peanuts	32.6	1.6	30.5	49.2	16.2	2.5	2,955
Peanut Butter	......	2.1	29.3	46.5	17.1	5.0	2,825

Digestibility of Nuts

Much has been said about the indigestibility of nuts, but this probably comes largely from the fact that nuts are most usually eaten at the end of a hearty meal after the appetite has been completely satisfied. If nuts were more often taken as a substitute for a part of the meat of the meal, there would probably be less difficulty with regard to their digestion. Another important factor in their digestibility as in the case of other foods, is that of their finely divided condition; often they are insufficiently masticated. Some of the nut meals and pastes on the market are valuable because of their fine division, and their use as a meat substitute certainly has a rational basis. Peanut butter is the most common of these preparations.

The common beverages, tea, coffee and cocoa, are in such general use today that it is difficult to realize that two of them were not introduced into Europe until the seventeenth century, and the other only a hundred years earlier, though other nations had known them long before. Tea drinking began in Japan in 692 A. D., while coffee, though not known to the Greeks and Romans, had been used in Abyssinia and Ethiopia from time immemorial.

Varieties of Tea

The tea plant seems to be a native of Assam, a province of Burmah, but it has been grown in China and Japan for fifteen hundred years. Two different types of the plant are illustrated by the Assamese and Chinese varieties. The tea of Assam grows luxuriantly, but is sensitive to drought, cold or winds. Its leaves are of bright green, sometimes reaching a size of nine inches in length and three in width, while the young leaf is of soft texture and golden color. It may produce as many as twenty "flushes," or successive crops of young leaf during each picking season. The Chinese plant is tough and hardy, able to endure severities of climate, and to grow in poor soil with deficient moisture. The leaf is smaller, tougher and darker than that of the Assam tea plant. Between these two extremes exist all varieties of tea. Most varieties produce three or four crops a year.

The tea plant produces small white flowers which eventually yield the seed from which cultivated tea is

Pekoe Tea

raised. In cultivating the plant an effort is made to produce abundant young leaf, since good tea is made from this alone. Pekoe tea is the choicest variety. The undeveloped bud at the end of a young shoot is

TEA LEAVES.

a—Flowery Pekoe. *b*—Orange Pekoe. *c*—Pekoe. *d*—Souchong (first). *e*—Souchong (second). *f*—Congou. *H*—Bohea.

Souchong Tea

called the pekoe tip, or flowery pekoe. It is said that this tea rarely comes to this country. From it is made Mandarin tea, that commands a very high price in its native country. The next leaves produce orange pekoe and pekoe. Souchong is the next larger leaf and Congou the next. A still larger leaf formerly on the market more generally than now yields Bohea.

Black and Green Tea

All of these different varieties may be made either into black or green tea, though some plants yield leaves better adapted for the manufacture of black tea, and some that serve better for green. Japan tea, for example, is usually made into green, while the Indian are generally black. Chinese tea provides both varieties. The difference between black and green tea is, however, in the method of preparation. Green tea is prepared by withering the leaves in iron vessels over a quick fire, or by steaming them on mats. The leaf is then rolled in order to break up the tissue containing the essential oil. It is then re-heated and subjected to long continued drying over a low fire. In black tea the fresh leaf is spread out to wilt in the sun, then rolled, spread out thinly, moistened and allowed to ferment. The leaves are then dried and fired in a furnace or over a charcoal fire.

Fermentation Process

The chief difference between the black and green tea lies in this fermentation process. By this means, some of the tannic acid in the leaves is changed so that it becomes less soluble. The black tea is thus less astringent than the green. Common varieties of green tea are hyson, corresponding to the pekoe or souchong, and gunpowder, corresponding to congou.

Names

Aside from the varieties given by the stage of growth at which the leaf is plucked and by the method of preparation, teas are named from the different countries or the special district that produces them, or even from the gardens where they are grown, Japan, Chinese, Indian and Ceylon teas each have their own marked characteristics, while the different districts of China give various kinds, as the oolongs from Formosa or the monings from north China.

Quality The quality is dependent on the cultivation of the plant, the age of the leaf, and the care in manufacture. Some of the finest tea of China is so high priced that it can be purchased there only by the very rich, while the lowest grades are often made into bricks (brick tea) and sent into the interior. The choicest Japan tea is raised under protection from direct sunlight and is prepared without rolling. It is said to be untouched with the hand after it is put upon the steaming apparatus. Most of the teas sent to the United States might be classed as low middling, with some superior grades. The choice varieties are rarely received.

Composition The most important constituents of tea are theine, or caffeine, tannic acid and the volatile oil that gives the flavor. Black and green tea contain practically the same amount of oil and caffeine, but black tea has only about half as much tannic acid as green.

Method of Making The method of making tea has an important influence on the constituents of the beverage. Methods vary all the way from one Japanese fashion of stirring the finely ground tea into warm water and drinking the whole infusion, to the Russian method of bringing the water just to a boil and making a delicate infusion.

The boiling of tea and the practice of keeping the teapot on the stove all day that the brew may be ready at any moment, each results in extracting the largest possible amount of tannic acid from the tea. If tea must stand after making, it should be poured off the leaves immediately. The difference in extract can be easily seen if equal amounts of tea be in one case boiled four or five minutes, in another allowed to stand in cold water, and in a third infused in hot water for the same length of time. If these three results be put into glasses, the depth of color will indicate the difference in material extracted. If a solution of ordinary copperas be made, and a few drops of this added to each, a black, inky substance, a tannate of iron, will form, the amount varying with the tannic acid extracted.

Adulteration of Tea

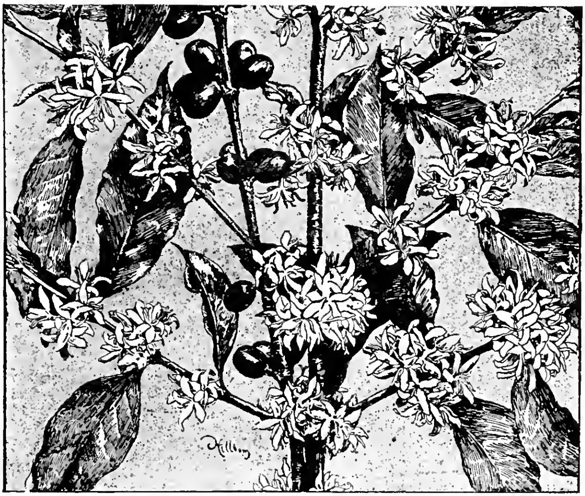
Adulterations of tea are much less common than formerly. The chief fraud practiced is that of substituting an inferior grade for a better. One method of doing this is by facing the tea. This is practiced especially on green teas, giving them a brighter color.

Occasionally spent or exhausted leaves are mixed with fresh ones, thus constituting an adulteration.

Tea tablets are sometimes prepared for the use of travelers by pressing finely ground tea of varying quality into tablets to be dissolved in hot water,

COFFEE

The coffee tree (caffaea arabica) belongs to the same botanical family as the tiny partridge berry found in our northern woods, the familiar button bush of the country roadside, and the gardenia.



COFFEE BEANS AND BLOSSOMS.

Native Home

It is native to Abyssinia, western Africa, and perhaps western Arabia, though it has now been naturalized in a large number of tropical countries. It blooms eight months in the year and with its small fragrant, white blossoms in the axils of the glossy evergreen leaves, it presents an attractive appearance. The ripe coffee berry is dark in color and is a pulpy fruit, somewhat resembling a cherry. The berries have two cells, each containing a single seed, the coffee bean. Three gatherings of coffee are generally made annually. The ripe fruit is dried and then freed from skin and pulp, usually by machinery.

In the east a decoction is frequently made of the unroasted seeds, while in some places the leaf of the tree is used for preparing a drink; and it is said that in the Sultan's coffee the dried pulp of the berry is employed.

Roasting The roasting of coffee so generally practiced, is chiefly for the purpose of developing its flavor and rendering the beans brittle so that they can be more easily ground, though it has other effects also. Coffee is imported from Mocha, Java, Ceylon, Maracaibo, Porto Rico, and other countries. But 75 per cent of that used in this country comes from Brazil. Our Mocha and Java mixtures are simply different kinds of berries from the same plant.

Preparation Coffee, unlike tea, may properly be prepared either as an infusion or a decoction; that is, it may be extracted without boiling, or it may be boiled.

Constituents The important constituents of coffee are caffeine and caffetannic acid, and caffeol, the oil that gives the fragrant aroma and flavor. Caffeol is developed by the process of roasting while the amount of caffeine is lessened. Sugar is present in considerable amounts,

PICKING COFFEE BERRIES.

and most of this is caramelized in the roasting. Fat also is found, sometimes to as much as 15 per cent, and proteid to about 10 per cent. A comparison of the composition of tea and coffee is given below:

Percentage Composition of Coffee

	Raw.	Roasted.
Moisture	8.98	0.63
Caffeine	1.08	0.82
Saccharine matter	9.55	0.43
Caffeic acid	8.46	4.74
Alcoholic extract	6.90	14.14
Fat and oil	12.60	13.59
Lugumin and albumen	9.87	11.23
Dextrin	0.87	1.24
Cellulose and insoluble coloring matter	37.95	48.62
Ash	3.74	4.56

Percentage Composition of Tea

	Unprepared Leaves.	Green Tea.	Black Tea.
Caffeine or theine	3.30	3.20	3.30
Ether extract	6.49	5.52	5.82
Hot-water extract	50.97	53.74	47.23
Tannin (as gallotannic acid)	12.91	10.64	4.89
Other nitrogen-free extract	27.86	31.43	35.39
Crude protein	37.33	37.43	38.90
Crude fibre	10.44	10.06	10.07
Ash	4.97	4.92	4.93
Nitrogen	5.97	5.99	6.22

Composition of Decoctions

This does not give a fair estimate of the composition of the drinks since we use more coffee to the cup

COFFEE BERRY AND LEAF, NATURAL SIZE
From Bulletin No. 25, Division of Botany, U. S. Department of Agriculture

than tea. Hutchison finds that a cup of black coffee contains nearly the same amount of caffeine and tannin as a cup of tea. This depends, of course, very largely upon the methods of preparation. It is generally considered that with our ordinary methods that less tannin is present in coffee than in tea.

Adulterants

The adulterants of coffee are many. One of the commonest is chicory. In France this is often used in order to add a desired flavor. Other adulterants that have been found are roasted peas, beans, wheat, brown bread, charcoal, red slate, and dried pellets consisting of ground peas, pea hulls and cereals held together with molasses. These are met with only in ground coffee. Although at one time artificial coffee beans were manufactured to some extent, they are said to be seldom found today. The adulteration of unground coffee consists rather of the substitution or admixture of cheap or inferior varieties. A simple rough test for the detection of adulteration in coffee consists in shaking some of the sample in cold water. The pure coffee usually floats on the surface while most of the adulterants sink, the grains of chicory coloring the water a brownish red as they fall. Sometimes adulteration can be detected if ground coffee is spread out upon a paper and examined with a magnifying glass. A better protection is afforded, however, by purchasing the coffee unground.

It is said that "the earliest intimation of the introduction of cocoa into England is found in the announcement in the Public Advertiser of Tuesday, 16th June, 1657 (more than a hundred and thirty years after its introduction into Spain), stating that "in Bishopgate street, in Queen's Head alley, at a Frenchman's house, is an excellent West India drink, called chocolate, to be sold, where you may have it ready at any time; and also unmade, at reasonable rates."

Early Use of Cocoa

In spite of this alluring advertisement, it was the beginning of the eighteenth century before chocolate became a fashionable beverage. And even as late as 1832 the consumption of cocoa was very limited, owing to a large duty that existed up to that time. Long before this it had become a great favorite in Spain as it was in Spanish Ameria. In New England a mill for the preparation of chocolate was established in 1765. The chocolate of the early Spanish days must have been somewhat different from the modern article. This is one receipt that is given: "Take a hundred cocoa kernels, two heads of Chili or long peppers, a handful of anise or orjevala, and two of mesachusil or vanille—or, instead, six Alexandria roses, powdered--two drachms of cinnamon, a dozen almonds and as many hazelnuts, a half pound of white sugar, and annotto enough to color it, and you have the king of chocolates."

Cocoa Tree

The cacao tree (theobroma cacao) from which chocolate and cocoa are obtained, is a native of tropical America. It grows to an average height of from thirteen to twenty, or even thirty feet, with a diameter of from five to ten inches. A quaint description of the appearance of the tree is given in the following

FLOWER AND FRUIT OF COCOA TREE.

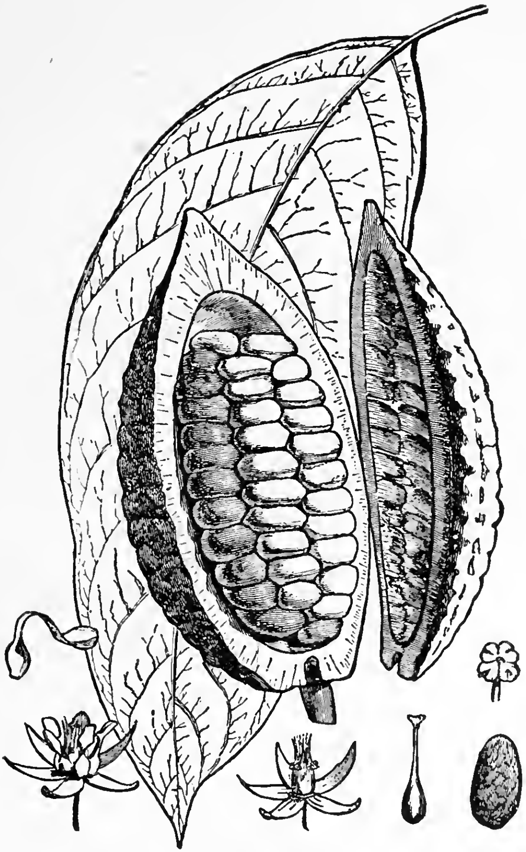
words: "The cacao-tree almost all the year bears fruit of all ages, which ripens successively, but never grows on the end of little branches, as our fruits in Europe do, but along the trunk and chief boughs, which is not rare in these countries, where several trees do the like. Such an unusual appearance would seem strange in the eyes of Europeans, who have never seen anything of that kind; but, if one examines the matter a little, the philosophical reason of the disposition is very obvious. One may easily apprehend that if nature had placed such bulky fruit at the ends of the branches their great weight must necessarily break them, and the fruit would fall before it came to maturity."

Cocoa is raised from seed, and the tree does not bear fruit till it has reached the fifth or sixth year. It requires an abundance of air and light, but must be shaded from too much direct sun. This is accomplishd by growing large shade trees at frequent intervals in the cocoa plantation.

Cocoa Bean

The cocoa beans are the seed of the plant and lie in even rows in a pod not very unlike a large cucumber in shape and size. The first step in the preparation of cocoa is the removal of the bean from this pod and its subjection to a "sweating" or fermentation process. After this the beans are dried in the sun and in this form are shipped to our market.

Beans from different places, Caracas, Trinidad, Maracaibo, Java, and others are imported by the manufacturer who mixes them in different proportions in order to get the result desired. The second step in the process of manufacture is the careful roasting of the beans to develop the flavor, and the crushing or cracking of the nuts and the removal of the thin husk or shell with which the seed is covered, by winnowing. The shells are used in many places for the preparation of a drink. If they are boiled for a long time, a smooth, oily beverage with a pleasant nutty



COCOA BEANS.
Showing Fruit, Flowers and Leaf.

flavor is obtained. The cracked cocoa, or cocoa nibs, as it is called, is also used for preparing a bev-

METHOD OF GROWTH OF COCOA.

erage. A mixture of the shells and nibs gives a very satisfactory result.

The next step in the preparation of chocolate is the grinding of the nibs and running the semi-liquid product into molds. If sugar or any flavoring is to be added, it is done at this time.

Chocolate

Cocoa in its purest form is chocolate with part of the fat removed. In order that it may stay in a powdered condition, it is necessary either to remove this oil or add some form of starchy material. Sometimes flavoring materials such as cinnamon or vanilla are also added.

Theobromine

Cocoa, like tea and coffee, contains an alkaloid called theobromine. Tannin is also present in the raw bean, but is changed during the roasting to cocoa-red which gives the color to the cocoa. A substance somewhat like the caffeol of coffee is also developed during the roasting process. Cocoa beans also contain a large amount of fat—about 50 per cent—with proteids, starch, and other substances in small amounts.

Percentage Composition of Cocoa

	Roasted Cocoa Nibs.
Water	2.72
Ash	3.32
Theobromine	1.44
Other nitrogenous substances	12.12
Crude fibre	2.64
Starch	8.07
Other nitrogen-free substances	19.57
Fat	50.12
	100.00

The food value of clear chocolate has never been questioned. Perhaps the writer of the eighteenth century who is responsible for the following statements may have exaggerated somewhat. He says:

"In reality, if one examines the nature of chocolate a little, with respect to the constitution of aged persons, it seems as though the one was made on purpose to remedy the defects of the other, and that it is truly the panacea of old age."

"There lately died at Martinico a counsellor, about a hundred years old, who, for thirty years past, lived on nothing but chocolate and biscuit. He sometimes, indeed, had a little soup at dinner, but never any fish, flesh, or other victuals. He was, nevertheless, so vigorous and nimble that at fourscore and five he could get on horseback without stirrups."

Food Value

So good a scientist as Liebig says, however: "It is a perfect food, as wholesome as delicious. It is highly nourishing and easily digested, and is fitted to repair wasted strength, preserve health, and prolong life." A simple statement of the case is that we have in chocolate a highly concentrated food, particularly rich in fat, but containing a fair amount of the other food principles. Since it is so concentrated it demands water in abundance. So far as its digestibility is concerned, there is more question. The very presence of so much fat means that it is too rich for some people, while others can digest it with no difficulty. Hutchison tells us that so far as cocoa as a drink is concerned the food value is over-estimated, since the amount we actually use is small. This depends to a large extent upon the manner in which the beverage is prepared. The milk and sugar used add appreciably to the nutriment, and if we follow Thudichum's suggestion, we shall have a beverage of high food value even if one questions its perfection in other respects. He says: "Chocolate should be served in cups and be of sufficient consistency to be eaten with a small spoon, rather than drunk. In this way it was used by the Mexicans; they also ate it with golden spoons. We have tasted the combination, and find chocolate in a red cup and saucer, to be eaten with a golden spoon, aesthetical perfection; both taste and sight are much pleased with the combination."

The possible effect upon digestion of the theobromine present has not been fully determined. It is a substance similar in character to caffeine in coffee and tea. These beverages, however, unlike cocoa, have no food value.

Physiological Effect of Tea, Coffee and Cocoa

The physiological effect upon the system of tea, coffee, and cocoa has been much discussed. Of the three, cocoa seems to have much less influence either in retarding digestion or as a stimulant, though there is reason to think that it is not without stimulating effects.

Tea has a marked influence in lessening the action of the saliva, while both tea and coffee retard digestion, the latter to a less extent than the former. This effect seems due to the tannic acid and the volatile oil. The caffeine itself favors digestion. Both tea and coffee act as stimulants because of the caffeine present. It is this that causes them to be so effective in lessening the feeling of fatigue. Strong coffee is a powerful antidote to narcotics, and is often used where a heart stimulant is needed. Coffee and tea may, because of the tannic acid and other astringent substances present, prove irritants to the mucous membrane of the stomach. This action is greater if the stomach is empty. The stimulating effect also is greater if taken upon an empty stomach.

Personal Equation

The effects of coffee and tea seem to be influenced largely by the personal equation, and quite opposite results are produced in different persons by them; while in most people they tend to produce wakefulness, in others they are conducive to sleep. Some people can use one freely and must refrain completely from the other.

The general conclusion from experiment and observation seems to be that, taken in moderate quantities and at suitable times, they are not injurious to the healthy adult, but that those of a feeble digestion, or who are nervous, should use them in exceedingly small quantities, if at all. Of the two, coffee seems to have the least harmful effect in the majority of cases.

Cereal Coffee

On the market at present there are a large number of coffee substitutes. Some of them undoubtedly are true cereal drinks, and may be used as such, though when a large amount of food value is attributed to them on this account, one cannot help wondering how the insoluble substances of the wheat grain can so largely be present in the drink made from the treatment of wheat kernels in water. Some of the so-called cereal coffees are said to derive their flavor from the volatile oils produced in the roasting of coffee, while others actually contain coffee.

Pure Food Campaign

Probably no food question has been so much discussed of late, or has appealed so generally to the public at large as that of food adulteration. Nearly all the states have passed laws providing for more or less stringent regulations, and the United States Congress has passed a national law and is considering further legislation on the same subject. Magazines and newspapers have taken up the matter; the women's clubs have enthusiastically pressed it and a vigorous "pure food" campaign has been made. This is right and proper; but, either through ignorance, or the belief that it is justifiable to do evil that good may come, many statements are made that are not only sensational in the extreme, but absolutely untrue. Others, while not absolutely wrong, convey a distinctly false impression.

False Impressions

Mrs. Abel, in a recent article, calls attention to some types of such statements by the following illustration:

"A baby has dined on a candy Easter egg and sausage, and the heading reads

DEATH FROM COAL TAR COLOR IN EASTER CANDY.

"Now sausage is not exactly an infant food and might perhaps have been held responsible for the sad result, but sausage is a trite and common thing, while chemical colors, bearing such a disagreeable name will surely catch the public eye!

"And did we not read one other day that a prominent hygienist had announced that 450,000 babies die yearly in this country of poisoned milk? Few of us had access to census reports from which to learn that this is a much larger number than die yearly from all causes under the ages of five, and perhaps fewer still saw the indignant denial of this official, and learned how a truthful and moderate statement can be distorted."

One of our most reputable city dailies is responsible for the following absurd statement in the report of a speech:

Newspaper Statements

"Dr. Wiley, chief of the national bureau of chemistry, says that nine-tenths of the deaths each year in this country are due to dyspepsia, generally caused by impure food. He declares that the tendency also is to shorten the duration of life, and cites figures to show that 2,000,000 deaths in the United States in the last ten years have been traceable largely to the use of bad food. It is the workingman, the poor man, who cannot afford to buy the higher priced articles of food, who suffers more from these conditions.

"Viewed from an economic standpoint also, the laboring man should be interested. In the report of the Kentucky state board of health for last year the statement is made that for every dollar spent in the purchase of food, 45 cents on the average is paid for adulterations."

The implication here is even worse than the actual statement, for while "impure food" and "bad food" might include water and milk contaminated with typhoid germs, or food that has been allowed to deteriorate by bacterial action till it is in a dangerous condition, it is evident that the meaning intended to be conveyed is that these phrases mean adulterated food.

The same paper in a recent editorial makes the absolutely ungrounded charge that numerous deaths have been caused by the presence of coal tar dyes in candy. It implies that all manufacturers are actuated by greed, and that they care nothing as to the poisonous character of their materials if only they make money.

Glucose

A circular advertising a certain breakfast food, after dividing glucose into good and bad kinds, introduces the following paragraph, saying that the definition is from the dictionary, "Glucose, the trade name of a syrup obtained as an uncrystallizable residue in the manufacture of glucose proper, and containing in addition to some dextrose or glucose, also maltose, dextrine, etc. It is used as a cheap adulterant of syrups, beers, etc. Thus we learn even in this public way that there are harmless and harmful kinds of glucose."

The implication is, of course, that glucose is unfit for food, and no account is taken of the facts that maltose is a sugar perfectly wholesome and digestible, and that dextrine is always an intermediate product in the change of starch into sugar, whether this change is induced by the action of acid as in the manufacture of commercial glucose, or by a ferment as in the change of starch into sugar by the saliva.

No good can come from exaggerated and false statements, and it is the business of every woman who has to do with the purchasing of foods to so inform herself that she shall not be misled.

Classification of Adulterants

We may classify the adulterants of foods, using the term in a broad sense, under three headings: *First,* additions or substitutions used for the sake of cheapening the product; *second,* material such as coloring matter, used either to imitate the natural product or to beautify and make more attractive some foods; *third,* preservatives. Of the first class, by far the greater number are such as affect the pocketbook and not the health. One of the common adulterants of spices, for instance, is starch, and this only means that when such a spice is used a larger amount is needed than would be the case if it were pure. Coffee to which has been added chicory or ground peas or beans, or for which has been substituted an artificial bean, cannot be said to be less wholesome because of this treatment. Cream of tartar, because of its expense, is often adulterated, but again the adulterant is usually harmless. Butterine substituted for butter means the payment on the part of the consumer of a large price for an inexpensive article; but the article consumed is in every way as digestible and wholesome as if no substitution had been made. This and many other articles used to adulterate more expensive ones, have their own value, and if placed upon the market under their own names, might be profitably used. There is no reason to think that corn syrup, or glucose, with a flavoring of caramel is less wholesome than maple syrup, but we all justly object to having the former product labelled with the name of the latter and sold at its price.

Correct Labelling

The crusade against adulterations should then, so far as this class is concerned, be directed toward full and correct *labelling,* and against the possibility of cheap articles being branded as superior ones or sold at the price of the better article. The consumer should demand the right to receive the full equivalent for money paid, and every effort should be made, not only to have right laws passed but to see that frequent tests are made of food materials bought in the open market, and to compel manufacturers to make a correct statement of the ingredients in their wares.

On the part of the housekeeper there should be a knowledge of materials, and ability to make simple tests, while for such tests as imply technical chemical knowledge material should be sent to the board of health or other experts. Most of all, skill in interpreting labels should be cultivated. A bottle purporting to be vanilla and labelled

PURE VANILLA,
Compound

on the face of it is not vanilla, though it may not necessarily be a less wholesome article.

Coloring Matter

The second kind of materials that we have classed as adulterants—the coloring matters, are used generally to satisfy a popular demand. Everyone knows that fresh butter is seldom of the bright yellow color of that on the market, yet few people would purchase an uncolored butter. Because in June, under the best conditions, butter is yellow, we have come to regard that as the only desirable thing. The manufacturer of a certain brand of cheese a few years ago made an attempt to put an uncolored product on the market, though he had formerly used coloring. To his surprise, he could not sell his cheese. The public, accustomed to a deep orange color in that brand, said the white cheese was not "so rich," that it was made of skim milk instead of cream, and refused to accept it.

As soon as the purchasing public has a different standard of values the manufacturer will cease to color his products. He will be content to offer properly canned tomatoes, even though the color is not as brilliant as that of the fresh fruit, and will put upon the market a catsup more attractive though less bright than the modern product. He will devise methods of canning peas and beans that will change their color as little as possible, but will not "green" them to deceive a credulous public. At the same time, the dishonest manufacturer will have less opportunity to conceal the inferiority of poor goods by the addition of color.

Coal Tar Dyes

Color is also used frankly to beautify articles, as in the case of candy, and this seems legitimate when the colors are harmless, and the coloring is delicate. In this case, as in that of other uses of it, the question arises as to the possible harmful effects of the colors used. Of late the so-called coal tar dyes have been frequently employed, and perhaps because of their name much anethema has been directed against them. As a matter of fact, most of the coal tar dyes used are perfectly harmless, with absolutely no physiological effect. They are so strong in coloring power that a very minute amount is all that is necessary to give the desired result. Some of the coal tar dyes are poisonous, and should not be used, though again the fact that so small an amount is required to produce the effect is a protection. Some vegetable dyes are also poison, as well as some of the mineral dyes used before the coal tar products were available, and both of these classes have less coloring power, and so must be used in larger quantities.

That the confectioners are not all "monsters of greed" "reeking" with the desire to make money at the cost of the health and lives of an unsuspecting public, is shown by the fact that long lists of harmless and harmful colors have been made by the National Confectioners' Association, and that the same association has offered resolutions for dealers in confectioners' colors as well for manufacturers of candies, urging only the legitimate use of non-poisonous colors. Legislation and public opinion should unite in forbidding the use of any harmful coloring even in minute quantities, and careful investigation should be made and lists of safe colors presented. An educated public will see no beauty in crude and vivid colors and will demand only the most delicate shades in candies and similar products, and this will mean less coloring of any kind.

Preservatives

As to the use of preservatives in food, there is an honest difference of opinion among experts. It is contended by many that in proper amounts and under proper regulation they are a desirable safe-guard, since they keep in a fresh and wholesome condition foods that would otherwise deteriorate. The amounts necessary are so small that they would seem presumably to have no effect on the users. On the other hand, the user may not be a healthy adult, but an infant or an invalid, presenting quite a different problem. In most cases a little more care would keep the food in proper condition without the resort to doubtful means.

The two sides of the case are stated as follows in the government pamphlet giving the result of the famous borax experiment.

Government Statement

"It is admitted by all who have examined the subject in a critical way, even by the users of preservatives, that in certain maximum quantities the limit of toleration is reached in each individual and positive injury is done. But it is also well recognized that many, if not all, of the usual foods when used in large excess produce injurious results. The many cases of disease produced by overeating, or by eating improperly prepared or poorly cooked foods, or by eating at unusual times, are illustrations of this fact. Upon this basis and upon the further statement that when used in extremely small quantities the preservatives in question cannot be regarded as harmful, is founded the principal argument in favor of the use of the preservatives, aside from the fact that the foods themselves are kept in a better and more wholesome state."

Small Quantities

"It would be useless to contend that the occasional consumption of small quantities of boric acid in a sausage, in butter, or in preserved meat would produce, even upon delicate stomachs, any continuing deleterious effect which could be detected by any of the means at our disposal, but naturally it seems that this admission does not in any way justify the indiscriminate use of this preservative in food products, implying, as it would, the equal right of all other preservatives of a like character to exist in food products without restriction.

"It appears, therefore, that there is no convincing force in the argument for the use of small quantities unless it can be established that there is only a single preservative used in foods, that this preservative is used in only a few foods, that it will be consumed in extremely minute quantities, and that the foods in which it is found are consumed at irregular intervals and in small quantities. On the other hand, the logical conclusion which seems to follow from the data at our disposal is that boric acid and equivalent amounts of borax in certain quantities should be restricted to those cases where the necessity therefor is clearly manifest, and where it is demonstrable that other methods of food preservation are not applicable and that without the use of such a preservative the deleterious effects produced by the foods themselves, by reason of decomposition, would be far greater than could possibly come from the use of the preservative in minimum quantities. In these cases it would also follow, apparently, as a matter of public information and especially for the protection of the young, the sick, and the debilitated, that each article of food should be plainly labeled and branded in regard to the character and quantity of the preservative employed."

Conclusion

More Experiments Needed

Many more experiments need to be conducted before we know the truth in the matter of preservatives. Meanwhile most careful supervision of their use should be exercised when they are allowed at all, and every effort should be directed toward securing cleanly processes of food preparation, and such good conditions that no preservatives should be needed other than the ordinary ones of salt, sugar, spices, with the processes of smoking and sterilization.

The most common preservatives in general use are formaldehyde, salicylic acid, benzoic acid, baking soda, borax and boric acid.

Home Tests

Some of the simpler tests for food adulterants can be successfully used by the housekeeper even without technical training.

The following methods of distinguishing between butter, oleomargarine and renovated butter are taken from the farmers' bulletin on the subject:

The Spoon Test for Butter

In the kitchen the test may be conducted as follows: Using as the source of heat an ordinary kerosene lamp, turned low and with chimney off, melt the sample to be tested (a piece the size of a small chestnut) in an ordinary tablespoon, hastening the process with a splinter of wood (for example, a match). Then, increasing the heat, bring to as brisk a boil as possible, and after the boiling has begun, stir the contents of the spoon *thoroughly*, not neglecting the outer edges, two or three times at intervals during the boiling—always shortly before the boiling ceases. In the laboratory a test tube, a spoon, or sometimes a small tin dish, is used in making this test. From the last-named utensils the test is often called the "spoon test," and sometimes the "pan test."

A gas flame, if available, can be used perhaps more conveniently than a kerosene lamp.

Oleomargarine and renovated butter boil noisily, sputtering (more or less) like a mixture of grease and water when boiled, and produce no foam, or but very little. Renovated butter produces usually a very small amount.

Genuine butter boils usually with less noise, and *produces an abundance of foam.*

To Distinguish Oleomargarine from Genuine and Renovated Butter

Utensils Required.—The utensils required in the test to distinguish oleomargarine from renovated and genuine butters are as follows:

(1) A one-half pint tin "measuring cup," common in kitchen use, marked at the half and quarters; or a plain one-half pint tin measure, ordinary narrow form; or an ordinary small tin cup, 2¾ inches in diameter and 2 inches in height, holding about one gill and a half.

(2). A common kitchen pan, about 9½ inches in diameter at the base.

(3). A small rod of wood, of the thickness of a match and of convenient length for stirring.

(4). A clock or watch.

The Process.—The process for distinguishing oleomargarine from renovated and genuine butters is as follows:

Use sweet skimmed milk, obtained by setting fresh milk in a cool place for twelve to twenty-four hours and removing cream as fully as possible. Half fill with this milk the half-pint cup or measure, or two-thirds fill the smaller cup mentioned, measuring accurately the gill of milk when possible; heat nearly to boiling, add a slightly rounded teaspoonful of the butter or butter substitute, stir with the wooden rod, and continue heating until the milk "boils up," remove at once from the heat and place in the pan (arranged while milk and fat are heating), containing pieces of ice with a very little ice water, the ice to be mostly in pieces of the size of one to two hens' eggs (not smaller, as small fragments melt too rapidly) and sufficient in quantity to cover two-thirds of the bottom of the pan; the water to be in quantity sufficient, when the cup is first placed in the pan, to reach on the outside of the cup to only one-fourth the height of the milk within; any water in excess of that amount must be removed. (This refers to the condition at the beginning of the cooling; later, as the ice melts, the water will rise to a higher level.) Stir the contents of the cup rather rapidly, with a rotary and a cross-wise motion in turn, continuously throughout the test, except during the moment of time required for each stirring of the ice and water in the pan, which must be done thoroughly once every minute by the clock. This is done by moving the cup about, in a circle, following the edge of the pan. Proceed in this manner for ten minutes, unless before that time the fat has gathered or has allowed itself to be easily gathered in a lump or a soft mass, soon hardening. If it so gathers, the sample is oleomargarine; if not, it is either genuine or renovated butter."

It will be seen that by trying both of these tests one may determine which of the three a suspected sample of butter really is.

A method of determining the presence of coal tar dyes in foods has been given in the following words by a recent writer:

Test for Aniline Colors

"Suppose that some cheap currant jelly is to be examined. Stir up about one-fourth of the contents of the tumbler of jelly with about a pint of water in an agate stewpan. Take a piece of white woolen cloth about five or six inches square and wet it thoroughly with boiling water. Care should be taken that it is "all wool," and white is better than cream color. Nun's veiling is an excellent thing to use. Immerse the cloth in the diluted jelly and boil it on the stove for five or ten minutes, stirring it frequently with a small wooden stick. Then remove it and wash well in boiling water. If a dye has been used in the jelly the cloth will be brightly colored.

"Natural colors impart to the wool, when treated in this way, only a dull pinkish-brown color, quite different from the brilliant color of the artificial dye. In order to be absolutely certain, however, it is best to take the dyed wool and boil it with about a tablespoonful of ordinary household ammonia in half a pint of water. After boiling for five minutes, remove the wool, and if the ammonia is colored add to it a third of a cupful of vinegar, immerse it in a second piece of the white woolen cloth and boil it as before. Any color that is imparted to the second piece of cloth is the analine dye, which was dissolved off by the ammonia. The natural color would not be removed from the first cloth by the ammonia, hence would not dye on the second piece. The coloring can be boiled out of sausages and dyed on wool in the same way."

Gelatine Test

"Another interesting way of showing the presence of these dyes, especially in beverages, is to dye them on gelatine. Dissolve one part of gelatine in ten parts of boiling water and pour it into a deep pan to harden. When it is cold, by means of a sharp knife cut it into inch cubes. Place one of these cubes into the suspected liquid and allow it to remain for twenty-four hours, then wash it slightly with cold water and cut through it with a knife. If the color is a natural one it will lightly tinge the outer surface of the cube, but will not penetrate far below the surface, so that the inner portions will be largely free from color. Nearly all of the coal-tar dyes, cochineal and similar colors, will be found to permeate the jelly cube, often to the center.

"One advantage of the dyeing on cloth, however, is that the sample can be preserved as evidence. Nothing is better than ocular proof to convince the average person."

Several other tests for food adulteration have been given under the special foods or in other papers of this series. (See also Bulletin No. 100. *Some Forms of Food Adulteration and Simple Methods for Their Detection.* Price 10 cents, of the Supt. of Documents, Washington, D. C.)

SPECIAL DIET

The housekeeper of today must know not only how to select food for the normal member of her household, and how to provide for the varying needs of different ages and activity, but she is many times called upon to direct the diet of an invalid or a delicate child or to provide special foods for those who are sick.

Housekeeper's Province

It is not her province to diagnose a case, or to prescribe special diet, but it is her part to be able intelligently to carry out the directions of a physician. If the invalid is to have starchy foods eliminated from his menu, the housekeeper must know where to turn to obtain foods that will furnish the requisite number of calories without recourse to carbohydrates, and she must be able to prepare such food in a palatable manner; if the diet is to contain a large amount of fat, as in the case of a tubercular patient, she must know where to obtain this food in a digestible form, and, if there is need for economy, how to substitute cheap forms of fat for the more expensive ones. She must know, when the direction is given for a nourishing diet, how to add the egg or milk that is required, or to substitute some other form of food if these are not acceptable.

The housekeeper then, so far as invalid diet is concerned, should be familiar first, with the composition of the ordinary food materials, and second, with the relative digestibility of the different foods so far as that knowledge is available and with their physiological effect. Then, and then only, can she intelligently carry out the directions given.

Food for Children

One of the troublesome problems for the mother is the deciding upon the right food for children, especially for those of school age. While the physician will direct her in the care of her invalids, and in the food necessary for the young baby, she is usually left to work out her own problems so far as the older child is concerned. One reason for this is that comparatively little attention has been given to this matter, while the diet for the baby has been studied for years.

Fortunately the healthy child settles the matter for himself to quite an extent and his own normal appetite guides him up to a certain point. But a normal appetite may easily become perverted, and lead him far astray.

High Proteid

As we have seen, the child needs a larger percentage of proteid in the diet than the adult. At about ten or twelve years the needs of the body rapidly increase, and a far larger amount of food in proportion to body weight is used than in the case of the adult. The mother who has a growing boy of this age is often astonished at the amount of food he eats and seems to need. The chart given on page 51 shows the proportional amounts of the different foods needed at different ages.

Little anxiety need be felt lest the child overeat if the food be *properly masticated* and so taken slowly, if it be of the right kind, and if it be taken at proper times. The latter point is particularly important in its relation to sweets. Candy at the end of a meal for dessert is legitimate and even desirable, but the same article bought at the candy store and eaten on the way home from school before dinner is seriously objectionable, since it satisfies the appetite and lessens the desire for the regular meal without giving adequate nourishment. An over amount of sugar may easily be taken in this way while rarely, if ever, does this happen if the appetite is first largely satisfied with bread and milk, vegetables and meat.

Children's Parties

The often objectionable children's party would be robbed of its evil effects if simple, attractive sandwiches were always provided in abundance before the ice cream and cake were offered, since few children would over-eat of the latter under these circumstances.

If children are to be allowed to eat freely the food must be simple in character and easy of digestion. The ordinary meats, with the exclusion of pork, cooked simply, few "made" dishes, an abundance of vegetables and fruits, only the simplest puddings, no pastry, occasional plain cake (not between meals), plenty of the best of bread and butter, of well cooked cereals and of milk and eggs will furnish variety sufficient for anyone. Tea and coffee are to be reserved for the adult, while cocoa may be used in moderation, chiefly for the milk with which it is made. Highly seasoned foods are to be avoided, as they tend to excite unduly the flow of the digestive juices and gradually make such flow dependent on their stimulation. Their continued use also seems to induce a craving for strong stimulants.

Fat in the Child's Diet

It is necessary to encourage many children to eat more fat than they are inclined to do. This may as legitimately be taken in the form of butter and cream as in that of fat meat, so generally repungant to children. Hutchison suggests that toffee taken at the end of the meal is a good medium for fat when there is difficulty in giving sufficient in other ways.

With young children special attention must be paid to the digestibility of the food. This is frequently a matter of personal idiosyncracy, and when this is the case the matter can only be determined by experiment. The safe way is to begin the diet with foods which are generally easily digested, and to allow those more difficult of digestion only at a later period. If any one article proves unwholesome in the particular case, it should of course be discarded.

Omniverous Tastes

On the other hand, it is most undesirable that children should grow up without learning to like all ordinary foods, and without being able to eat every kind of wholesome food. Such habit cannot be acquired unless a certain variety is provided and unless the child who is old enough be encouraged to try different articles. Even those less easily digestible may at a proper age be taken occasionally with impunity, for the sake of accomplishing this end. Vegetables, while so desirable in the diet, often seem to be an acquired taste.

Above all things there should be no yielding to a child's whims in allowing him to refuse the food offered and to require special provision for himself.

Eating Between Meals

The question of eating between meals is one that frequently arises. During the school period there is difficulty in providing food at sufficiently short intervals. The child who has breakfasted early, often becomes exhausted before the time of the noon meal. This exhaustion sometimes is shown by the apparent stupidity or the inattention and restlessness of the child, and sometimes by extreme irritability. Wherever this interval is a long one, there should be provision for some luncheon during the morning. School lunches have been established in many places and when well conducted serve an excellent purpose. Where the establishment of such a luncheon is not possible, a light lunch carried from home, such as a sandwich, a slice of bread and butter sprinkled with sugar, or even some fruit or sweet chocolate, eaten in the middle of the morning, will do much to preserve the good temper of the child and to make it possible for him to do his work adequately. The child who at home grows hungry between meals should be allowed to have something to eat, provided it be bread and butter, a sandwich, or crackers and milk, or fruit. With the younger children the heartiest meal should be in the middle of the day, and the evening meal should be chosen with especial reference to ease in digestion.

In general, then, the food for children should differ from that of adults, first, in being of the most simple character; second, in the absence of stimulating substances, such as large amounts of spice; third, in the proportions of the different food principles. In addition to this the child should think as little as possible about the food he eats. The constant discussion of the wholesomeness of different articles of diet and the consequent directing of the attention of the child to his own bodily processes seems distinctly harmful. Such discussion should only be used when necessary in order to show the unsuitableness of some especially desired food that must be denied. Good habits in regard to food should be established at this age, rather than theories about it.

Students' Diet

Much has been said in regard to food for older students, and a number of studies of student diet have been made. A few points only can be considered. In the first place, the student is leading a sedentary life, and does not need the hearty food required by the laborer or the one who is doing much outdoor or manual work. The proportion of proteid should be somewhat high in comparison with that of the carbohydrates, and the food should be simple and digestible, in order that but little energy be used in carrying on the processes of digestion.

A good variety is needed, however, and especial care must be exercised to make the food attractive that the appetite may be stimulated. The comparatively small amount of exercise taken generally by the student makes this especially necessary, though no amount of attention paid to the food can or should be a substitute for the healthy appetite.

As in the case of the child, it is frequently wise for the student to eat oftener than at the regular meal time. A glass of milk, a cup of cocoa, or of broth with a cracker in the middle of the morning will often prevent a headache from exhaustion.

Old Age Diet

Old age needs especial consideration in regard to diet as well as youth. After middle life the total amount of food needed lessens somewhat, and the proportion of building material, both of proteids and of mineral salts is less. Again, as in childhood, care must be exercised in regard to digestibility and simplicity of food. Often special conditions of the system must be considered and certain kinds of food avoided, but this is a matter for intelligent following of a physician's directions.

One of the question that frequently arises in regard to diet is that of reducing or increasing flesh by this means. Increase in weight implies that more food is taken into the body than is utilized in the repair of waste and in work. To prevent the storage of fat more work must be performed or less food taken. The well known systems for curing obesity depend chiefly on the reduction of the total amount of food,—sometimes to two-fifths of the standard dietary, and on the lessening of the proportion of fats and carbonydrates, especially of the latter. So radical a treatment as this should only be undertaken under the direction of a physician as there is a possibility of serious injury to health. A diminution of the sugar and starch in the diet and a slight lessening of the total amount eaten with increased light exercise may be undertaken by almost anyone with the result of decreasing the fat of the body.

The converse of course holds true. Rest, a full diet, and one rich in carbohydrate and fat tend to increase the storing of fat in the body, although there is occasionally a person who fails to respond to such treatment. In increasing the diet due regard must be paid to the digestive powers of the individual that they may not be over-taxed.

It is said that some oriental countries, wiser than we, have a custom of paying the physician for keeping the family well, not for restoring the sick member to health. In the absence of such a custom and with physicians not trained for this purpose, the housemother herself must perform this office.

Special diet in disease must be directed by the physician, for the housekeeper, even though she informs herself upon the general principles of such diet, cannot recognize special symptoms that often require individual modification of general rules. She must content herself, then, with the role of preserver of health, and though she can by no means ward off all sickness by the best planned dietary, she can do much toward strengthening the constitution of the members of her family, and making their bodies more resistant to disease.

BIBLIOGRAPHY

A. B.—Z of Our Own Nutrition ($1.00, postage .10). Horace Fletcher.

Air, Water, and Food ($2.00, postage .18). Richards and Woodman.

Corn Plants ($1.00, postage .08). F. L. Sargent.

Cost of Food ($1.00, postage .10). Ellen H. Richards.

Cost of Living ($1.00, postage .10). Ellen H. Richards.

Dietary, The ($0.15, postage .02). Ellen A. Huntington.

Dietary Computer ($1.50, postage .12). Ellen H. Richards.

Dietetic Value of Bread ($1.50, postage .14). Goodfellow.

Diet in Relation to Age and Activity ($1.00, postage .08). Sir Henry Thompson.

Elements of the Theory and Practice of Cookery ($1.00, postage .08). Williams and Fisher.

Essentials of School Diet ($2.00). Clement Dukes.

Essentials of Chemical Physiology ($1.50, postage .14). Halliburton.

Food ($1.20, postage .08). A. H. Church.

Food as a Factor in Student Life ($0.25, postage .02). Richards and Talbot.

Food and Its Functions ($1.00, postage .08). James Knight.

Food Inspection and Analysis ($7.50). Albert E. Leach.

Food Products of the world ($1.50, postage .14). Mary E. Green, M. D.

Food and the Principles of Dietetics ($3.00, postage .26). Robert Hutchison, M. D.

Food and Feeding ($1.75, postage .14). Sir Henry Thompson.

Food in Health and Disease ($5.00). I. B. Yeo.

Food Materials and their Adulterations ($1.00, postage .08). Ellen H. Richards.

Handbook of Domestic Science and Household Arts ($1.00, postage .10). L. L. W. Wilson.

How to Feed Children ($1.00, postage .10). Louise E. Hogan.

Milk and Its Products ($1.00, postage .08). Wing.

Physiological Economy in Nutrition ($3.00, postage .20). R. H. Chittenden.

Plain Words About Food (Rumford Leaflets) ($1.00, postage .06). E. H. Richards.

Practical Dietetics ($5.00). Gilman Thompson, M. D.

Practical Sanitary and Economic Cooking ($0.40, postage .06). Mary Hinman Abel.

Story of a Grain of Wheat ($1.00, postage .10). W. C. Edgar.

Story of the Living Machine ($0.35, postage .04). H. W. Conn.

Note.—Books may be ordered through the School at the prices given. Any book for which the postage is given may be *borrowed* by members of the School for one week. Send the postage in stamps with the request.

U. S. DEPARTMENT OF AGRICULTURAL PUBLICATIONS

Farmers' Bulletins.

Free, of the Department of Agriculture, Washington, D. C.

No. 34—Meats, Composition and Cooking.

No. 42—Facts About Milk.

No. 63—Care of Milk on the Farm.

No. 74—Milk as Food.

No. 85—Fish as Food.

No. 93—Sugar as Food.

No. 112—Bread and the Principles of Bread Making.

No. 121—Beans, Peas and other Legumes as Food.

No. 128—Eggs and their Uses as Food.

No. 129—Sweet Potatoes.

No. 142—Principles of Nutrition and the Nutritive Value of Food.

No. 175—Home Manufacture and Use of Unfermented Grape Juice.

No. 182—Poultry as Food.

No. 183—Meat on the Farm: Butchering, Curing, and Keeping.

No. 203—Canned Fruit, Preserves and Jellies.

Reprint from Year Book of 1900—The Value of Potatoes as Food.

Reprint from Year Book of 1902—The Cost of Food as Related to Its Nutritive Value.

Circular No. 43—Foods, Nutrients, Food Economy.

Circular No. 46—The Functions and Uses of Food.

Also, see the List of Bulletins and Circulars of U. S. Department of Agriculture for Free Distribution, for contents of the Farmers' Bulletins called "Experimental Work," which have many brief articles of interest, compiled chiefly from State Agricultural Station reports.

STATE AGRICULTURAL EXPERIMENT STATION BULLETINS.

Free, within their own states, usually sent to others free or for a two cent stamp. Apply to the various stations.

Maine Agricultural Experiment Station, Orono, Maine.

Bulletin No. 54—Nuts as Food.

Bulletin No. 65—Coffee Substitutes.

Bulletin No. 84—Cereal Breakfast Foods.

Bulletin No. 118—Cereal Foods.

Illinois Agricultural Experiment Station, Urbana, Ill.

Circular No. 71—Roasting of Beef.

Cornell Agricultural Experiment Station, Ithaca, N. Y.

Bulletin No. 230—The Cooking Quality of Potatoes.

Minnesota Agricultural Experiment Station, St. Paul, Minn.

Bulletin No. 74—Digestibility of Beans.

Bulletin No. 92—Digestibility of Cabbage, Cheese, Rice, Peas and Beans.

Note.—There are many other State bulletins but their results are usually republished in the bulletins of the Office of Experiment Stations.

FOR SALE BULLETINS OF THE OFFICE OF EXPERIMENT STATIONS.

Send coin or money order (stamps not accepted) to the Superintendent of Documents, Washington, D. C.

No. 28—The Chemical Composition of American Food Materials. By W. O. Atwater. Price 5 cents.

No. 29—Dietary Studies at the University of Tennessee in 1895. By Chas. E. Wait, Ph. D. Price 5 cents.

No. 35—Food and Nutrition Investigations in New Jersey. By Edward B. Voorhees. Price 5 cents.

No. 40—Dietary Studies in New Mexico. By Arthur Goss, M. S. Price 5 cents.

No. 43—Losses in Boiling Vegetables and the Composition and Digestibility of Potatoes and Eggs. By H. Snyder, B. S. Price 5 cents.

No. 52—Nutrition Investigations in Pittsburg, Pa. By Isabel Bevier, Ph. M. Price 5 cents.

No. 53—Nutrition Investigations at the University of Tennessee. By Chas. E. Wait, Ph. D. Price 5 cents.

No. 55—Dietary Studies in Chicago. Jane Addams and Caroline L. Hunt. Reported by W. O. Atwater. Price 5 cents.

No. 63—Description of a New Respiration Calorimeter and Experiments on the Conversion of Energy in the Human Body. By W. O. Atwater, Ph. D. Price 10 cents.

No. 84—Nutrition Investigations at the California Agricultural Experiment Station. By M. E. Jaffa, M. S. Price 5 cents.

No. 85—A Report of Investigations on the Digestibility and Nutritive Value of Bread. By Chas. D. Woods. Price 5 cents.

No. 91—Nutrition Investigations at the University of Illinois, North Dakota Agricultural College, and Lake Erie College, Ohio. By H. S. Grindley, J. L. Sammis, E. F. Ladd, Isabel Bevier, and Elizabeth C. Sprague. Price 5 cents.

No. 101—Studies on Bread and Bread Making at the University of Minnesota. By Henry Snyder, B. S. Price 5 cents.

No. 102—Experiments on Losses in Cooking Meat. By H. S. Grindley, D. Sc. Price 5 cents.

No. 107—Nutrition Investigations Among Fruitarians and Chinese at the California Agricultural Experiment Station. By M. E. Jaffa, M. S. Price 5 cents.

No. 126—Studies on the Digestibility and Nutritive Value of Bread at the University of Minnesota in 1900-1902. By Harry Snyder, B. S. Price 5 cents.

No. 129—Dietary Studies in Boston and Springfield, Mass., Philadelphia, Pa., and Chicago, Ill. By Lydia Southard, Ellen H. Richards, Susannah Usher, Bertha M. Terrill, and Amelia Shapleigh. Price 10 cents.

No. 132—Further Investigations Among Fruitarians at the California Agricultural Experiment Station. By M. E. Jaffa, M. S. Price 5 cents.

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No. 143—Studies on the Digestibility and Nutritive Value of Bread at the Maine Agricultural Experiment Station, 1899-1903. By C. D. Woods. Price 5 cents.

No. 149—Studies of the Food of Maine Lumbermen. By C. D. Woods. Price 10 cents.

No. 152—Dietary Studies with Harvard University Students. By Edward Mallinckrodt, Jr. Price 5 cents.

No. 156—Studies of the Digestibility and Nutritive Value of Bread and of Macaroni at the University of Minnesota. By Harry Snyder, B. S. Price 10 cents.

No. 162—Studies on the Influence of Cooking upon the Nutritive Value of Meats at the University of Illinois, 1903-1904. By H. S. Grindley, Sc. D. Price 15 cents.

PURE FOOD

Circular No. 16—Officials charged with the Enforcement of Food Laws in the United States and Canada.

Circular No. 17—Standards of Purity for Food Products.

Circular No. 59—Influence of Formaldehyde on the Digestive Enzymes.

Extract No. 44—Butter Substitutes.

Extract No. 221—The Use and Abuse of Food Preservatives.

Extract No. 328—Determination of the Effect of Preservatives on Food and Health.

Extract No. 331—The Adulteration of Drugs.

Farmers' Bulletin, No. 131—Household Tests for the Detection of Oleomargarine and Renovated Butter.

Bulletin No. 13—(Bureau of Chemistry). Part 9, Cereals and Cereal Products. Price 5 cents.

Bulletin No. 13—(Bureau of Chemistry). Part 10, Preserved Meats. Price 10 cents.

Bulletin No. 84—(Bureau of Chemistry). Influence of Food Preservatives on Health, Part I Boric Acid and Borax. Price 30 cents.

Bulletin No. 69—(Bureau of Chemistry). Food and Food Control. (Revised). Parts I, II, III, IV, V, VI, VII, VIII. Price 5 cents each.

National laws to 1905 in Part I and laws of all the States in alphabetical order. Request State laws wanted.

Bulletin No. 100—(Bureau of Chemistry). Some Forms of Food Adulteration and Simple Methods for their Detection. Price 10 cents.

Bulletin No. 46—(Bureau of Animal Industry). The Milk Supply of 200 Cities and Towns. Price 15 cents.

Bulletin No. 70—(Bureau of Animal Industry). Milk Supply of 29 Southern Cities. Price 5 cents.

Bulletin No. 81—(Bureau of Animal Industry). The Milk Supply of Boston, New York, and Philadelphia. Price 5 cents.

Also, see State publications on pure food, especially bulletins and reports of North Dakota Experiment Station, Fargo, N. D.; Wyoming Agricultural Experiment Station, Laramie, Wyo.; Wisconsin Dairy and Food Commission, Madison, Wis.; Pennsylvania Dairy and Food Commission, Harrisburg, Pa.; Massachusetts State Board of Health, Boston, Mass.; Maine Agricultural Experiment Station, Orono, Me.; Nebraska Food Commission, Lincoln, Neb.; Minnesota Dairy and Food Commission, St. Paul, Minn., etc.

PERIODICALS AND LISTS.

Experiment Station Record, published by U. S. Department of Agriculture, Office of Experiment Stations. Price $1.00. Published monthly and contains extracts and summaries of national and state publications, foreign and domestic magazines, and current books relating to food and the work of the various departments.

The *Monthly List of New Publications* of the Department of Agriculture will be sent regularly to all who apply for it. (Free.)

Complete list of bulletins for free distribution and for sale will be sent on application to the Department of Agriculture, also the list food of the Office of Experiment Stations, Bureau of Chemistry, etc.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

FOOD AND DIETETICS

PART III

Read Carefully. It will be advisable to read the following United States Department of Agriculture Bulletins in connection with this lesson: No. 121—Beans, Peas, and Other Legumes as Food. No. 129—Sweet Potatoes. Reprint—The Value of Potatoes as Food. Circular No 17—Standards of Purity for Food Products. Circular No. 16—Officials Charged with the Enforcement of Food Laws. Extract No. 221—Use and Abuse of Food Preservatives. *Make your answers full and complete.*

1. In what different ways may vegetables be classified? Classify the following according to each method: Tomatoes, potatoes, sweet potatoes, squash, turnips, beets, green corn, lettuce, spinach, cabbage, green peas, dried peas, string beans, dried lima beans, celery, rice.
2. How does the percentage of water in milk compare with that in vegetables and fruits?
3. How does the presence of cellulose in vegetables affect our use of them?
4. Why do vegetables have an important place in the diet?
5. Compare fruits and nuts as to food value.
6. Name three fruits that have a high food value.
7. Compare tea, coffee and cocoa as beverages.
8. Describe the process of the preparation of tea for the market, and account for the names of different kinds.
9. What are the reasons for prohibiting the adulteration of foods?
10. (a) How ought this to be accomplished? (b) What do you know of the food laws in your own state?

11. Give examples, from your own experience if possible, of misleading statements in regard to food, and show the truth in the matter.
12. Can you suggest any way in which standards may be changed so that the public will not demand such articles as colored butter?
13. Give the arguments for and against the use of preservatives. Which side seems to you to have the better case?
14. Try the two tests for distinguishing butter, butterine, and renovated butter, and report your results.
15. How should the diet of a child, say from five to ten years of age, differ from that of the adult?
16. What is the objection to the use by the child of tea, coffee and highly seasoned food?
17. What control should be exercised over eating between meals on the part of the child?
18. What is the need for fat in the child's diet? In what ways may it be supplied?
19. Make out a menu for three days for a child of about eight.
20. What is the province of the housekeeper in regard to food for the sick?
21. Summarize the chief new points that you have learned from *Food and Dietetics.*
22. To what extent and how has the study of these lessons resulted in the modification of your own diet or that of your family?
23. What questions have you?

Note.—After completing the test, sign your full name.

FOOD AND DIETETICS

NOTES ON THE QUESTIONS

The chief difficulty that our students seem to have in answering the questions seems to be in the calculations necessary in question 6 and 21 of Part I. These seem to arise chiefly from lack of practice in using percentages.

Question 6 reads: "Which would be the cheaper source of proteid, beefsteak at 22 cents per pound, milk at 7 cents per quart, bread at 5 cents per pound, corn meal at 3 cents per pound?"

As percentage simply denotes the number of parts in 100, it seems simplest in this problem to calculate the cost of 1 pound of proteid in 100 pounds of each of the materials, viz., if beef contains 19% of proteid (table page 57), 100 pounds of beef will contain 19 pounds of proteid, and

100 lbs. beef steak @ 22c. a lb. costs $22.00. Then
1 lb. proteid in beef steak will cost $22.00 ÷ 19 = $1.15 per lb.

In the same way,—

100 lbs. of milk with 3.3% proteid contains 3.3 lbs. 100 lbs. milk = 50 qts. @ 7c. a qt. costs $3.50. 1 lb. proteid in milk costs $3.50 ÷ 3.3 = $1.06 per lb.

In like manner, the cost of one pound of proteid in bread and in corn meal is obtained with little calculation and the cheapest source of proteid is obvious. In the use of percentage and decimals, to avoid errors in pointing off, note whether the answer is *reasonable*.

Although Question 21 is optional, — "Calculate the amount of proteid, carbohydrates, and fat in own diet for one day as nearly as you can," a number of interesting solutions have been sent in. The following is a good example:

MENU

Breakfast			Lunch			Dinner		
Orange	3	oz.	Potato Soup			Tomato Soup		
Oatmeal	½	"	Potato	2	oz.	Butter	⅛	oz.
Cream	1½	"	Milk	4	"	Flour	⅛	"
Sugar	½	"	Butter	¼	"	Tomatoes	4	"
Toast	2	"	Flour	¼	"	Crackers	⅛	"
Butter	¼	"	Cold Beef	2	"	Beefsteak	6	"
			Bread	2	"	Potatoes	4	"
			Butter	½	"	Lettuce with Oil Dressing		
			Chocolate			Lettuce	1	oz.
			Milk	3	"	Oil	¼	"
			Sugar	1	"	Bread	1	"
			Chocolate	⅓	"	Butter	¼	"
						Strawberries	4	"
						Cream	1	"
						Sugar	1½	"

Percentage Composition and Weight of Nutrients of Food Consumed

	Weight, Ounces	Per cent of Proteid	Ounces of Proteid	Per cent of Carbohydrate	Ounces of Carbohydrate	Per cent of Fat	Ounces of Fat
Oatmeal	½	16 7	0835	66.2	.331	7.3	.0365
Cream	3	2 5	.075	4.5	.135	18.5	.555
Orange	3	.6	.018	8.5	.255	.1	.003
Bread	5	11.9	.595	51.5	2.575	.3	.015
Butter	1⅜	1.0	.013	....	.....	85.0	1.168
Potato	6	3.6	.216	22.4	1.344	4 5	.270
Milk	7	3.3	.231	5.0	.350	4.0	.280
Flour	⅜	7 9	.029	76 4	.286	1 4	.005
Cold Beef	2	22.3	.446	....	...	28 6	.572
Chocolate	⅓	12.9	.043	30.3	.101	48.7	.162
Sugar	3	....	....	100.0	3.000	....	....
Tomato	4	.9	.036	3 9	.156	.4	.016
Crackers	⅛	9.8	.012	73.1	.091	9.1	.011
Beefsteak	6	23 9	1.434	....	....	10.2	.612
Lettuce	1	.1	.001	2.5	.025	.2	.002
Oil	¼	....	....	....	....	100 0	.250
Strawberries	4	.9	.036	7.0	.280	.6	.024
	47		3 268		8.929		3.981

Total Amount of Food Consumed During the Day

PROTEID	CARBOHYDRATE	FAT
3 268 ounces	8.929 ounces	3 981 ounces
or	or	or
92.615 grams	253.019 grams	112.821 grams

There are 28.34 grams (28⅓) in an ounce.

Fuel and Energy Value of Food Consumed

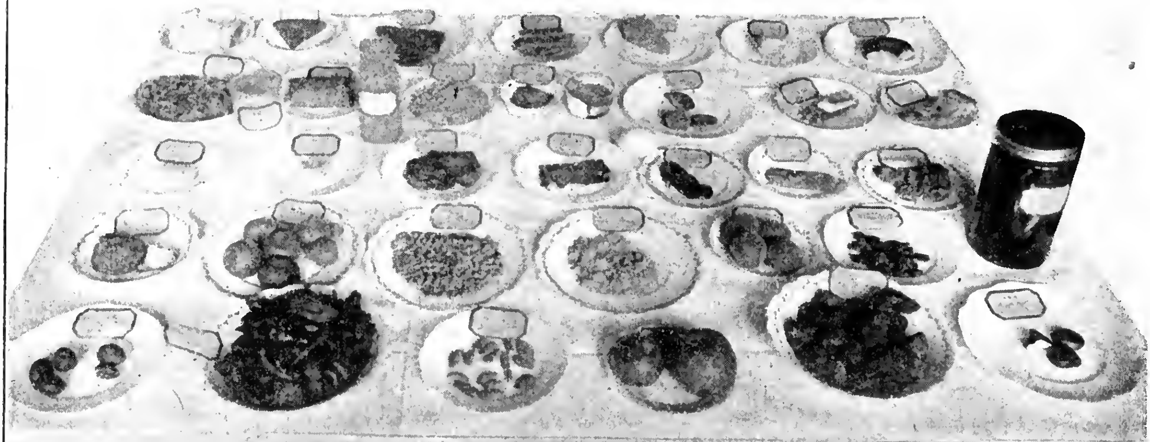
	Calories
92.615 grams proteid × 4.1 =	379.7
253.019 grams carbohydrate × 4.1 =	1,037.3
114.821 grams fat × 9.3 =	1,049.0
Total	2,466.0

Of course this involves a great deal of calculation, and no one would think of undertaking so much extra work often. As stated on page 60, the chief value of calculating a few dietaries is in giving a definite idea of the composition of food. It is not expected or necessary that each day's ration should conform to any standard. It is only when the diet is calculated for a considerable period of time that it becomes of much use for comparison.

The method of studying the diet for a month is described on page 59. When this is done, there is in reality less calculation involved, for then the figures are based on the amount of raw materials used and the composition of each individual dish need not be calculated. That is, the total weight of flour, butter, milk, eggs, and sugar is known and there only remains the allowance to be made for waste.

The whole subject of standard dietaries is in a somewhat chaotic state at present. Professor Chittenden's experiments have shown that it is possible to maintain health and strength on about half the amount of proteid recommended in the standard dietaries. If Dr. Folin's theory is correct (see following article), any ordinary diet contains more than sufficient proteid for the physiological needs of the body. Nearly all dietetians agree that, from the *physiological* standpoint, it is immaterial whether the body obtains its supply of heat and energy from fats, carbohydrates, or proteids.

But all this does not mean that a proper balance between the food materials is not necessary for health. Digestibility, bulk, personal taste and habit must be considered. The problem, then, of the balanced ration becomes an individual one, to be solved according to the conditions and experience of each individual person. To make the best selection of foods it is necessary to know as much as possible about the composition of all ordinary foods. Then proper cooking and serving and especially the manner of eating and the amount eaten are fully as important as the composition. So there is no royal road to the selection of a *best* diet, but experience based on knowledge should give good judgment.—*M. Le Bosquet.*



DR. FISHER'S "STANDARD PORTIONS" OF COOKED FOODS

100 Food Units (Calories) Each*

Prepared at
Lewis Institute, June '08

Copyright 1909, by
American School of Home Economics
Chicago

KEY

White Bread 1.3 oz. Corn Bread 1.3 oz. Brown Bread 1.5 oz. Graham Crackers 0.82 oz. Sponge Cake 0.89 oz. Frosted Cake 0.98 oz. Doughnuts 0.8 oz.
Corn Flakes 0.97 oz. Shredded Wheat 0.94 oz. Macaroni 3.8 oz. Baked Beans 2.6 oz. Caramel Custard 2.5 oz. Macaroons 0.82 oz. Lemon Pie 1.8 oz. Apple Pie 1.3 oz.
Milk 4.9 oz. Oat Meal Mush 5.6 oz. Egg 2.1 oz.
Butter 0.44 oz. Cheese 0.77 oz. Veal Leg 2.4 oz. Fat Roast Beef 0.36 oz. Lamb Chop 0.96 oz. Bacon 0.53 oz. Canned Salmon 1.6 oz.
Baked Potato 3 oz. Beets 8.7 oz. Canned Green Peas 6.3 oz. Succotash 3.5 oz. Peaches 10 oz. Raisins (seeded) 1.0 oz. Consomme 29 oz.
Olives 1.1 oz. Pickles 14.8 oz. Almonds 0.53 oz. Apples 7.3 oz. Strawberries 9.1 oz. Chocolate Creams 0.9 oz.

* Data from "A Graphic Method in Pratical Dietetics" by Irving Fisher, Ph. D.

NEW METHODS IN DIET CALCULATIONS

THE ordinary method of figuring dietaries, using the tables of food by percentage composition, involves much tedious figuring so that such dietaries are very seldom calculated in practice. Although there is no settled "best diet" for human beings applicable to all conditions a scientific diet cannot be planned unless it is known definitely what people eat.

In one of the Bulletins of the School, Professor Irving Fisher's article "A Graphic Method in Practical Dietetics" was reviewed. The number of the *Journal of the American Medical Association* April 20, 1907, and the reprint of the article, both are exhausted. As his method of calculating food values is very valuable we are republishing in this Supplement the tables given in the original article.

Dr. Fisher's method of calculation is given in the article as follows: "Two methods have hitherto been used for computing proportions of proteids, fats, and carbohydrates. One consists in using the tables of *percentages by weight* of proteids, fats and carbohydrates; the other, Dr. J. H. Kellogg's, in using a table which gives the number of calories in the form of proteids, fats and carbohydrates *per ounce* of each kind of food. These may be described, respectively, as the method, of 'weight per cent' and the method of 'calories per ounce.' The method here suggested is different from either, and may be called the method of 'calories per cent.'

"It takes as its starting point not a unit of weight, but a unit of *food value,* called a 'standard portion' of each kind of food. A 'standard portion' is defined as that amount of food which contains 100 calories, or food units. A table is constructed which gives the weight in a 'standard portion' of each particular kind of food, and out of the 100 calories contained therein the number of calories in the form of proteids, fats and carbohydrates.

"In order to carry out this method food should be served at the table in 'standard portions,' or simply multiples thereof. The amount of milk served, instead of being a whole number of ounces should be (for average milk) 4.9 ounces — the amount that contains 100 calories. This 'standard portion' constitutes about two-thirds of an ordinary glass of milk. Of the 100 calories which it contains 19 will be in the form of proteid, 52 in fat, and 29 in carbohydrates. In other words, of the food value of milk, 19 per cent is proteid, 52 per cent fat, and 29 per cent carbohydrates.

"One advantage of this method is apparent at once. It enables us to make a true comparison between different foods as to the relative amounts of proteids, fat and carbohydrate. The other methods are misleading in this regard. For instance, though it is well recognized that milk is a higher proteid food than pecan nuts, yet, if we compare milk and the pecans on the basis of the method of weight per cent, we shall find that the pecans appear three times as rich in proteid, milk containing 3.3 per cent and pecans 11 per cent. But if we compare them on the basis of calories per cent we find that, while milk contains 19 calories of proteid out of each 100 of total calories, pecans contain only 6, milk showing three times as much proteid as pecans. * * *

Moreover by having the composition of foods in food units (calories) the fats are on the same basis as the proteids and carbohydrates. This is not the case in composition by weight, for one ounce of fat in the body produces 264 calories of heat and energy, while one ounce of carbohydrate or proteid produces only 116 calories. Or in grams, one gram fat gives 9.3 calories, one gram carbohydrate or proteid 4.1 calories. (A calorie is approximately the amount of heat required to raise the temperature of 1 pound of water, 4° F.)

THE GRAPHIC METHOD

"Different foods contain the three food elements, proteids, fats and carbohydrates, in different proportions. The tripartite constitution of any particular food is represented in the present method by the position of a point in the triangle CPF (Fig. 1). The method of locating the point on the triangle is analogous to that of locating a city on a map by latitude and longitude; the per cent of proteid in the food is represented, like latitude, by the height of the point above the base line CF (the total height, CP, being taken as 100 per cent). The percentage of fat is represented like longitude, by the distance of the point horizontally from the vertical line CP (the total horizontal breadth, CF, being taken as 100 per cent). Thus, the point O, representing milk, is located at a height above CF ('latitude') 19 per cent of the total height of the triangle, which signifies that 19 per cent of the food value of milk is proteid; and at a distance to the right of CP ('longitude') 52 per cent of the total breadth of the triangle, which signifies that 52 per cent of the food value of milk is fat. Foods high in proteid will be represented by points high up in the triangle. White of egg, of which the food value is all proteid, will be represented at the point P, representing 100 per cent. P is, therefore, called the 'proteid corner' of the triangle. Foods rich in fats, as nuts, cream, and butter, are represented by points far to the right. Pure fats, like olive oil, are located at F at the extreme right, representing 100 per cent of fat. F is therefore called the 'fat corner.'

"The point representing a food is completely located by means of the percentage of proteid and fat; no attention

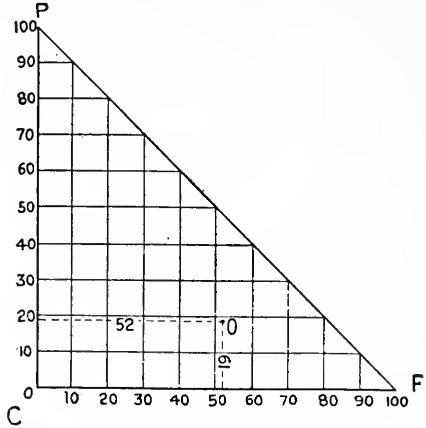
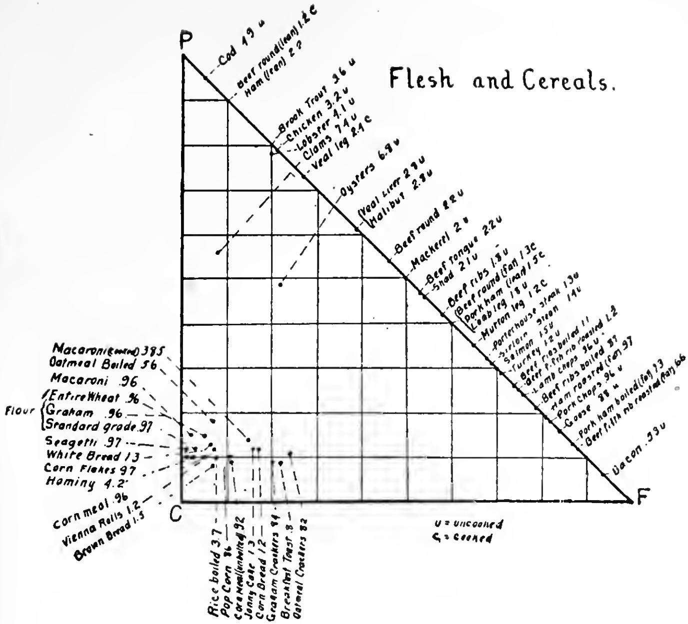
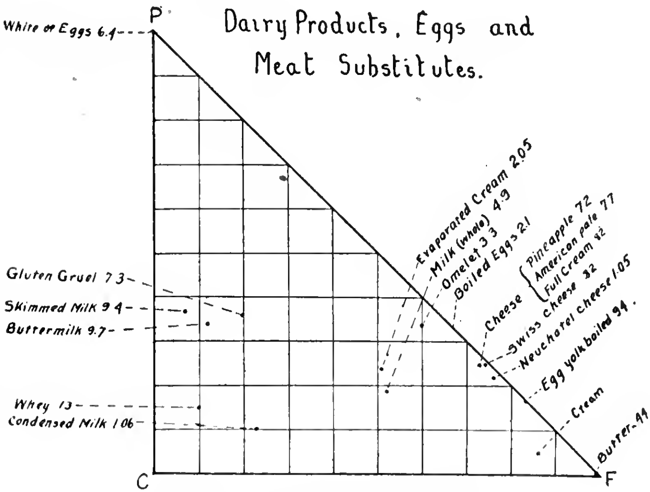


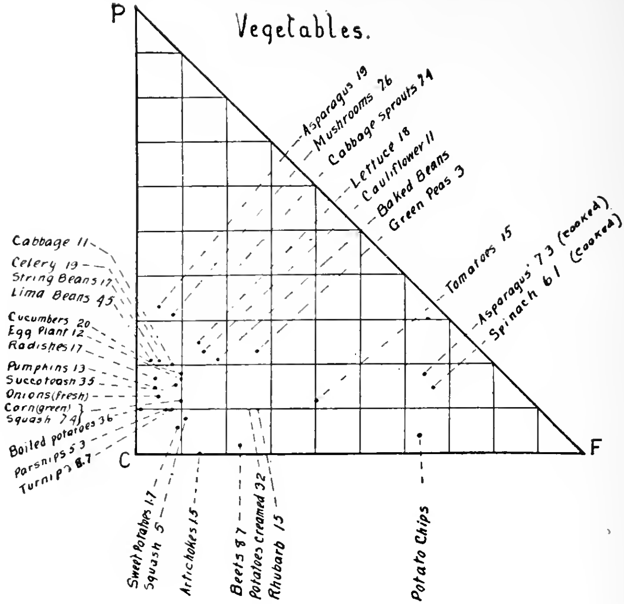
Fig. 1 "Food Map." Composition of Milk Represented by Position of Point O.

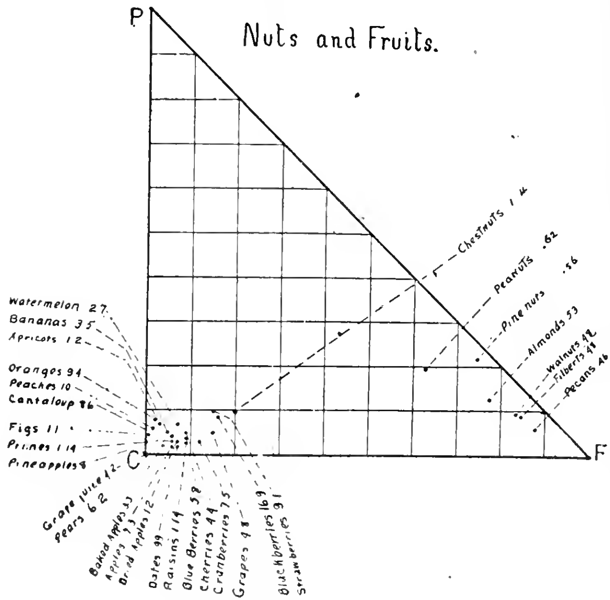
need be paid to the carbohydrate. If one desires a graphic representation of carbohydrates it is found in the distance of the point O from the third side of the triangle, FP (the total distance of this side from the opposite corner being taken as 100 per cent). Foods like bread, cereals and fruits, which are mostly carbohydrate, will thus be represented by points far away from the side FP. Foods such as sugar, of which the food value is wholly carbohydrate, will be repre-



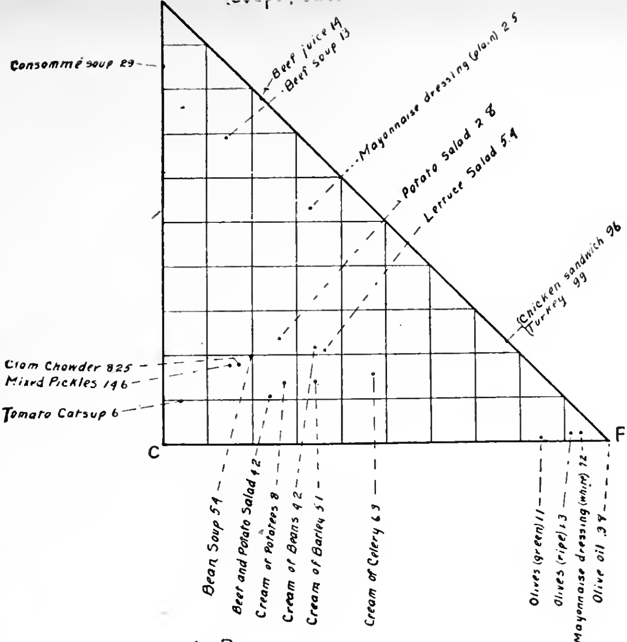


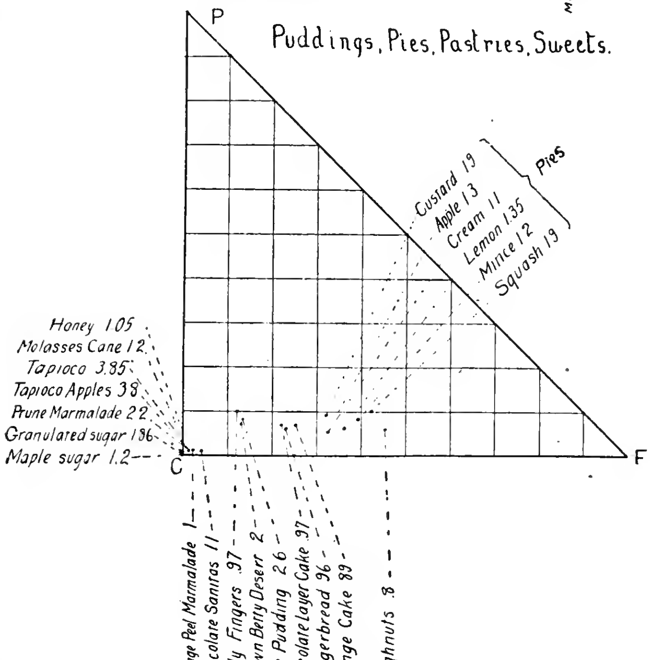
Figs. 2 and 3, "FOOD MAPS"





Figs. 4 and 5, "FOOD MAPS"





Figs. 6 and 7. "FOOD MAPS

sented at the remotest point C, representing 100 per cent carbohydrate, which is, therefore, called the 'carbohydrate corner.'

"Any food is thus represented on the 'food map' by a point, the relative distances of which from the three sides of the triangle represent the proteid, fat and carbohydrate. On this food map, fatty foods are represented by points near the fat corner, F; starchy and saccharine foods by points near the carbohydrate corner, C, and proteid foods by points near the proteid corner, P. A food devoid of proteid is evidently located on the base line C; a food devoid of fat, on the side CP, and a food devoid of carbohydrate on FP. The chief classes are represented in the accompanying diagrams, flesh foods and cereals being shown in Figure 2; dairy products, eggs and meat substitutes in Figure 3; vegetables in Figure 4; nuts and fruits in Figure 5; soups, salads and relishes in Figure 6, and puddings, pies, pastries and sweets in Figure 7. In each case the position of the point relatively to the sides of the triangle represents the proportions of the proteids, fats, and carbohydrates, and the number opposite each name represents the weight (in ounces) of a 'standard portion.' * * *

COMBINATIONS

"The combination of two foods equal in calories is represented by a point midway between them. Thus, to combine one 'portion' of bread and one 'portion' of butter (Fig. 9) draw a straight line between their points and at the middle of it mark a cross and label it '2'; this point will represent two 'portions' of bread and butter.

"If the calories of the two foods are unequal, the point representing the combination will be proportionately nearer the point with the larger number. Thus, if one portion of bread is combined with one-half portion of butter, the bread and butter point will be midway between the points for bread and for butter, but will lie twice as near the bread point as the butter point.

"When three foods are combined, the point representing the combination is, in like manner, the 'center of gravity' of

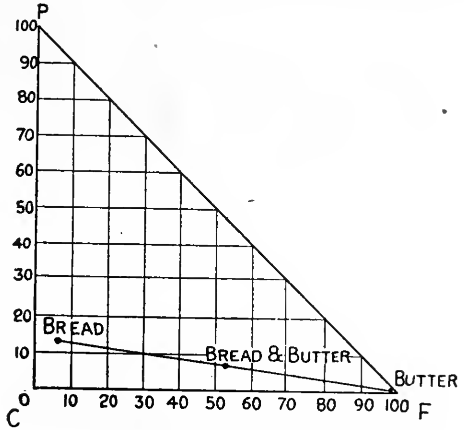


Fig. 9. Food Map Showing Combination of one "Portion" of Bread and one "Portion" of Butter.

the three, and may be found by first obtaining the center of gravity of two, and then obtaining the center of gravity of the point thus obtained, and the third. Thus if, as in Fig. 10, we have three points representing respectively, 3, 4 and 5 calories of three separate foods, shown by the attached numbers 3, 4 and 5, the point representing the combination may be found by joining the points labeled 3 and 4, and finding their center of gravity 7, situated nearer the point 4 than point

3, and dividing the line between them in the ratio of 3 to 4. The first two points, 3 and 4, may be considered as concentrated at 7 with their combined weight, 7. We then find the center of gravity of this new point 7 and the remaining point, 5. The center of gravity at this point 7 and point 5 will be a point 12, on the straight line between them, situated nearer the 7 than the 5, and dividing the distance between in the

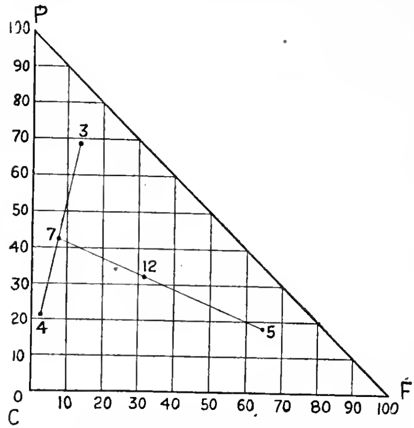


Fig. 10. Showing Method of Combining Three or More Foods.

ratio of 5 to 7. At point 12 the whole combination of 12 portions may be considered to be concentrated. It is evident that we could find the center of gravity of the same three points by combining them in a different order, but the result would be the same.

"It is evident that more than three points may be combined on the same principles by combining them by twos and threes and then combining the combinations. * * * *

"If we accept Professor Chittenden's results as to proteid requirements, a well balanced daily ration for the average person will be represented by a point lying within the 'normal rectangle,' as shown in Fig. 11. This shows that proteid should be near 10 per cent. * * * *

"Since the resultant point, representing the ration, is the center of gravity of the points representing its constituents,

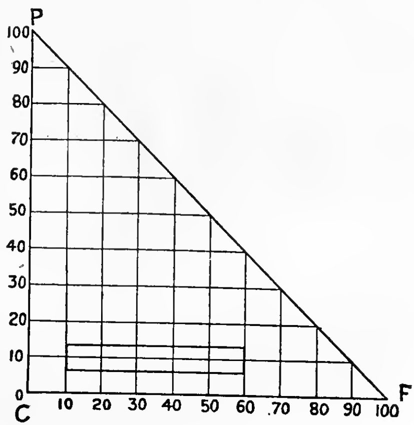


Fig. 11. Food Map with "Normal Rectangle," Chittenden's Standard, of Well Balanced Ration.

it is evident it can be obtained by mechanical as well as by geometrical methods. For this purpose a mechanical diet indicator has been devised, as shown in Fig. 12.

"The essential feature of this apparatus is a card on which is drawn the right-angled triangle with which we have already become familiar. Points on this card may be located to represent the various foods employed. These points may be easily found from table given at the end of this article. . . .

At points representing foods eaten, pins with heavy heads are thrust through the cardboard, the weight of each representing one 'standard portion.' Similar pins but one-half and one-quarter as heavy are also provided to represent half

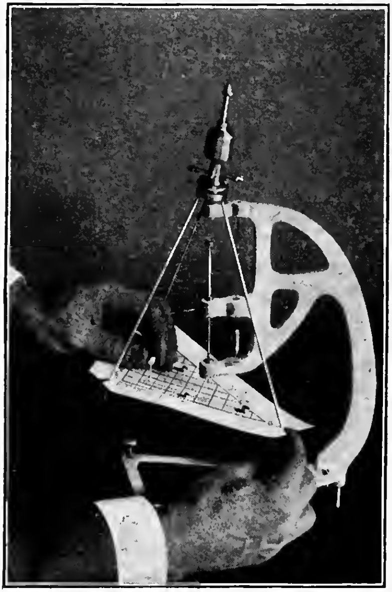


Fig. 12. Mechanical Diet Indicator.

and quarter 'portions.' When these pins are placed the total ration which has been consumed is easily found, simply by counting the 'portions' thus represented. In order to find the precentages of proteid, fat and carbohydrate in this rations it is only necessary to obtain the center of gravity of all the pins. For this purpose the card is placed in a basket and suspended on a standard so that the center of gravity is easily indicated on the card by means of a vertical pricker, which may be pressed on the card. Thus, almost instantaneously, the center of gravity is found. The total time consumed in placing the pins, adjusting the card and basket, and finding the center of gravity, is found to be, for accurate work, about five minutes."

Professor Fisher's mechanical diet indicator is now manufactured and may be obtained through the Purchasing Department of this School for $25.00, express collect.

Further details are given in the original article, reprint of which will be *loaned* to *Members of the School* for 1c. postage.

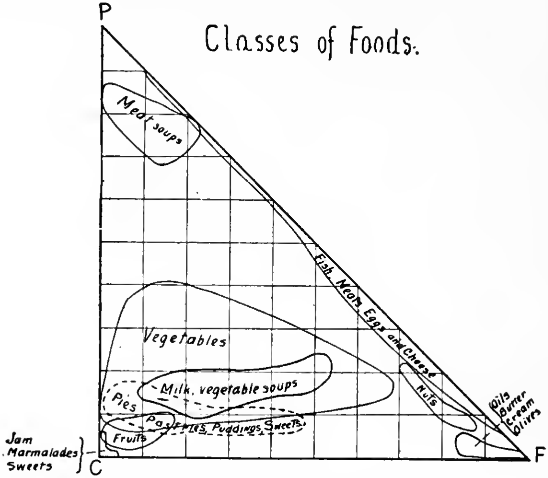
Aside from the "food map" and the diet indicator, the table will repay careful study in making clear the real composition of foods as eaten.

The proportion of proteids given in the table for some of the foods is not absolutely correct, as proteid-like substances like gelatin and also the so-called "extractives," the latter having no food value, are calculated as proteids. The error is not serious, for the proportion of such substances is usually very small.

The table is particularly valuable in showing equivalent total food values. After weighing out a few "portions" of various foods it is very easy to tell by the eye the amount of food being served and so obtain a fairly accurate idea of the total food value of one's diet. An ordinary postal scale will serve for weighing.

An educated appetite is the best guide for diet in health. In a diet for an invalid, foods may easily be served in "standard portions" or multiplies or fractions thereof, so that a physician's prescription as to food may be followed. It would, of course, be necessary to deduct food served but not eaten.

If it is desired to add further items to the table, the weight of a "standard portion" and the calories per cent is found from the percentage composition given in the Department of Agriculture Bulletin No. 28, Chemical Composition of Ameri-



can Food Materials,* as follows: The weight in ounces of a "standard portion" is found by dividing 1,600 by the number of calories per pound given in the table.

The "calories per cent" of proteid is found by multiplying the percentage of proteid in the *Bulletin* table by 1,860 and dividing the result by the figure giving the numbers of calories per pound. The same calculation and the same factor 1,860 applies to carbohydrates. For fat the same calculation applies, but with the substitution of the factor 4,220 in place of 1,860. The three results may be verified by adding the resulting figures for proteid, fat and carbohydrate, the sum of which should be 100 per cent.

* For this Bulletin send 5 cents (*coin*) to the Supt. of Documents, Washington, D. C.

TABLE OF 100 FOOD UNITS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories: Grams	Oz.	Per cent of: Proteid	Fat	Carbo-hydrate
COOKED MEATS						
†Beef, r'nd, boiled (fat) 1099‡..	Small serving..	36	1.3	40	60	00
†Beef, r'd, boiled (lean) 1206‡	Large serving..	62	2.2	90	10	00
†Beef, r'd, boiled (med.) 1188‡	Small serving..	44	1.6	60	40	00
†Beef, 5th rib, roasted, 1538‡	Half serving...	18.5	.65	12	88	00
†Beef, 5th rib, roasted, 1616‡.	Small serving..	32	1.2	25	75	00
†Beef, 5th rib, roasted, 1615‡.	Very small s'v'g	25	.88	18	82	00
‡Beef, ribs boiled, 1169‡......	Small serving..	30	1.1	27	73	00
†Beef, ribs boiled, 1170‡.....	Very small s'v'g	25	.87	21	79	00
*Calves foot jelly............	....	112	4.	19	00	81
*Chicken, canned...........	One thin slice...	27	.96	23	77	00
*Lamb chops, boiled, av......	One small chop	27	.96	24	76	00
*Lamb, leg, roasted.........	Ord. serving...	50	1.8	40	60	00
†Mutton, leg, boiled, 1184‡...	Large serving..	34	1.2	35	65	00
†Pork, ham, boiled (fat) 1174‡	Small serving..	20.5	.73	14	86	00
†Pork, ham, boiled, 1192‡....	Ord. serving...	32.5	1.1	28	72	00
†Pork, ham, r'st'd, (fat) 1484‡	Small serving..	27	.96	19	81	00
†Pork, ham, r'st'd, (lean), 1511‡	Small serving..	34	1.2	33	67	00
*Turkey, as pur., canned.....	Small serving..	28	.99	23	77	00
†Veal, leg, boiled, 1182‡......	Large serving..	67.5	2.4	73	27	00
UNCOOKED MEATS, EDIBLE PORTION						
*Beef, loin, av. (lean)........	Ord. serving...	50	1.8	40	60	00
*Beef, loin, av. (fat).........	Small serving..	30	1.1	22	78	00
*Beef, loin, p'house steak, av..	Small steak....	36	1.3	32	68	00
*Beef, loin, sirloin steak, av...	Small steak....	40	1.4	31	69	00
*Beef, ribs, lean, av..........	Ord. serving...	52	1.8	42	58	00
*Beef, round, lean, av.......	Ord. serving...	63	2.2	54	46	00
*Beef, tongue, average.......	Ord. serving...	62	2.2	47	53	00
*Beef, juice................	....	395	14.	78	22	00
*Chicken (broilers), av.......	Large serving..	90	3.2	79	21	00
*Clams, r'nd in shell, av.....	Twelve to 16...	210	7.4	56	8	36
*Cod, whole................	Two servings...	138	4.9	95	5	00
*Goose (young) av..........	Half serving...	25	.88	16	84	00
*Halibut steaks, av.........	Ord. serving...	81	2.8	61	39	00
*Liver (veal) av............	Two small s'v'g	79	2.8	61	39	00
*Lobster, whole, av.........	Two servings...	117	4.1	78	20	2
*Mackerel (Span.), whole, av.	Ord. serving...	57	2.	50	50	00
*Mutton leg, hind, lean, av....	Ord. serving....	50	1.8	41	59	00
*Oysters, in shell, av........	One dozen.....	193	6.8	49	22	29
*Pork, loin chops, av........	Very small s'v'g	27	.97	18	82	00
*Pork, ham, lean, av........	Small serving..	36	1.3	29	71	00
*Pork, bacon, med. fat, av....	Small serving..	15	.53	6	94	00
*Salmon (Cal.), average......	Small serving..	42	1.5	30	70	00
Shad, whole, average.......	Ord serving...	60	2.1	46	54	00
*Trout, brook whole, av.....	Two small s'v'g	100	3.6	80	20	00
*Turkey, average...........	Two small s'v'g	33	1.2	29	71	00

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories Grams	Wt. of 100 Calories Oz.	Per cent of Proteid	Per cent of Fat	Per cent of Carbohydrate
	VEGETABLES					
*Artichokes, av. canned		430	15	14	0	86
*Asparagus, av. canned		540	19	33	5	62
*Asparagus, av. cooked		206	7.19	18	63	19
*Beans, baked, canned	Small side dish	75	2.66	21	18	61
*Beans, Lima, canned	Large side dish	126	4.44	21	4	75
*Beans, string, cooked	Five servings	480	16.66	15	48	37
*Beets edible portion, cooked	Three servings	245	8.7	2	23	75
*Cabbage, edible portion		310	11	20	8	72
*Carrots, edible pt., fresh		215	7.6	10	8	82
Carrots, cooked	Two servings	164	5.81	10	34	56
*Cauliflower, as purchased		312	11	23	15	62
*Celery, edible portion		540	19	24	5	71
Corn, sweet, cooked	One side dish	99	3.5	13	10	77
*Cucumbers, edible pt		565	20	18	10	72
*Egg plant, edible pt		350	12	17	10	73
Lentils, cooked		89	3.15	27	1	72
*Lettuce, edible pt		505	18	25	14	61
*Mushrooms, as purchased		215	7.6	31	8	61
*Onions, fresh, edible pt		200	7.1	13	5	82
*Onions, cooked	Two large s'v'gs	240	8.4	12	40	48
*Parsnips, edible pt	1½ serving	152	5.3	10	7	83
Parsnips, cooked		163	5.84	10	34	56
*Peas, green, canned	Two servings	178	6.3	25	3	72
*Peas, green, cooked	One serving	85	3	23	27	50
Potatoes, baked	One good sized	86	3.05	11	1	88
*Potatoes, boiled	One large sized	102	3.62	11	1	88
*Potatoes, mashed (creamed)	One serving	89	3.14	10	25	65
Potatoes, steamed	One serving	101	3.57	11	1	88
*Potatoes, chips	One-half s'v'g	17	.6	4	63	33
*Potatoes, sweet, cooked	Half av. potato	49	1.7	6	9	85
*Pumkpins, edible pt		380	13	15	4	81
Radishes, as purchased		480	17	18	3	79
Rhubarb, edible, pt		430	15	10	27	63
*Spinach, cooked	Two ord. s'v'g	174	6.1	15	66	19
Squash, edible pt		210	7.4	12	10	78
*Succotash, canned	Ord. serving	100	3.5	15	9	67
*Tomatoes, fresh as purchased	Four av	430	15	15	16	69
Tomatoes, canned		431	15.2	21	7	72
*Turnips, edible pt	Two large s'v'g	246	8.7	13	4	83
Vegetable oysters		273	9.62	10	51	39
	FRUITS (DRIED)					
*Apples, as purchased		34	1.2	3	7	90
Apricots, as purchased		35	1.24	7	3	90
*Dates, edible portion	Three large	28	.99	2	7	91
*Dates, as purchased		31	1.1	2	7	91
*Figs, edible portion	One large	31	1.1	5	0	95
*Prunes, edible portion	Three large	32	1.14	3	0	97
*Prunes, as purchased		38	1.35	3	0	97
*Raisins, edible portion		28	1.	3	9	88
*Raisins, as purchased		31	1.1	3	9	88

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories: Grams	Wt. of 100 Calories: Oz.	Per cent of: Proteid	Per cent of: Fat	Per cent of: Carbohydrate
FRUITS (FRESH OR COOKED)						
*Apples, as purchased........	Two apples....	206	7.3	3	7	90
Apples, baked.............	....	94	3.3	2	5	93
Apples, sauce..............	Ord. serving...	111	3.9	2	5	93
*Apricots, edible pt	....	168	5.92	8	0	92
Apricots, cooked...........	Large serving..	131	4.61	6	0	94
*Bananas, edible pt..........	One large......	100	3.5	5	5	90
*Blackberries...............	....	170	5.9	9	16	75
Blueberries................	....	128	4.6	3	8	89
*Blueberries, canned.........	....	165	5.8	4	9	87
Cantaloupe.................	Half or. serv'g .	243	8.6	6	0	94
*Cherries, edible portion.....	....	124	4.4	5	10	85
*Cranberries, as purchased....	....	210	7.5	3	12	85
*Grapes, as purchased av.....	....	136	4.8	5	15	80
Grape fruit................	....	215	7.57	7	4	89
Grape juice................	Small glass.....	120	4.2	0	0	100
Gooseberrries..............	....	261	9.2	5	0	95
Lemons....................	....	215	7.57	9	14	77
*Lemon juice................	....	246	8.77	0	0	100
Nectarines.................	....	147	5.18	4	0	96
Olives, ripe................	About seven...	37	1.31	2	91	7
Oranges, as purchased, av....	One very large.	270	9.4	6	3	91
*Oranges, juice.............	Large glass....	188	6.62	0	0	100
Peaches, as purchased av....	Three ordinary.	290	10.	7	2	91
*Peaches, sauce.............	Ord. serving...	136	4.78	4	2	94
Peaches, juice..............	Ordinary glass .	136	4.80	0	0	100
Pears.....................	One large pear.	173	5.40	4	7	89
*Pears, sauce...............	....	113	3.98	3	4	93
Pineapples, edible p't'n, av..	....	226	8.	4	6	90
*Raspberries, black..........	....	146	5.18	10	14	76
Raspberries, red............	....	178	6.29	8	0	92
Strawberries, av............	Two servings...	260	9.1	10	15	75
*Watermelon, av.............	....	760	27.	6	6	88
*						
DAIRY PRODUCTS						
*Butter....................	Ordinary pat...	12.5	.44	.5	99.5	00
*Buttermilk................	1 ½ glass.......	275	9.7	34	12	54
*Cheese, Am., pale..........	1 ½ cubic in....	22	.77	25	73	2
*Cheese, cottage............	4 cubic in....	89	3.12	76	8	16
*Cheese, full cream..........	1 ½ cubic in....	23	.82	25	73	2
*Cheese, Neufchatel.........	1 ½ cubic in....	29.5	1.05	22	76	2
*Cheese, Swiss..............	1 ½ cubic in....	23	.8	25	74	1
*Cheese, pineapple..........	1 ½ cubic in....	20	.72	25	73	2
*Cream....................	¼ ord. glass ..	49	1.7	5	86	9
Kumyss....................	....	188	6.7	21	37	42
*Milk, condensed, sweetened .	....	30	1.06	10	23	67
*Milk, condensed, unsweet'd.	....	59	2.05	24	50	26
*Milk, skimmed.............	1 ½ glass.......	255	9.4	37	7	56
*Milk, whole...............	Small glass.....	140	4.9	19	52	29
Milk, human, 2nd week	....	162	5.7	11	47	42
Milk, human, 3rd month.....	....	171	6	7	46	47
*Whey.....................	Two glasses....	360	13	15	10	75

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories: Grams	Oz.	Per cent of: Proteid	Fat	Carbo-hydrate
CAKES, PASTRY, PUDDINGS AND DESSERTS						
*Cake, chocolate layer	Half ord. sq. pc	28	.98	7	22	71
*Cake, gingerbread	Half ord. sq. pc	27	.96	6	23	71
Cake, sponge	Small piece	25	.89	7	25	68
Custard, caramel		71	2.51	19	10	71
Custard, milk	Ordinary cup	122	4.29	26	56	18
Custard, tapioca	Two-thirds ord.	69.5	2.45	9	12	79
*Doughnuts	Half a doughn't	23	.8	6	45	49
*Lady fingers	Two	27	.95	10	12	78
*Macaroons	Four	23	.82	6	33	61
*Pie, apple	One third piece	38	1.3	5	32	63
*Pie, cream	One-fourth pc.	30	1.1	5	32	63
*Pie, custard	One-third piece	55	1.9	9	32	59
*Pie, lemon	One-third piece	38	1.35	6	36	58
*Pie, mince	One-fourth pc.	35	1.2	8	38	54
*Pie, squash	One-third piece	55	1.9	10	42	48
Pudding, apple sago		81	3.02	6	3	91
Pudding, brown betty	Half ord. s'v'g.	56.6	2.	7	12	81
Pudding, cream rice	Very small s'v'g	75	2.65	8	13	79
Pudding, Indian meal	Half ord. ser'g.	56.6	2.	12	25	63
Pudding, apple tapioca	Small serving	79	2.8	1	1	98
Tapioca, cooked	Ord. serving	108	3.85	1	1	98
SWEETS AND PICKLES						
*Catsup, tomato, av.		170	6.	10	3	87
Candy, plain		26	.9	0	0	100
Candy, chocolate		30	1.1	1	4	95
*Honey	Four teasp'ns.	30	1.05	1	0	99
*Marmalade (orange)		28.3	1	.5	2.5	97
*Molasses, cane		35	1.2	.5	0	99.5
*Olives, green edible portion	Five to seven	32	1.1	1	84	15
*Olives, ripe, edible portion	Five to seven	38	1.3	2	91	7
*Pickles, mixed		415	14.6	18	15	67
*Sugar, granulated	Three heaping tsp or 1½ lumps.	24	.86	0	0	100
*Sugar, maple	Four teaspoons	29	1.03	0	0	100
*Syrup, maple	Four teaspoons	35	1.2	0	0	100
NUTS, EDIBLE PORTION						
*Almonds, av	Eight to 15	15	.53	13	77	10
*Beechnuts		14.8	.52	13	79	8
*Brazil Nuts,	Three ord. size.	14	.49	10	86	4
*Butternuts		14	.50	16	82	2
*Cocoanuts		16	.57	4	77	19
*Chestnuts, fresh, av.		40	1.4	10	20	70
*Filberts, av.	Ten nuts	14	.48	9	84	7
*Hickory nuts		13	.47	9	85	6
*Peanuts, av.	Thirteen double	18	.62	20	63	17
*Pecans, polished	About eight	13	.46	6	87	7
*Pine nuts, (pignolias)	About eighty	16	.56	22	74	4
*Walnuts, California	About six	14	.48	10	83	7

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories Grams	Oz.	Per cent of Proteid	Fat	Carbohydrate
	CEREALS					
*Bread, brown, average......	Ord. thick slice.	43	1.5	9	7	84
*Bread, corn (johnnycake) av..	Small square....	38	1.3	12	16	72
*Bread, white, home made...	Ord. thick slice	38	1.3	13	6	81
*Cookies, sugar............	Two..........	24	.83	7	22	71
Corn flakes, toasted..........	Ord. cer. dish f'l	27	.97	11	1	88
*Corn meal, granular, av......	2½ level tbsp..	27	.96	10	5	85
Corn meal, unbolted, av......	Three tbsp.....	26	.92	9.	11.	80
*Crackers, graham...........	Two crackers..	23	.82	9.5	20.5	70
*Crackers, oatmeal..........	Two crackers..	23	.81	11	24	65
*Crackers, soda..............	3½ "Uneedas"	24	.83	9.4	20	70.6
*Hominy, cooked............	Large serving. .	120	4.2	11	2	87
*Macaroni, av...............	....	27	.96	15	2	83
*Macaroni, cooked...........	Ord. serving. ..	110	3.85	14	15	71
*Oatmeal, boiled............	1½ serving....	159	5.6	18	7	75
*Popcorn,..................	....	24	.86	11	11	78
*Rice, uncooked............	....	28	.98	9	1	90
*Rice, boiled...............	Ord. cereal dish	87	3.1	10	1	89
*Rice, flakes...............	Ord. cereal dish.	27	.94	8	1	91
*Rolls, Vienna, av...........	One large roll..	35	1.2	12	7	81
*Shredded wheat............	One biscuit....	27	.94	13	4.5	82.5
*Spaghetti, average.........	....	28	.97	12	1	87
*Wafers, vanilla............	Four..........	24	.84	8	13	71
*Wheat, flour, e't'e w'h't, av..	Four tbsp	27	.96	15	5	80
*Wheat, flour, graham, av.. ..	4½ tbsp	27	.96	15	5	80
*Wheat, flour, patent, family and straight grade spring wheat, av................	Four tbsp......	27	.97	12	3	85
*Zweiback..................	Size of thick slice of bread.....	23	.81	9	21	70
	MISCELLANEOUS					
*Eggs, hen's boiled..........	One large egg..	59	2.1	32	68	00
*Eggs, hen's whites..........	Of six eggs.....	181	6.4	100	0	00
*Eggs, hen's yolks...........	Two yolks.....	27	.94	17	83	00
*Omelet....................	....	94	3.3	34	60	6
*Soup, beef, av..............	....	380	13.	69	14	17
*Soup, bean, av.............	Very large plate	150	5.4	20	20	60
*Soup, cream of celery.......	Two plates.....	180	6.3	16	47	37
*Consomme.................	....	830	29.	85	00	15
*Clam chowder..............	Two plates.....	230	8.25	17	18	65
*Chocolate, bitter	Half-a-square...	16	.56	8	72	20
*Cocoa	....	20	.69	17	53	30
Ice Cream (Phila)..........	Half serving....	45	1.6	5	57	38
Ice Cream (New York)......	Half serving....	48	1.7	7	47	46

*Chemical Composition of American Food Materials, Atwater and Bryant, U. S. Department of Agriculture Bull. No. 28.

†Experiments on Losses in Cooking Meats. (1900–03), Grindley, U. S. Department of Agriculture Bull. No. 141.

‡Laboratory number of specimen, as per Experiments on Losses in Cooking Meat.

FOOD VALUES IN CALORIES PER OUNCE

In some respects Dr. Kellogg's method of giving the composition of foods in food units (calories) per ounce is simpler and more useful in the actual calculation of dietaries. By having a table with composition in food units, the day's ration may be calculated by simple addition, combined with a little mental multiplication. If the results are wanted in ounces, the calories of proteid or carbohydrate are divided by 116, and calories of fat by 264. For grams, the factor is 4.1 for proteids and carbohydrate and 9.3 for fats.

Such a table is given in the Battle Creek Sanitarium *Diet List* which contains the composition of all foods served at that institution in calories per ounce. Dr. Fisher's method of serving the food in "standard portions" has been adopted and the figures by that method of calculation are also given in the last edition of the booklet.

The *Diet List* also contains tables giving normal height, weight, skin surface and calories required, on the average, for men and women, boys and girls, per day. Some of these tables are given in the following pages, also the calculation of a dietary with the figures in calories per ounce and one with food served in 100 calorie portions.

These tables are based on Professor Chittenden's standards and so are lower in proteid requirements and total food value than the Atwater standard dietaries. For example, the diet for an average man, 5 feet 8 inches tall and weighing 157 pounds, is given as 236 calories of proteid, 708 calories of fat, 1,416 calories of carbohydrates, with a total of 2,360 calories per day.

The Atwater standard for man with light exercise is 100 grams of proteid, 100 grams of fat, 360 grams of carbohydrate, or on a calorie basis: 410 calories of proteid, 930 calories of fat, 1,476 calories of carbohydrate, total 2,816 calories or nearly 20 per cent higher in total food value.

Under the Chittenden standard, of every 100 food units about 10 should be proteid, 30 fat and 60 carbohydrate. Based on the Atwater standard, of 100 food units, about 14 are proteid, 32 fat, and 52 carbohydrate.

It must be remembered that no one in formulating a "standard diet" attempts to give anything more than a possible average, from which to vary, according to conditions. It is recognized that health may be maintained on various proportions of proteid and that the ratio of fat to carbohydrates is immaterial, provided digestion remains perfect.

The following table has been taken from some of the figures in the *Diet List*. The figures based on standard portions are omitted.

NOTE —Members of the School are expected hereafter to solve question No. 21, Part I, *Food and Dietetics* — "Calculate the amount of proteid, carbondrate and fat in your own diet for one day," in the usual way, as shown on page 193, and by the "calories per ounce" method, using the following figures. The total calories should be found by each method. The two figures will not come out exactly the same, but should be approximate.

Also plot one of these meals on the enlarged "Food Map" on page 223. Find the "center of gravity" by the method shown in Figs. 9 and 10. This is most easily done by marking and folding a strip of paper to find halves, thirds, etc. Say what the resulting point represents in terms of calories and of ounces of proteids, fats and carbohydrates. Give full details.

These "Food Maps" may be obtained of the School in quantity, printed on good paper—25 for 10 cents, 100 for 30 cents (in stamps).

FOOD VALUES IN FOOD UNITS PER OUNCE

	Calories Per Ounce			
	Proteid	Fat	Carbohydrate	Total
Apples, baked	.6	1.3	28.4	30.3
Apples, fresh	2.75	7.15	91.3	101.1
Apple sauce	.3	.8	20.6	21.7
Apricots	1.3	0	15.6	16.9
Asparagus in cream	2.8	17	4.9	24.7
Bananas	1.5	1.6	25.7	28.8
Barley, pearl	2.97	.87	27.24	31.08
Beans, string, (cooked)	.9	2.9	2.2	6
Beets, (cooked)	2.7	.3	8.6	11.6
Biscuit, cream	10.3	27.5	49.6	87.5
Blanc Mange, Farina	4.16	21.56	18.6	44.4
Bread, corn	8.5	12.3	52	72.8
Bread, graham	10.4	4.8	60.8	76
Bread, rye	10.5	1.6	62.1	74.2
Bread, white	9.3	3.7	63.4	76.4
Bread, whole wheat	11.3	2.4	58	71.7
Buns	7.3	17.3	66.8	91.4
Butter, (dairy)	1.2	226.6	0	227.8
Buttermilk	3.5	1.3	5.6	10.4
Cake, frosted	6.8	24	74.9	105.7
Cake, layer	8.2	45.1	76.5	130.6
Cake, sponge	12.4	14.2	94.2	120.8
Candy, (Sanitas chocolates)	1	3.8	85.2	90
Canteloupe	.7		10.9	11.6
Carrots, creamed	2.01	7.5	10.3	19.8
Cashew nuts	28.87	125.7	28.24	182.81
Celery	1.3	.3	3.9	5.5
Cheese, cottage	19.9	12.4	5.1	37.3
Crackers, graham	11.7	25.1	86.1	122.9
Crackers, oatmeal	13.3	29.6	80.5	123.8
Cream	2.9	49.3	5.3	57.5
Cream sauce	3.7	22.9	9	35.6
Custard, caramel	5.2	11.4	23.6	40.2
Custard, plain	5.7	13	12.5	31.2
Dates,	2.5	7.5	91.5	101.5
Eggs, poached, etc.	16.3	32		48.3
Eggs (each, whole, a'v'g.)	26.3	41.9		68.2
Eggs (white) each	15.5	.6		16.1
Eggs (yolk) each	10.8	41.3		52.1
Figs	.5	8	86.6	92.4
Grape fruit	.9	.5	11.8	13.2
Grapes,	1.16	3.2	16.6	20.9
Gruel, barley	1.48	.7	10.2	12.39
Gruel, oatmeal	1.3	1.4	5.8	8.5
Honey	.5		94.7	95.2
Macaroni and tomato	5	3.86	17.16	26
Maple syrup			83	83
Mayonnaise, cooked	6.87	67.1	2.85	76.8

	Calories Per Ounce			
	Proteid	Fat	Carbohy-drate	Total
Milk, skimmed	4	.8	6	10.8
Milk, whole	3.8	11	5.8	20.6
Nut butter	34.2	124	20	178.2
Nuts, almonds	24.5	146.4	20.2	191.1
Nuts, Brazil	19.8	178.1	8.2	206.1
Nuts, Filberts	18.2	174.1	15.2	207.5
Nuts, Pecans	11.2	188	17.8	217.8
Nuts, walnut, Eng	19.4	169.2	18.2	206.8
Oats, rolled (cooked)	3.3	1.3	13.4	18
Olive oil	0	264.1	0	264.1
Olives, ripe (7)	2	69.1	5	76.1
Onions, boiled	1.13	4.29	5.1	10.52
Oranges	.9	.5	13.5	14.9
Parsnips, creamed	2.56	6.5	17.29	26.35
Peanuts	30.1	102.9	8.5	161.5
Pears	.7	1.3	16.5	18.5
Peas, green	7.8	9.1	17.5	34.4
Pie, apple	7.5	18	37.2	62.7
Pie, custard	4.9	16.8	30.5	52.2
Pie, squash	4.27	22.7	36.5	63.5
Potatoes, baked	3.4	.4	28.9	32.7
Potatoes, boiled	2.9	.3	24.4	27.6
Potatoes, mashed	3	8	20.8	31.8
Potatoes, sweet, browned	4.11	11.25	59.7	75
Prunes (cooked)	.8	.3	26.4	27.5
Pudding, baked Indian	4.8	21.8	20	46.6
Pudding, bread custard	6.44	32	19.12	37.56
Pudding, snow	4.78	9.22	16.37	30.38
Pudding, apple tapioca	4.5	17.58	26.44	48.5
Raisins	3	8.8	88.8	100.6
Rice, boiled	3.3	.3	28.5	32.1
Salad, apple and celery	2.26	4.27	26.16	32.7
Salad, egg mayonnaise	13.37	30.66	1.46	44.5
Salad, potato	4.56	25.77	15.06	45.39
Sandwich, cottage cheese	11.2	33.9	37.6	82.8
Soup, cream of celery	2.8	19	4.7	26.5
Soup, cream of potato	2.7	19.2	.9	30.9
Soup, split pea	7.18	1.85	18.07	27.1
Soup, tomato bisque	3.1	10.5	2.4	16
Soup, vegetable	.96	5.71	6.9	13.5
Spinach	3.3	1	4.93	9.3
Squash, steamed or canned	1	1.3	12.3	14.6
Sugar (granulated)	0	0	116.6	116.6
Toast, breakfast	11.4	27.5	86.2	125.15
Toast, cream	4.15	29.9	13.6	47.6
Tomatoes, stewed or canned	1.4	.5	4.7	6.6
Wheat flakes, toasted	11	3.9	88.9	103.8
Zwieback	11.4	26.4	85.8	123.6

	Calories Per Ounce			
	Proteid	Fat	Carbohydrate	Total
FLESH FOODS				
Beef, roasted (fat)	18.14	136.85	0	155.26
Beef, round (boiled, lean)	40.9	4.54	0	45.6
Bouillon	2.3	.3	3	3
Chicken (broilers)	24.6	6.56	0	31.16
Cod fish	19.3	1.02	0	20.32
Goose	18.1	95.4	0	113.5
Halibut (steak)	21.78	13.9	0	35.68
Lamb chops (boiled)	25.3	79.7	0	105
Lamb (leg, roast)	22.2	33.3	0	55.5
Liver (veal)	21.78	13.9	0	35.68
Lobsters	19	4.8	0	23.82
Mutton (leg, boiled)	29.1	54.1	0	83.2
Oysters	7.2	3.23	0	10.43
Pork (bacon, smoked medium fat)	11.3	177.3	0	188.6
Pork (ham, boiled)	25.4	65.4	0	90.3
Pork (loin, chops)	18.5	84.5	0	103
Salmon (California)	20.4	46.6	0	66.6
Shad	21.9	25.71	0	47.61
Trout (brook)	22.2	55.5	0	77.7
Turkey	24.1	59.1	0	83.2
Veal (leg, boiled)	30.4	11.2	0	41.6
UNCOOKED FOODSTUFFS.				
Barley, pearled	9.9	2.9	90.8	103.6
Beans (dried)	26.3	4.8	69.5	100.6
Cocoa	25.2	77.1	44.0	146.3
Corn, green	3.6	2.9	23.0	29.5
Cornmeal	10.7	5.1	87.9	103.7
Cornstarch			105.0	105.0
Flour, graham	15.5	5.9	83.3	104.7
Flour, rye	7.9	2.4	91.8	102.1
Flour, wheat (entire wheat)	16.1	5.1	83.8	105.0
Flour, wheat (patent)	12.6	2.9	87.7	103.2
Lemon juice	0	0	11.4	11.4
Macaroni	3.5	4.0	18.4	25.9
Oatmeal	18.8	19.2	78.8	116.8
Oats, rolled	19.5	19.5	77.2	116.2
Peas (dried)	28.7	2.7	72.3	100.7
Peas, green	8.2	1.3	19.7	29.2
Potatoes	2.6	.3	21.5	24.4
Rice	9.0	.8	92.0	101.8
Sweet potatoes	2.1	1.9	32.0	36.0
Wheat, cracked	13.0	4.3	88.1	106.6

Tables Showing Average Height, Weight, Skin Surface and Food Units Required Daily With Very Light Exercise

BOYS

Age	Height in Inches	Weight in Pounds	Surface in Square Feet	Calories or Food Units
5	41.57	41.09	7.9	816.2
6	43.75	45.17	8.3	855.9
7	45.74	49.07	8.8	912.4
8	47.76	53.92	9.4	981.1
9	49.69	59.23	9.9	1,043.7
10	51.58	65.30	10.5	1,117.5
11	53.33	70.18	11.0	1,178.2
12	55.11	76.92	11.6	1,254.8
13	57.21	84.85	12.4	1,352.6
14	59.88	94.91	13.4	1,471.3

GIRLS

Age	Height in Inches	Weight in Pounds	Surface in Square Feet	Calories or Food Units
5	41.29	39.66	7.7	784.5
6	43.35	43.28	8.1	831.9
7	45.52	47.46	8.5	881.7
8	47.58	52.04	9.2	957.1
9	49.37	57.07	9.7	1,018.5
10	51.34	62.35	10.2	1.081.0
11	53.42	68.84	10.7	1.148.5
12	55.88	78.31	11.8	1,276.8

MEN

Height in In.	Weight in Pounds	Surface in Square Ft.	Proteids	Calories or Food Units Fats	Carbohydrates	Total
61	131	15.92	197	591	1,182	1,970
62	133	16.06	200	600	1.200	2,000
63	136	16.27	204	612	1.224	2.040
64	140	16.55	210	630	1,260	2,100
65	143	16.76	215	645	1,290	2.150
66	147	17.06	221	663	1,326	2,210
67	152	17.40	228	684	1.368	2.280
68	157	17.76	236	708	1,416	2.360
69	162	18.12	243	729	1,458	2,430
70	167	18.48	251	753	1.506	2.510
71	173	18.91	260	780	1,560	2.600
72	179	19.34	269	807	1,614	2,690
73	185	19.89	278	834	1,668	2.780
74	192	20.33	288	864	1,728	2,880
75	200	20.88	300	900	1,800	3.000

WOMEN

Height in In.	Weight in Pounds	Surface in Square Ft.	Proteids	Calories or Food Units Fats	Carbohydrates	Total
59	119	14.82	179	537	1,074	1,790
60	122	15.03	183	549	1,098	1,830
61	124	15 29	186	558	1,116	1,860
62	127	15.50	191	573	1.146	1,910
63	131	15.92	197	591	1,182	1,970
64	134	16.13	201	603	1.206	2.010
65	139	16.48	209	627	1.254	2.090
66	143	16.76	215	645	1.290	2.150
67	147	17.06	221	663	1,326	2,210
68	151	17.34	227	681	1,362	2.270
69	155	17.64	232	696	1.392	2.320
70	159	17.92	239	717	1,434	2.390

NOTE—With active exercise an increase of about 20 per cent total food units may be needed.

Dietary Calculation with Food Values in Calories per Ounce

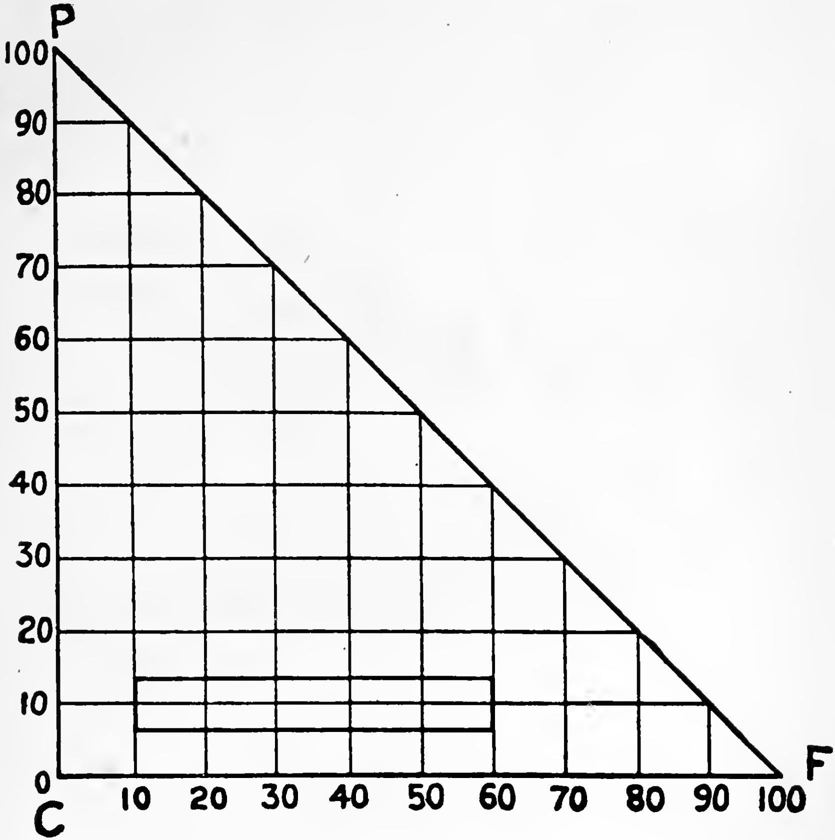
Breakfast	Proteids	Fats	Carbohydrates	Total
Gluten Gruel 5 oz.	*4.7* 23.5	*.2* 1.0	*6.0* 30.0	
(each) Soft-Boiled Egg	*26.3* 26.3	*41.9* 41.9		
Malt Honey 1 oz.			*86.2* 86.2	
Creamed Potatoes 5 oz.	*3.0* 15.0	*8.0* 40.0	*20.8* 104.0	
Zwieback 2 oz.	*11.4* 22.8	*26.4* 52.8	*85.8* 171.6	
Pecans ¾ oz.	*11.2* 8.4	*188.0* 141.0	*17.8* 13.4	
Apple 5 oz.	*.5* 2.5	*1.3* 6.5	*16.6* 83.0	
	98.5	283.2	488.2	869.9

Dietary Calculation with Food Served in 100 Calories Portions

Dinner	Portions in serving	Proteins	Fats	Carbo-hydrates	Total
French Soup	½	10	20	20	
Nut Sauce	1	29	55	16	
Macaroni, Egg	1	15	59	26	
Baked Potato	2	22	2	176	
Cream Gravy	½	5	33	12	
Biscuit	1½	20	2	128	
Butter	1	1	99		
Honey	2			200	
Celery	¼	4		21	
Apple Juice	½			50	
	10¼	106	270	649	1,025

Hourly Outgo in Heat and Energy from the Human Body as Determined in the Respiration Calorimeter by the U. S. Dept. of Agriculture

Average (154 lbs.)	Calories
Man at rest (asleep)	65
Sitting up (awake)	100
Light exercise	170
Moderate exercise	190
Severe exercise	450
Very severe exercise	600



DR. FISHER'S FOOD MAP
Normal Rectangle for a Balanced Diet, Chittenden's Standard

PROTEIN METABOLISM IN ITS RELATION TO DIETARY STANDARDS*

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Present views concerning the role of fats, carbohydrates, and proteins in the animal organism are not essentially different from views that prevailed a generation ago. An earlier theory, brilliant but untenable in the light of later more exact experiments, was advanced by Liebig about the middle of the 19th century. This theory held that the protein taken with the food constitutes the sole source of muscular energy and that fats and carbohydrates serve only to maintain the body temperature.

LIEBIG'S THEORY

Voit, in the course of experiments undertaken to test the validity of Liebig's theory, established the remarkable fact that severe physical work is not accompanied by any material increase in the destruction of protein within the animal organism, as of course would be the case if protein were the sole or even the chief source of muscular energy. The destruction of Liebig's erroneous but definite theory of metabolism naturally led to renewed investigations concerning the function of fats, carbohydrates, and

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protein; and in this necessary constructive work, Voit became the recognized leader. From his laboratory came investigations and deductions which have since been almost universally accepted as final.

Voit's dietary standards, the practical outcome of all this work, are intended to represent a few fundamental facts. A man of average size gives off in a day a certain quantity of energy (in the form of work and heat). This energy can be measured and often has been measured, with a fair degree of accuracy. The more physical work a man does the more energy both in the form of work and of heat is given off, and the increase in energy consumption due to work or exercise has also been measured. The daily consumption of energy in the animal organism is obtained at the expense of food. And since it is known just how much energy can be obtained from burning a given quantity of fat, starch, or protein, it becomes theoretically simple, and practically quite possible, to calculate the amount of food that a given individual doing a certain work must consume in order to maintain the equilibrium of the intake and outgo of energy. Such calculations are based on the assumption that food materials when oxidized within the animal organism liberate the same amount of energy as when burned in ordinary air or oxygen, and there is no reason to doubt the correctness of this assumption.

VOIT'S DIETARY STANDARDS

In so far as Voit's dietary standards prescribe the amount of dry food material, of available energy-giving material necessary under given conditions, they have undoubtedly been of very great service. The dietary standards, however, prescribe not only how much available energy the daily food must contain, but also how much of that energy can be most profitably supplied in the form of protein and how much in the form of fats and carbohydrates. Voit's well known average diet, for example, calls for 56 gm. fat, 500 gm. carbohydrates, and 118 gm. protein. The justification and probable value of such more specific standards of diet is the subject of this paper, and it is a subject on which I think there is room for differences of opinion. It should, however, at once be stated that such differences of opinion do not concern the non-nitrogenous part of the dietary standards. Voit, and with him all competent to have an opinion, are agreed that the fats and carbohydrates need not at all be provided in the ratio of 56 to 500.

PROPORTION OF FATS TO CARBOHYDRATES

It is a well-known fact that if more fat than the animal organism can advantageously oxidize is supplied, such fat, in so far as it is absorbed, is stored as fat in the body. If an excess of carbohydrates is taken, such excess is also converted into fat and is likewise stored as fat for future use. Further Pflüger has recently advanced the not improbable hypothesis that fats are not completely oxidized as such within the animal organism, but are first converted into carbohydrates. The animal organism is then able to convert carbohydrates into fat and fat into carbohydrates according to its needs, and the logical conclusion therefore is quite in harmony with the accepted view that it is theoretically a matter of relatively small importance what ratio is selected for the fats and carbohydrates. The two taken together must of necessity furnish the greater part of the fuel value of the food, but upon individual peculiarities, relative cost, and a number of other accidental factors depends what ratio between the two may be most suitable in any given case.

PROTEIN IN THE DIETARY

With regard to the protein prescribed by the dietary standards the case is different. The animal or human organism, while able to convert carbohydrates into fat and probably also fat into carbohydrates, can effect no such transformation of non-nitrogenous food into the highly nitrogenous proteins. It may be able to produce carbohydrates, and therefore also fat, out of protein, but it certainly can not produce protein out of fat or carbohydrates. The protein of the food not only furnishes energy and heat, as do the fats and carbohydrates, but it, and it alone, furnishes the material which replaces the constant loss of living protoplasm. It is therefore clearly necessary that the daily food should contain enough protein to protect the organism against loss of body tissue. On the other hand, it is generally believed that instead of being advantageous it is probably detrimental to the full-grown organism to have to take care of more protein than is needed for the replacement of lost tissue material. An excess of fat or carbohydrates, the human organism can to a very great extent take care of by adding it to its store of body fat, but it has not the power similarly to increase its supply of reserve protein. Any excess of nitrogenous material supplied with the food leads at once to a correspondingly increased destruction of protein. And the formation of excessive quantities of nitrogenous katabolism products within the body is supposed to be more or less a source of danger. I think all are agreed that gout at least is largely the result of "high living."

MINIMUM PROTEIN

The important question then is, How much protein must the diet of normal persons contain? Voit came to the difinite conclusion that 118 grams are needed for a man weighing 70 kilos (150 lbs.), and for more than a generation this figure has been generally accepted as substantially correct. But is it? Since the publication in 1881 of Voit's great monograph on metabolism it has been shown by Hirschfeld, Klemperer, Pechsel, and Sivèn that the daily protein destruction in men of average size can be reduced to 40 grams or less, and that nitrogen equilibrium can be maintained by furnishing such small amounts of protein with the food. The experiments by means of which Voit secured the almost universal acceptance of his standard minimum protein requirement are essentially similar and in no way superior to these more modern experiments which seem to prove that 40 grams of protein, or less, are enough to maintain nitrogen equilibrium. One might therefore suppose that the later experiments would have been accepted as proving the erroneousness of Voit's figures, or that they would at least have been deemed sufficiently important to lead to a general reopening of the whole question. But the earlier conclusions and generalizations of Voit had in the meantime, so to speak, survived the probation period, and had become the accepted doctrine, not to say tradition, of the scientific public. In addition, it must be remembered that Voit's standard comes much nearer the average common usage. The widespread and earnest acceptance of Voit's figure is undoubtedly in a great measure due to the fact that it agrees tolerably well with the protein consumption actually prevailing among the people, specially among those not too poor to procure the more expensive articles of food.

AVERAGE CONSUMPTION

It has frequently been asserted that the people at large do as a matter of fact consume on the average about 118 grams of protein per 70 kilos of weight. But I venture to insist that the question of average protein consumption has little or nothing to do with the problem before us. To argue that the customary or the average consumption of protein is the necessary consumption suggests that the necessary potein consumption is after all far more flexible than is indicated by the standard diets. It also implies that the people have solved the problem without the aid of science, and further that their average health and vigor is now all that we can hope for in so far as the protein contents of the food have anything to do with it.

Voit, himself, remained, I think, somewhat under the strong influence of Liebig's teachings concerning the peculiar value of protein as a food. It is difficult to see how he could otherwise have failed to find that it is possible to maintain nitrogen equilibrium on a comparatively small fraction of the protein which he declared to be the minimum. It was right and natural that Voit should not put the necessary protein requirement at too low a figure; its great practical import demanded cautiousness. But the minimum protein requirement for man could of course not be found except by studying the metabolism of man under the influence of smaller and smaller quantities of protein. This is clearly demonstrated by the results of the modern low nitrogen equilibrium experiments.

The disciples of Voit can not and do not question the accuracy of the results recorded from the low protein feeding experiments. But it is now rightly enough held that to prove that a person can maintain nitrogen equilibrium for a limited length of time, as for a few days, on a very small amount of protein does not at all prove that he can permanently do so with advantage or even with impunity. The correctness of this position must be granted, and it is, in fact, the position taken by the more conservative experimenters on low nitrogen equilibrium, as for example by Siven. But while freely admitting this, it must, in my opinon, be insisted that the low protein experiments of even such short duration, as a few days, have completely destroyed the scientific basis on which the protein prescriptions of Voit and his disciples are supposed to rest.

LOW PROTEIN EQUILIBRIUM

As far as we yet know there is no reason for assuming that a diet capable of maintaining nitrogen equilibrium for a week should fail to do so at the end of a month or any other time. In fact, investigations of the last three or four years clearly indicate that nitrogen equilibrium can be maintained for long as well as for short periods on very small quantities of protein.

In 1902 Dr. R. O. Neumann, privatdocent in the Hygiene Institute at Kiel, published an account of metabolism experiments with himself covering a period of over two years. The average composition of his diet during that time corresponded to 117 grams fat, 213 grams carbohydrates, and 74.2 grams protein per 70 kilos of body weight. Neumann's experiments covering such a long period would certainly seem to constitute definite proof that Voit's so-called minimum protein requirement is at least half again as large as is really necessary for the permanent maintenance of nitrogen equilibrium, physical vigor, and efficiency.

More striking still are the metabolism records published last year by Professor Chittenden. I shall not go into details of this work, as Mrs. Richards is on the program for a report on it. But I must cite the fact that Chittenden maintained a body weight of 57 kilos as well as nitrogen equilibrium from July, 1903, until the publication of his book in the fall of 1904, on an average protein consumption of less than 35 grams a day.

DR. FOLIN'S STUDIES

My own studies of protein metabolism in man, though pursued in a different way and for a different purpose, have a direct bearing on the problem of the necessary minimum protein consumption. The specific waste products formed from the destruction of protein within the human organism are eliminated in soluble form with the urine. They are therefore easily available for detailed chemical investigations, and as the result of innumerable studies much exact knowledge has been gained concerning the normal katabolism products of protein. My investigations lie within this field.

The views that have till recently prevailed concerning the chemistry of urine, in so far as it relates to the problem of protein metabolism, may be concisely stated as follows: All the nitrogen of the protein destroyed in the body is eliminated with the urine, and almost 90% of it appears in the form of urea. From 95% to 98% of the nitrogen is eliminated as urea, kreatinin, ammonia, and uric acid. The absolute amount of each of these nitrogenous products depends upon the amount of protein katabolized, but changes in the amount of protein destroyed affect them all equally, thus leaving them always in about the same proportion to each other and to the total nitrogen. This fact, if correct, is very important, because it clearly indicates a certain unity in the chemical processes concerned with the use and destruction of protein within the body. It indicates that the protein of the food and the protein of the living tissues are essentially alike and in the same condition with reference to the organism at the time of their final destruction. The two rival theories concerning this subject accordingly agree in assuming the essential unity of the chemical processes involved in protein katabolism, and the only point of difference between the two is that one, the theory of Voit, holds that the protein must be in solution and dead before being oxidized and destroyed, while the other, that of Pflüger, assumes that it is only actually living protoplasm that is destroyed.

It would be useless in this connection to go into a detailed discussion of these two theories, because I think it can be shown that the fundamental premise of both, namely, the supposed constancy in the relative distribution of the urinary nitrogenous products, is no longer tenable.

RELATIVE PROPORTION OF NITROGEN WASTE PRODUCTS

The fact that the relative proportions of the various nitrogenous constituents of normal human urine have so long been supposed to be approximately constant is in a measure directly the result of Voit's teachings concerning the minimum protein requirement. The destruction of 100 grams protein or more within the organism, as demanded by the dietary standards, rendered it well nigh impossible to discover the laws that govern the formation and elimination of each product. About a year and a half ago I discovered accidentally that the urine corresponding to a very low protein katabolism has a chemical composition which is very different from that of urine derived from the standard diets. This led to numerous attempts to reduce the daily protein destruction in normal persons to the lowest possible level.

Nearly all preceding attempts to reduce the protein katabolism have also been attempts to maintain at the same time nitrogen equilibrium. In mine the question of nitrogen equilibrium, or loss of protein, was not considered, and I have as a matter of fact used a diet containing almost no protein. I have kept several normal persons for a week or more, two or three persons for two weeks, and one for 17 days on a diet consisting exclusively of pure arrow root starch and 300 cc. of cream. In this way the daily protein katabolism has repeatedly been reduced to about 20 grams a day.

Detailed chemical studies of the urines corresponding to such greatly reduced protein katabolism have shown that the relative proportion which the nitrogenous products bear to each other and to the total nitrogen does change and very greatly. For example, the kreatinin elimination is entirely *independent* of the total amount of protein katabolized. It is just as great on a diet containing no protein as on one containing 118 grams of protein. In the one case it represents from 17% to 20% of the total nitrogen, in the other from 3% to 4%. The urea, on the other hand, is peculiarly a product of excessive protein katabolism. When the urinary nitrogen represents a katabolism of 100 grams of protein, 90% of that nitrogen is present as urea, while when the protein katabolism has been reduced to 20 grams, only from 50% to 60% of its nitrogen appears in the form of urea.

DIFFERENT KINDS OF PROTEIN METABOLISM

These facts concerning urea and kreatinin suffice to show how entirely erroneous has been the assumption that the nitrogen of katabolized protein is always distributed in the same proportion among the different waste products. It may therefore be superflous now to go into further details concerning the laws that govern the formation and elimination of the different products. The fact that these laws are widely different for different products, as for urea and kreatinin, demonstrates with a fair degree of certainty that protein metabolism is not all of one kind.

The true minimum katabolism or protein, as obtained in my feeding experiments with starch and fats, is clearly very different from the katabolism of the large quantities of protein demanded by the dietary standards. The former converts not over 60% of the protein nitrogen into urea, and is the source of all the kreatinin eliminated with the urine. The katabolism of that food protein which is not absolutely needed for the maintenance of nitrogen equilibrium, on the other hand, yields probably at least 95% of its nitrogen in the form of urea and yields no kreatinin whatever. The katabolism which yields the kreatinin clearly tends to be constant and independent of the food protein; it can therefore fairly be said to represent the tissue metabolism. The katabolism which yields chiefly urea is the katabolism of the excessive food protein, and its amount depends directly upon the amount of protein contained in the food. This I have called the exogenous metabolism.

EXOGENOUS METABOLISM

Since the exogenous metabolism seems to have nothing to do with the tissue metabolism, and since it increases immediately with every increase of protein furnished with the food and in porportion to such increase, it represents nothing else than the effort of the organism to get rid of nitrogen that it does not need and can not use. The remarkable ability of the human organism to establish nitrogen equilibrium on almost any quantity of protein does therefore not mean, as has been believed, that the organism uses protein by preference instead of fats and carbohydrates. This phenomenon is merely the result of our habitual consumption of more protein than can be used in the tissue metabolism. Being always supplied with an excess, we have always with us the maximum amount of reserve protein that we can advantageously carry, and any further increase in the supply simply leads to an increased elimination.

CONCLUSIONS

Such, in brief, are the conclusions which I have drawn from detailed studies of the waste products of protein katabolism.

To recapitulate: We have learned from Voit that protein is not needed to supply energy; and the work of more recent investigators has demonstrated that nothing like 100 grams of protein is needed to maintain nitrogen equilibrium in a man of average size. Further, from detailed analytic studies, we have learned that some waste products, like kreatinin, represent tissue metabolism, and others, like urea, the metabolism of that food protein which is destroyed as rapidly as it is taken in. The two kinds of metabolism are independent. The tissue metabolism is for each individual a constant quantity, irrespective of the amount of protein contained in the food. Obviously, therefore, there is a constant minimum protein requirement to prevent loss of tissue material. The amount of protein needed for this purpose is very small, probably not over 25 grams a day. It does, however, not necessarily follow that 25 grams protein should be prescribed instead of 118 grams. The prevailing idea that consumption of more than the minimum amount of protein is detrimental to health may not be true. The minimum may not be the optimum. But what has been considered the minimum, 118 grams, may be beyond the optimum, possibly even above the maximum amount of protein that any normal person should consume.

DISCUSSION

Mrs. Abel — I should like to ask Dr. Folin if he would recommend for tuberculosis patients a great deal of milk and eggs.

Dr. Folin — Any opinion I give must simply be my own. I should be inclined to think it unnecessary to prescribe any quantity of protein whatever. By that I do not mean to say how much should be consumed, because in our food products, say bread and butter, there is enough to meet all requirements as shown by these investigations, but at the same time the experience of past generations shows that we can at least, without any noticeable disadvantage, consume considerable quantities of protein. For instance, I should not advise stopping all use of meat. I should be inclined to take the same attitude toward protein as toward fats and carbohydrates. We must have enough food to maintain the energy that is consumed, and I think the same liberty can be taken toward protein as toward the other two. We do not quite know just what is the effect of compelling the system to eliminate large quantities, and so long as we do not know I do not believe we can take a very definite standpoint on the question. It is generally believed that such diseases as gout are more or less directly due to high living, but we can not prove it, and moreover it is a question whether protein consumption and meat eating are at all identical. Such products as uric acid are formed in large quantities by meat eaters, but they are not formed when such products as milk and eggs are taken; consequently, I should say that we do not know.

In regard to such disease as consumption, I have no personal experience, but if the point is merely to build them up and give them a large amount of reserve material, we can see that it is entirely unnecessary to feed large quantities of milk and eggs, because the nutrition of milk and eggs is at once eliminated, and presumably the rest of that food is stored as fat and carbohydrates, and so I should be inclined at least to consider it worth while to try whether fat and carbohydrates would not produce just as good results.

Mrs. Abel—There are several here I think who have to do with feeding people in hospitals, and one lady with tuberculosis patients, and I should like very much for my own information to know whether these patients take and digest and seem to flourish under this high feeding of eggs and milk. I myself have to visit a poorhouse where there are 100 tuberculosis patients. Eggs are 40 cents a dozen in winter, and the state must pay for them. Still the prescription is 3 and 4 eggs a day and a large quantity of milk. If it is not necessary, it is of immense importance to the whole country to know it, for other patients need the money which now goes for this purpose.

Miss Fraser — I am trying to feed consumptive patients as economically as possible, to give them the things they like and must have and to do it all on a certain sum. Our patients are fed in the following way. They have breakfast at 7.30. We expect them to take half an hour for that meal, and they may stay as much longer as they like. At 10.30 they have their lunch of milk and eggs, no limit to the quantity of milk and eggs or egg nog. At 12.30 we have dinner. A number of patients at that meal take a raw egg and milk. At 3.30 they are called to lunch, milk and eggs. At 5.45 supper, milk and eggs again and just as much as they can eat besides. At 8.30 milk and eggs again. Some of those patients during the night take milk and eggs. We give them cereal twice a day, for breakfast and supper, cooked eight hours in a double boiler. They are very fond of that, but we find that if they know there is steak they do not take so much. The same at dinner with soups. I find they do not take as much, for they think they must save space for roast beef. Vegetables they are fond of. I try to give them as much as they can eat. They seem to have an idea that they must eat plenty of rare beef and milk and eggs. I have heard patients who have been cured, come back and say to the others "Now eat all the meat and milk and eggs that you can and never mind the other things." Farther than that I cannot tell. The patients look healthy and no one would have any idea that they were a lot of sick people.

Miss Bevier — Would Dr. Folin say that we can not help getting from any food as much protein as the system needs and so there is no such thing as balanced rations?

Dr. Folin — If you eat enough bread and butter to give 2500 calories, I believe you would get enough protein. Be sparing of the butter if fat is too great. It is exceedingly difficult to get any diet that does not contain nutrition that is equal to the metabolism.

The one point that you would need to consider would be fuel value and in regard to that there is now perhaps a little difference of opinion. The work done by the department of agriculture is probably the safest guide at present.

Dr. Langworthy — Dr. Folin's is the most important contribution to the subject made in a long time. It clears up some matters, throws light on others, and I think when work has gone on for a time longer we shall know a great deal more about this subject. I like his attitude in not drawing frenzied conclusions from so many and interesting results. I never want to forget that whenever we find a race living on a small amount of food, or largely on vegetable diet, it is not a capable race. The Italian peasants who live on corn meal and a little fish do little work, yet bring them to this country and give them better diet and they do a great deal more and better work in a day. The second and third generation develops a larger man than his father or grandfather. We find that the Japanese eat just about the same amount of protein as the standard covers.

* * * * *

Mrs. Richards — One point which every one has very carefully left out of this discussion is the food of the child. All these experiments in lowering the food protein must be practiced on our own and not on the children's diet at present.

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASS STUDY ON

FOOD AND DIETETICS

MEETING I

(Study pages 1 – 29)

The Food Problem

Food materials and their Adulteration, by Ellen H. Richards. Chapter I. ($1.00, postage 10c.)

Cost of Food, by Ellen H. Richards. Pages 1–7. ($1.00, postage 12c.)

Sanitary and Economic Cooking, by Mary Hinman Abel. Pages 1–5. (40c., postage 10c.)

Cost of Food

Cost of Food, by Ellen H. Richards. Chapters XI–XIV.

Bulletin No. 129 (Office of the Experiment Stations), Dietary Studies in Boston, Springfield, Philadelphia, and Chicago. Price 10c. (coin), of the. Supt. of Documents, Washington, D. C.

Sanitary and Economic Cooking — Some Cheap Dishes. Pages 25 – 33.

Rumford Kitchen Leaflets — Good food for little Money, by Ellen H. Richards. ($1.00, postage 10c.)

Principles of Nutrition and the Nutritive Value of Food. Farmers' Bulletin No. 142. (Free of Dept. of Agriculture, Washington, D. C.)

Topic: Food in Relation to National Character.

MEETING II

(Study pages 30 – 49.)

Food and the Body

Principles of Nutrition and Nutritive Value of Food. Farmers' Bulletin No. 142.

Food and Dietetics, by Hutchison. Chapter I. ($3.00, postage 30c.)

Food Principles

Make experiments on proteids described on pages 41 and 42.

Clean and grate a small potato under slowly running water, pour through muslin to collect fibers, let starch settle.

Exhibit: Make up an exhibit showing quantities of food having the same fuel and energy value — say 800 calories, which is a little over one-third the daily requirement for a woman at moderate work according to dietary standards. Show bread, meat, butter, milk, eggs, sugar, potatoes, apples, etc., and label each food with the weight in ounces and cost.

Calculation. Bread furnishes about 1650 calories per pound; to furnish 800 calories would require 800 divided by 1650; which multiplied by 16, equals 7.75 oz. — about half a loaf. Milk furnishes 325 calories per pound. 800 divided by 325 and multiplied by 16 equals about 40 oz., or a quart and half a pint, and so on.

Exhibit: Make an exhibit of foods containing 1.126 oz., of proteid, — one-third the daily ration for a woman — labeling each with the weight and cost.

MEETING III

(Study pages 50–61)

Dietary Standards

Food and Dietetics, by Hutchison. Chapters II and III. ($3.00, postage 26c.)

Dietary Computer, by Ellen H. Richards. ($1.50, postage 12c.)

Bulletin No. 28, American Food Materials. Price 5 cents (coin), of the Supt. of Documents, Washington, D. C.

Physiological Economy in Nutrition, by Chittenden. Introduction, Chapters IV, V, and Conclusion. ($3.00, postage 20c.)

Article in Century Magazine, February, 1905, by Chittenden.

Protein Metabolism in Relation to Dietary Standards, by Folin. See Supplement, pages 196-215. See "Notes on the Questions," pages 191-195.

Send to the Battle Creek Sanitarium, Battle Creek, Mich., for some of their menus giving fuel value of food served.

See articles in Good Housekeeping,— August, 1906, "Fletcherism as Household Economy," and October, 1906, "Sense and Science in Dietetics," by Dr. Stedman.

Exhibit: Make up exhibits showing a standard day's ration for a woman with light exercise — 80 grams (about 3 oz.) of proteid — with sufficient fats and carbohydrates to bring the total fuel value up to 2300 calories. See Bulletin No. 28, American Food Materials, for composition of any foods not given in the lesson books.

(Select answers to Test Questions on Part I and send them to the School and report on exhibits and supplemental work.)

MEETING IV

(Study pages 63 – 116)

Special Foods

Food and Dietetics, by Hutchison, and other standard books.

Food Products of the World, by Green. ($1.50, postage 14c.)

Meat and Fish

Meats, Composition and Cooking. Farmers' Bulletin No. 34.

Fish as Food. Farmers' Bulletin No. 85.

Poultry as Food. Farmers' Bulletin No. 182.

Meat on the Farm, Butchering, Keeping, Curing. Farmers' Bulletin No. 183.

Roasting of Beef, Circular 71, University of Illinois. Isabel Bevier. (Postage 2c.)

Eggs, Milk, and Milk Products

Eggs and their use as Food. Farmers' Bulletin No. 128.

Milk as Food. Farmers' Bulletin No. 74.

Facts about Milk. Farmers' Bulletin No. 42.

Food Value of Cheese, in Farmers' Bulletin No. 244.

Milk Supply of Two Hundred Cities and Towns. Bulletin No. 46. Price 10 cents (coin), of the Supt. of Documents, Washington, D. C.

Milk and its Products, by Wing. ($1.00, postage 10c.)

Cereals and Cereal Products

Bread and the Principles of Bread Making. Farmers' Bulletin No. 112.

Wheat, Flour, and Bread. Extract No. 324.

Macaroni Wheat. Extract No. 326.

Studies in Bread and Bread Making. Bulletin No. 101. Price 5 cents (coin), of Supt. of Documents, Washington, D. C.

Cereal Breakfast Foods. Farmers' Bulletin No. 249.

Cereal Breakfast Foods. Bulletin No. 84 and 118, Maine Agricultural Experiment Station, Orono, Maine.

Pop Corn, in Farmers' Bulletin No. 202.

Corn Plants, by Sargent. (75c., postage 6c.)

Story of Grain of Wheat, by Edgar. ($1.00, postage 10c.)

Sugar

Sugar as Food. Farmers' Bulletin No. 93.

Maple Syrup and Sugar, in Farmers' Bulletin No 124.

(Select answers to Test Questions on Part II and report on supplemental work.)

MEETING V

(Study pages 119–157)

Vegetables, Fruits, and Nuts

Beans, Peas, and other Legumes as Food. Farmers' Bulletin No. 121.

Sweet Potatoes. Farmers' Bulletin No. 127.

Peanuts: Culture and Uses. Farmers' Bulletin No. 25.

Value of Potatoes as Food. Extract from Year Book, 1900.

Losses in the Cooking of Vegetables. Farmers' Bulletin No. 73.

Mushrooms as Food, in Farmers' Bulletin No. 79.

Banana Flour; Canned Tomatoes, in Farmers' Bulletin No. 119

Chestnuts, in Farmers' Bulletin No. 114.

Coffee Substitutes, in Farmers' Bulletin No. 122.

Food Value of Beans, in Farmers' Bulletin No. 169.

Nuts as Food. Bulletin No. 54, Maine Agricultural Experiment Station, Orono, Maine.

Coffee Substitutes. Bulletin No. 65, Maine Agricultural Experiment Station, Orono, Me.

Nutrition Investigations among Fruitarians and Chinese, Bulletin No. 107. Price 5 cents (coin,) of the Supt. of Documents, Washington, D. C.

Further Investigations among Fruitarians, Bulletin No. 132. Price 5 cents (coin), of the Supt. of Documents, Washington, D. C.

Food and Dietetics, by Hutchison. Chapters XIV and XVIII.

Cocoa and Chocolate. Walter Baker Co., Dorchester, Mass. (Postage 6c.)

MEETING VI

(Study pages 158 – 180)

Adulteration of Food

See Articles on "Safe Food" in the Delineator, January to July, 1906, by Mary Hinman Abel.

Food Materials and their Adulterations, by Ellen H. Richards. ($1.00, postage 10c.)

Standards of Purity for Food Products. Circular No. 17.

Use and Abuse of Food Preservatives. Extract No. 221.

Some forms of Food Adulteration and Simple Methods for their Detection. Bulletin No. 800, Bureau of Chemistry. Price 10 cents (coin), of the Supt. of Documents, Washington, D. C.

Make some of the tests described in the text and above bulletins.

Officials Charged with Enforcement of Food Laws. Circular No. 16.

The food laws of your own state. Write to the officer given in Circular No. 16 for them and send for the part of bulletin of Bureau of Chemistry containing them.

Topics: Laws, if any, in your own town. Are they enforced?
The Local Milk Supply,— investigate.
Condition of the Local Slaughter Houses.

Special Diet

Food and Dietetics, by Hutchison. Diet in Disease, Chapter XXVII.

Diet in Obesity and Fattening Diet. Chapter XXVIII.

Food as a Factor in Student Life, by Richards and Talbot. (25c., postage 2c.)

Diet in Relation to Age and Activity, by Thompson. ($1.00, postage 8c.)

A, B and Z of our own Nutrition, by Fletcher. ($1.00, postage 10c.)

Vegetarianism, by Kellogg.

(Select answers to Test Questions on Part III and report on supplemental work.)

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