U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 107.

A. C. TRUE, Director.

NUTRITION INVESTIGATIONS

AMONG

FRUITARIANS AND CHINESE

AT THE

CALIFORNIA AGRICULTURAL EXPERIMENT STATION,

1899-1901.

BY

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WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1901.

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OFFICE OF EXPERIMENT STATIONS

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., October 25, 1901.

Sir: I have the honor to transmit herewith a report of investigations on the nutrition of man, conducted at the agricultural experiment station of the University of California in 1899–1901, by M. E. Jaffa, M. S., assistant professor of agriculture of the University of California. Six dietary studies of fruitarians, a digestion experiment and a metabolism experiment with a fruitarian, and three dietary studies of Chinese are included in the investigations. In connection with the work a number of analyses of food materials and excretory products were made. These studies form a part of the nutrition investigations conducted by this Office, and were carried on in accordance with instructions given by its Director. As was the case with earlier investigations, they were under the general direction of Prof. W. O. Atwater, special agent in charge of nutrition investigations.

In carrying on this investigation Professor Jaffa was aided in the analytical work by Mr. G. E. Colby, and in collecting data, calculating results, and in other ways by Messrs. F. J. Snow, R. R. Bishop, and C. L. Biedenbach. Acknowledgment is also due to Mr. W. N. Fong, instructor in the department of Oriental languages of the University of California, for assistance in interpreting and for other courtesies.

Fruit is one of the very important agricultural products of this country, yet little is known of its true food value. The studies here reported of persons living largely upon fruit are, therefore, of special interest in this connection, and, so far as known, are the first of their kind.

In order that data may be secured for the satisfactory determination of dietary standards, it is desirable to conduct dietary studies with persons living under widely different circumstances and of different dietary habits. Most of the studies already reported have been made with persons consuming a mixed animal and vegetable diet. It seemed desirable to secure results with persons living on a diet in which vegetable foods formed the principal or sole source of nutrients. These

studies were accordingly made with members of a fruitarian colony who claimed to live almost exclusively on a diet of raw fruits and nuts, and with the Chinese, who are commonly said to live very largely upon rice. The results obtained are of interest in themselves and valuable for purposes of comparison. The report is transmitted with the recommendation that it be published as Bulletin No. 107 of this Office.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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NUTRITIVE VALUE OF FRUITS.

INTRODUCTION.

Fruit is considered by the majority of persons as an accessory or supplementary food, eaten for its agreeable flavor or supposed hygienic or medicinal virtues, rather than as a staple article of diet. Perhaps for this reason very little scientific study has been given to fruit as compared with the investigations which have been carried on in connection with other more common food materials. Chemical analysis has shown the comparative composition of fruits, but our knowledge of their dietetic value, digestibility, and comparative cost as sources of nutrients is far from being complete. In view of these facts it has been thought best that California should undertake, as her share of the nutrition investigations made under the auspices of the United States Department of Agriculture, studies of the nutritive value and digestibility of fruit. Perhaps no State in the Union is in better condition to exploit such problems. No month in the year finds the California market without fresh fruit of local production, and many people are to be found in the State who make this article an important part of their dietary.

It is not an infrequent occurrence to see popular articles in the daily papers and magazines which assert the superiority of the vegetarian diet over the ordinary diet, or the fruitarian over the vegetarian. The fruitarians claim, and with some degree of justice, that the so-called vegetarians are not true vegetarians, but are simply non-meat eaters. This is certainly true of many of them, as a large proportion include animal products in their dietaries, since they consume considerable quantities of milk, butter, cheese, eggs, etc., and some even go so far as to eat fish.

There seems to be an infinite variety in the views and habits of those who depart from the conventional methods of eating, and any conclusions drawn from the investigations of the dietaries of some of these apply to only comparatively small subdivisions of a class. It would appear, however, that mankind may be divided in the main into two classes—meat eaters and non-meat eaters. In the first-named class the

variations are principally in the relative quantities of meat and other food consumed, and are comparatively simple. But of the second class we have many subdivisions, including, among others—

(1) Those who for one reason or another abstain from the use of meat entirely, but eat other animal products, such as milk, eggs, etc.

(2) Vegetarians, who rule out all animal foods and animal products as such, but who partake of made dishes (puddings, pastry, cake, etc.) which contain milk, eggs, etc.

(3) Vegetarians who object to "made dishes," and who eat as far as possible uncooked food; living practically the same as the next subdivision, though naming themselves differently.

(4) Fruitarians, who live principally on fruits and nuts, but who allow in their dietary some vegetables or grain products.

(5) The strict fruitarians, who live exclusively on fruits and nuts.

The last subdivision is perhaps of the greatest interest, as possessing the most restricted dietary, and one that differs most widely from the ordinary diet.

In inaugurating these investigations it was deemed desirable to select such subjects as were not only accustomed to the large use of fruit, but whose dietaries did not contain many other foods. Fortunately subjects were found whose ordinary mode of living placed them in the last two subdivisions (4 and 5); that is, they lived almost exclusively on raw fruit and nuts.

A number of dietary studies with persons living on a more or less strictly vegetarian diet have been reported by Cremer,[1] Constantinidi,[2] Rutgers,[3] Voit,[4] Avsitidiski,[5] Tanaguti,[6] Kellner and Mori,[7] and others. Of these the study made by Voit is most directly comparable with those reported herewith. It was made with a young man, an upholsterer, living in Munich. For three years he had lived on a diet of coarse bread (pumpernickel and graham), fresh and dry fruits, and oil. The diet differed from those studied in California in that bread, i. e., cooked food, was eaten. However, no warm cooked food was used and the amount of fresh and dried fruits and oil eaten daily was comparatively large. The results of these studies are discussed elsewhere (p. 19) in connection with those of the present investigation.

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[1] Ztschr. Physiol. Chem., 1882, p. 357.

[2] Ztschr. Biol., 23 (1887), p. 447.

[3] Ztschr. Biol., 25 (1888), p. 371.

[4] Ztschr. Biol., 25 (1889), p. 232.

[5] The Metabolism of Nitrogen and Losses through Skin and Lungs on a Vegetable diet. (Russian.) Inaug. Diss., St. Petersburg, 1889.

[6] Jahresbr. Thier Chem., 1892, p. 468.

[7] Ztschr. Biol., 25 (1889), p. 102; see also U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

The investigation of fruitarians living in California includes (1) the study of six dietaries which, with two exceptions, were made up of fruit and nuts exclusively (in the first case the subject ate a small quantity of a cereal preparation, and in the second some green vegetables); (2) one digestion experiment with a girl, in which fruit and nuts constituted the entire diet; (3) a study of the income and outgo of nitrogen in the digestion experiment; and (4) estimation of metabolic nitrogen in the feces. In connection with the experiments, the composition of various food materials and excretory products was determined.

ANALYSIS OF FOOD MATERIALS.

In connection with the present investigations a number of analyses of food materials were made. The methods of analysis followed were practically those adopted by the Association of Official Agricultural Chemists.[1]

The following is a brief description of the samples analyzed:

DESCRIPTION OF SAMPLES.

No. 2. Apple, "Newtown pippin;" No. 4, apple, "Early Astrachan;" and No. 6, apricots, "Hemeskirk," sampled and analyzed in connection with dietary studies.

No. 19. Dates, sampled and analyzed in connection with dietaries Nos. 328–331 and 333.

No. 7. Figs, sampled and analyzed in connection with dietaries Nos. 328–331 and 333.

No. 9. Peach, "Early Crawford;" No. 11, pears; No. 13, Japanese plum; and No. 15, early red plum, sampled and analyzed in connection with the dietary studies.

No. 30. Bananas, quoted from a previous publication,[2] with the exception of the fiber, which was determined.

No. 21. Almonds; No. 22, pignolias; and No. 24, pine nuts, sampled and analyzed in connection with the dietary studies.

The figures in the column "reference number" refer to corresponding numbers in parentheses after the different food materials recorded in Tables 3–7.

The results of the analyses are given in Table 1.

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[1] U. S. Dept. Agr., Division of Chemistry Bul. 46, revised.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 28.

TABLE 1.—*Composition of food materials analyzed in connection with dietary studies Nos. 328 to 333—composition determined.*

Food materials.	Reference No.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Crude fiber.	Ash.	Fuel value per pound.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Fresh fruits:									
Apples—									
Pippin, edible portion	1	.....	85.3	0.6	0.1	12.7	1.1	0.2	270
Pippin, as purchased	2	25.0	63.9	.5	.1	9.5	.9	.1	205
Astrachan, edible portion	3	.....	90.5	.4	.1	4.7	4.1	.2	175
Astrachan, as purchased	4	28.4	64.8	.3	.1	3.4	2.9	.1	125
Apricots—									
Edible portion	5	.....	86.2	1.4	.1	6.5	5.3	.5	250
As purchased	6	30.0	60.3	1.0	.1	4.5	3.7	.4	175
Figs	7	.....	78.2	1.5	.2	17.5	2.0	.6	400
Peaches, Early Crawford—									
Edible portion	8	.....	89.6	.4	.1	5.8	3.6	.5	185
As purchased	9	22.0	69.8	.3	.1	4.6	2.8	.4	145
Pears—									
Edible portion	10	.....	84.7	.6	.5	13.9	.....	.3	290
As purchased	11	10.0	76.2	.5	.5	12.5	.....	.3	265
Plums, Japanese—									
Edible portion	12	.....	89.7	.7	.1	4.9	4.2	.4	185
As purchased	13	7.5	83.0	.6	.1	4.5	3.9	.4	170
Plums, red—									
Edible portion	14	.....	88.9	.9	.1	5.8	4.0	.3	205
As purchased	15	15.0	75.6	.7	.1	4.9	3.4	.3	170
Oranges—									
Edible portion	16	.....	87.5	.8	.1	11.1	.....	.5	225
As purchased	17	40.0	52.5	.5	.1	6.6	.....	.3	135
Dried fruits:									
Dates—									
Edible portion	18	.....	38.2	2.9	.3	35.9	21.3	1.4	1,130
As purchased	19	6.5	35.7	2.7	.3	33.6	19.9	1.3	1,055
Nuts:									
Almonds—									
Edible portion	20	.....	3.9	21.3	54.2	15.0	3.1	2.5	3,020
As purchased	21	43.8	2.2	12.0	30.5	8.4	1.7	1.4	1,700
Pignolias, pine kernels	22	.....	6.3	34.0	49.4	5.6	1.3	3.4	2,845
Pine nuts, piñons—									
Edible portion	23	.....	2.8	14.9	59.4	18.3	1.8	2.8	3,160
As purchased	24	42.9	1.6	8.5	33.9	10.5	1.0	1.6	1,805

The composition of a number of foods used was assumed from average values previously reported, as follows:

TABLE 2.—*Composition of food materials used in connection with dietary studies Nos. 328 to 333—composition assumed.*

Food materials.	Reference No.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.		Ash.	Fuel value per pound.
						Sugar, starch, etc.	Crude fiber.		
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Cereals, prepared	25	.....	5.3	11.7	1.0	79.7		2.3	1,740
Vegetables:									
Celery—									
Edible portion	26	.....	94.5	1.1	.1	3.3		1.0	85
As purchased	27	20.0	75.6	.9	.1	2.6		.8	70
Tomatoes	28	.....	94.3	.9	.4	3.3	0.6	.5	105
Fresh fruits:									
Bananas—									
Edible portion	29	.....	81.6	1.5	.....	15.3	1.0	.6	330
As purchased	30	31.0	56.3	1.0	.....	10.6	.7	.4	230
Grapes—									
Edible portion	31	.....	80.0	1.3	.....	18.2		.5	365
As purchased	32	25.0	60.0	.9	.....	13.7		.4	270
Olives—									
Edible portion	33	.....	65.5	1.7	25.1	3.2		4.5	1,150
As purchased	34	17.0	54.3	1.4	20.9	2.7		3.7	960
Dried fruits:									
Raisins—									
Edible portion	35	.....	19.0	4.1	.....	75.3		1.6	1,475
As purchased	36	10.0	17.1	3.6	.....	67.9		1.4	1,330
Nuts:									
Brazil nuts—									
Edible portion	37	.....	5.3	17.0	66.8	7.0	.....	3.9	3,265
As purchased	38	49.6	2.7	8.6	33.6	3.5	.....	2.0	1,640
Walnuts—									
Edible portion	39	.....	2.5	16.6	63.5	13.5	2.5	1.4	3,285
As purchased	40	57.2	1.1	7.1	27.1	5.8	1.1	.6	1,405
Honey, light	41	.....	18.2	.8	.....	80.8	.....	.2	1,520
Vegetable oils: Olive oil	42	.....	.....	.....	100.0	.....	.....	.....	4,220

THE DIETARY STUDIES.

The subjects were a family consisting of two women and three children. One of the women was the aunt of the children and took care of them. They had all been fruitarians from five to seven years, and made no change in the character of their diet during these experiments.

In the six studies here reported the subjects ate only twice a day. Their first meal was at 10.30 a. m. and always consisted of nuts and fruit, the nuts being eaten before the fruit. At their second meal, which was taken about 5 p. m., they usually ate no nuts, substituting therefor olive oil and honey. Almonds, Brazil nuts, pine nuts, pignolias (a variety of pine nuts), and walnuts were used, as well as fresh and dried fruit, the former including apples, apricots, bananas, figs, grapes, olives (pickled), oranges, peaches, pears, plums, the latter dates and raisins. Some celery and tomatoes were also eaten, and in one study a small amount of a prepared cereal food.

As tomatoes are really fruit, though ordinarily used as a vegetable, the only articles used which were not fruit or nuts were celery, olive oil, honey, and the cereal food.

It was interesting to watch the three children (the subjects of dietary studies Nos. 330, 331, 332, and 333) at their meals and hear them discuss the relative virtues of the different nuts as persons ordinarily discuss the different dishes of an ordinary diet.

In calculating the results to the corresponding value for a man the usual factors were used (see p. 18).

The crude fiber in the food was recorded in these studies, as this constituent was regarded as of especial interest in a diet made up so largely of fruit and nuts. Generally speaking, such a distinction is not made in reporting dietary studies, but instead the sum of the crude fiber and the sugars, starches, etc., is called carbohydrates.

DIETARY STUDY OF A FRUITARIAN (No. 328).

The study commenced July 18, 1900, and ended August 7, lasting 20 days. The subject was a woman 33 years old, height 5 feet, weighing 90 pounds.

The number of meals taken was 40, equivalent to 1 woman for 20 days or 1 man for 16 days. The results of the study are shown in the following table.

TABLE 3.—*Weights and cost of food and nutrients consumed in dietary study No. 328.*

Kinds, amounts, and cost of different food materials.[1]	Cost and composition of food per person per day.					
	Cost.	Protein.	Fat.	Sugar, starch, etc.	Crude fiber.	Fuel value.
VEGETABLE FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Fresh fruits: Apples, 13,381 grams, $1.18 (4); apricots, 5,291 grams, 46 cents (6); bananas, 454 grams, 10 cents (30); figs, 510 grams, 16 cents (7); grapes, 4,054 grams, 45 cents (32); olives, 80 grams, 3 cents (34); oranges, 2,693 grams, 40 cents (17); peaches, 4,621 grams, 40 cents (9); pears, 1,418 grams, 12 cents (11); plums, red, 1,080 grams, 9 cents (15)	16.7	9	3	100	38	630
Dried fruits: Dates, 28 grams, 2 cents (19)	.1	.....	.....	1	.....	5
Vegetable oils: Olive oil, 269 grams, 40 cents (42)	2.0	.....	13	.....	.....	120
Honey, 18 grams, 1 cent (41)	.....	.....	.....	1	.....	5
Nuts: Almonds, 897 grams, 30 cents (21); pignolias, 1,035 grams, 60 cents (22); pine nuts, 57 grams, 1 cent (24); walnuts, 224 grams, 7 cents (40)	4.9	24	43	8	2	540
Total vegetable food	23.7	33	59	110	40	1,300

[1] The numbers in parentheses after each food material in this and succeeding tables (Nos. 3–8) refer to corresponding numbers in the second column of Tables 1 and 2, p. 10.

The tentative standard for a woman at light work calls for 90 grams protein and 2,500 calories (see p. 18). From the table it appears that the daily diet (33 grams protein and 1,300 calories) is far below the tentative standard. But it must be remembered that the subject was a very small woman, taking almost no physical exercise. She believed, as do fruitarians generally, that people need far less raw than cooked food.

DIETARY STUDY OF A FRUITARIAN (No. 329).

The study continued for 25 days in July and August, 1900.

The subject was a woman 30 years old, weighing 104 pounds. The number of meals taken was equivalent to 1 woman for 25 days or 1 man for 20 days. Table 4 shows in detail the results of this study.

TABLE 4.—*Weights and cost of food and nutrients consumed in dietary study No. 329.*

Kinds, amounts, and cost of different food materials.	Cost and composition of food per person per day.					
	Cost.	Protein.	Fat.	Sugar, starch, etc.	Crude fiber.	Fuel value.
VEGETABLE FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Vegetables: Celery, 113 grams, 2 cents (27); tomatoes, 3,624 grams, 32 cents (28)	1.4	2	1	5	1	40
Fresh fruits: Apples, Astrachan, 9,130 grams, 80 cents (4); apricots, 3,360 grams, 30 cents (6); figs, 408 grams, 7 cents (7); olives, 630 grams, 18 cents (34); oranges, 822 grams, 10 cents (17); peaches, 4,711 grams, 52 cents (9); pears, 1,755 grams, 16 cents (11); plums, Japanese, 900 grams, 10 cents (13); plums, red, 1,080 grams, 10 cents (15)	9.3	5	7	45	24	370
Dried fruits: Dates, 93 grams, 3 cents (19); raisins, 60 grams, 3 cents (36)	.2	.....	.....	3	1	15
Vegetable oils: Olive oil, 255 grams, 40 cents (42)	1.6	.....	10	.....	.....	95
Honey, 337 grams, 12 cents (41)	.5	.....	.....	11	.....	45
Nuts: Almonds, 1,067 grams, 36 cents (21); Brazil nuts, 146 grams, 5 cents (38); pignolias, 765 grams, 42 cents (22); pine nuts, 142 grams, 3 cents (24); walnuts, 672 grams, 20 cents (40)	4.2	18	39	8	1	475
Total vegetable food	17.2	25	57	72	27	1,040

The table shows that the food eaten during the test was even less than that consumed in the previous dietary. One reason for this was the fact that the subject was, for part of the time at least, under great mental strain and did not have her usual appetite. Even this small amount of food, however, judging by her appearance and manner, seemed sufficient for her needs, enabling her to do her customary housework and take care of her two nieces and nephew, the subjects of dietary studies Nos. 330, 331, 332, and 333.

DIETARY STUDY OF A FRUITARIAN (No. 330).

The study began July 18, 1900, and continued for 28 days. The subject was a girl 13 years old, weighing 75½ pounds.

The number of meals taken, 56, was equivalent to 1 girl for 28 days or 1 man for 20 days. The subject had lived in the conventional way until she was over 6 years of age, and since being placed upon the fruitarian diet had often expressed a desire for other foods. She was given cereals and vegetables when she craved them, but her aunt states "that she never looks or feels so well when she has much starchy food, and she always returns to her next meal of uncooked food with an increased appreciation of its superiority."

In Table 5 is given the results of this study.

TABLE 5.—*Weights and cost of food and nutrients consumed in dietary study No. 330.*

Kinds, amounts, and cost of different food materials.	Cost and composition of food per person per day.					
	Cost.	Protein.	Fat.	Sugar, starch, etc.	Crude fiber.	Fuel value.
VEGETABLE FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Cereals, prepared: 1,091 grams, 30 cents (25)	1.1	5	.....	31	.....	150
Fresh fruits: Apples, Astrachan, 6,640 grams, 45 cents (4); apricots, 8,190 grams, 72 cents (6); figs, 340 grams, 6 cents (7); olives, 130 grams, 3 cents (34); peaches, 13,137 grams, $1.16 (9); plums, Japanese, 4,059 grams, 54 cents (13); plums, red, 5,960 grams, 53 cents (15)	12.5	8	2	62	44	485
Dried fruits: Dates, 47 grams, 2 cents (19); raisins, 278 grams, 6 cents (36)	.....	.....	.....	7	.....	30
Vegetable oils: Olive oil, 305 grams, 34 cents (42)	1.2	.....	11	.....	.....	100
Honey, 25 grams, 1 cent (41)	.....	.....	.....	1	.....	5
Nuts: Almonds, 2,239 grams, 75 cents (21); Brazil nuts, 97 grams, 4 cents (38); pine nuts, 28 grams, 1 cent (24); walnuts, 1,330 grams, 37 cents (40)	4.2	13	39	10	2	465
Total vegetable food	19.0	26	52	111	46	1,235

The commonly accepted American dietary standard for a child 13 years old and of average activity calls for about 0.6 or 0.7 as much protein and energy as for a man at ordinary work (see p. 18), or not far from 90 grams of protein and 2,450 calories of energy. The food consumed per day by this child contained 26 grams protein, 52 grams fat, and 157 grams carbohydrates, together furnishing 1,235 calories,

the protein used in the dietary being less than one-third, and the fuel value only about 60 per cent of that called for. Notwithstanding the facts brought out by this comparison, the subject had all the appearances of a well-fed child in excellent health and spirits.

DIETARY STUDY OF A FRUITARIAN (No. 331).

The study began July 18, 1900, and continued for 22 days. The subject was a boy (brother of the subject of study No. 330) 9 years old, weighing 43 pounds at the beginning and 45 pounds at the end of the experiment—a gain of 2 pounds. It was not practicable to weigh the subject without clothes, but the same clothes were worn and the same scales were used for both weighings. The gain was undoubtedly due to the fact that the family had been in straitened circumstances and the subject had a more abundant diet during the study than for some time previous to it.

The number of meals eaten was 44, equivalent to 1 boy for 22 days or 1 man for 15 days. The table following gives the details of the study.

TABLE 6.—*Weights and cost of food and nutrients consumed in dietary study No. 331.*

Kinds, amounts, and cost of different food materials.	Cost and composition of food per person per day.					
	Cost.	Protein.	Fat.	Sugar, starch, etc.	Crude fiber.	Fuel value.
VEGETABLE FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Fresh fruits: Apples, Astrachan, 8,964 grams, 60 cents (4); apricots, 7,910 grams, 80 cents (6); figs, 227 grams, 4 cents (7); olives, 80 grams, 2 cents (34); peaches, 14,745 grams, $1.30 (9); pears, 2,265 grams, 20 cents (11); plums, Japanese, 357 grams, 5 cents (13); plums, red, 1,640 grams, 12 cents (15)	14.2	8	3	80	47	580
Dried fruits: Dates, 47 grams, 2 cents (19); raisins, 278 grams, 6 cents (36)	.4	1	.....	9	1	45
Vegetable oils: Olive oil, 131 grams, 13 cents (42)	.6	.....	6	.....	.....	55
Honey, 39 grams, 1 cent (41)	.....	.....	.....	2	.....	10
Nuts: Almonds, 1,325 grams, 45 cents (21); Brazil nuts, 97 grams, 3 cents (38); pignolias 369 grams, 20 cents (22); pine nuts, 567 grams, 12 cents (24); walnuts, 798 grams, 23 cents (40)	4.7	18	47	11	2	565
Total vegetable food	19.9	27	56	102	50	1,255

Although this boy was 4 years younger than his sister, the subject of the preceding dietary study, he consumed about the same amount of food per day, the diet furnishing 27 grams protein, 56 grams fat, 152 grams carbohydrates, and 1,255 calories. He therefore approached more closely to the commonly accepted standard for a boy of his age, 65 grams protein and 1,750 calories, than did his sister, although here again the difference is large.

DIETARY STUDY OF A FRUITARIAN (No. 332).

The study continued for 25 days in July and August, 1900. The subject, a sister to the subjects of dietary studies Nos. 330 and 331,

was 6 years old, weighing 30.5 pounds when the study began and 33 pounds at its conclusion. This subject had been very delicate as a baby, and her family stated that she did not begin to thrive until a decoction of dried figs was added to the milk eaten. She was given other fruit at a very early age, and as soon as she could eat nuts was confined closely to the nut and fruit diet and has never had anything else except olive oil, honey, and occasionally a small quantity of green vegetables. It was stated that she often craved lettuce. The subject was very small for her age, being about 10 pounds under what is usually considered the average weight and 7 inches less than the average height. This is presumably partly due to heredity, as her father is a small man and her mother and grandmother were much below the average height and weight.

It is interesting to note that her only gain in weight during the past year was made during this dietary study and the one immediately following (No. 333). It seems fair to assume that this can be accounted for by the fact that since the food was provided by those making the study and the child was urged to eat all she wanted of what she most preferred, she ate more than previously. Between these two studies her weight remained stationary. During this time she was limited to such fruit as came within the means of the family. For a time they could not afford the pignolias (pine kernels), of which she was very fond, and as apples became very expensive the amount purchased for her was limited.

The total number of meals taken was 50, equivalent to 1 girl for 25 days or 1 man for 13 days. The details of the study are shown in Table 7.

TABLE 7.—*Weights and cost of food and nutrients consumed in dietary study No. 332.*

Kinds, amounts, and cost of different food materials.	Cost and composition of food per person per day.					
	Cost.	Protein.	Fat.	Sugar, starch, etc.	Crude fiber.	Fuel value.
VEGETABLE FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Fresh fruits: Apples, Astrachan, 8,383 grams, 55 cents (4); apricots, 6,510 grams, 58 cents (6); figs, 2,040 grams, 35 cents (7); oranges, 1,021 grams, 12 cents (17); peaches, 7,520 grams, 66 cents (9); pears, 1,950 grams, 18 cents (11); plums, Japanese, 630 grams, 8 cents (13); plums, red, 480 grams, 5 cents (15)	10.3	7	2	66	31	445
Dried fruits: Dates, 494 grams, 17 cents (19); raisins, 60 grams, 2 cents (36)	.7	1	.....	8	4	55
Vegetable oils: Olive oil, 202 grams, 23 cents (42)	.9	.....	8	.....	.....	75
Honey, 337 grams, 12 cents (41)	.5	.....	.....	11	.....	45
Nuts: Almonds, 1,735 grams, 56 cents (21); Brazil nuts, 146 grams, 5 cents (38); pignolias, 107 grams, 6 cents (22); pine nuts, 666 grams, 13 cents (24); walnuts, 1,274 grams, 35 cents (40)	4.6	16	48	12	2	570
Total vegetable food	17.0	24	58	97	37	1,190

This child was only a little over 6 years old, and small for her age; therefore it seems fairer to compare her dietary with the standard for

2 to 6 years than with that for 6 to 9 years. The tentative standard for a child 2 to 6 years old calls for about 0.4 the protein required by a man at moderate work (see p. 18), or 50 grams protein and 1,420 calories of energy. Since the child received on an average daily 24 grams protein, 58 grams fat, and 134 grams carbohydrates, together furnishing 1,190 calories, it appears that the present dietary is deficient in protein and fuel value. The protein consumed in the present instance is less than that required according to the tentative standard (25 grams) for a child from 1 to 2 years old. At the same time the subject appeared to be perfectly well and was exceedingly active. She impressed one as being a healthy child, but looked younger than 6 years.

DIETARY STUDY OF A FRUITARIAN (No. 333).

This study, undertaken in connection with the digestion experiment reported hereafter (p. 21), began March 23, 1901, and continued 10 days. The subject was the same as in dietary study No. 332, the interval between the two studies being about eight and one-half months. The subject's seventh birthday occurred during this time. Her weight at the commencement of the study was 34 pounds and at the end 35 pounds. This increase in weight has already been referred to.

The total number of meals eaten was 20, equivalent to 1 child for 10 days or 1 man for 5 days. The details of the study are given in Table 8.

TABLE 8.—*Weights and cost of food and nutrients consumed in dietary study No. 333.*

Kinds, amounts, and cost of different food materials.	Cost and composition of food per person per day.					
	Cost.	Protein.	Fat.	Sugar, starch, etc.	Crude fiber	Fuel value.
VEGETABLE FOOD	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Fresh fruits: Apples, pippin, 4,763 grams, 60 cents (2); bananas, 1,106 grams, 15 cents (30); oranges, 8,477 grams, $1 (17)	17.5	8	1	113	5	525
Dried fruits: Dates, 31 grams, 5 cents (19)	.5	.....	.....	1	1	10
Vegetable oils: Olive oil, 92 grams, 15 cents (42)	1.5	.....	9	.....	.....	85
Honey, 15 grams, 5 cents (41)	.5	.....	.....	1	.....	5
Nuts: Almonds, 530 grams, 20 cents (21); pignolias, 652 grams, 40 cents (22); walnuts, 504 grams, 15 cents (40)	7.5	32	62	11	2	760
Total vegetable food	27.5	40	72	126	8	1,385

The average daily diet furnished 40 grams protein, 72 grams fat, and 134 grams carbohydrates, the fuel value being 1,385 calories. The results are not far from the accepted standard for a child between 2 and 6 years (50 grams protein and 1,400 calories), but much less than those for a child 6 to 9 years old (65 grams protein and 1,750 calories). More protein was consumed in this dietary than in any of the other five studied, but even this amount is only about three-fourths of the

amount commonly supposed to be needed. This child was just 7 years old, but as she was small for her age it seems fairer to compare her dietary with that of a child of 2 to 5 years than that of one 6 to 9 years old.

DISCUSSION OF FRUITARIAN DIETARIES.

The foods used in these studies were almost exclusively fruits and nuts, articles which are used in the ordinary household more as luxuries or accessories than as staple articles of diet. Honey (a food gathered from flowers and fruit) and olive oil (expressed from a fruit) were also included. The daily diet of the fruitarians, however, contained the same kind of chemical constituents as the usual mixed diet. The bulk of the protein is usually supplied by meat, fish, milk, eggs, cheese, cereals, and legumes; the fat by butter and other animal fats, olive oil, etc., and the carbohydrates by bread and other cereal foods, starch, and sugar. In the fruitarian dietaries the protein was supplied chiefly by nuts, the fat by nuts and olive oil, and the carbohydrates by the fruit and honey. The fruit also supplied a little protein and fat or ether extract.

The carbohydrates in the ordinary diet consist of starches, grape and fruit sugar (dextrose and levulose), cane sugar, and crude fiber. The foods eaten by these "fruitarians" furnished little starch, the bulk of the carbohydrates being crude fiber and the different sorts of sugar.

The nuts and dried fruits are concentrated foods; that is, they contain a fairly low percentage of water and a correspondingly high percentage of nutritive material in proportion to their bulk. Nuts, like the cereal grains and many other foods, are naturally concentrated. The dried fruits are concentrated by evaporating the water originally present in the fresh fruit. Generally speaking, the concentrated foods are cheaper sources of nutrients than the succulent foods. It should be remembered that in the ordinary diets concentrated foods are usually diluted before they are eaten. Thus, flour, which is comparatively dry, is wet with milk or water when made into bread; oatmeal, rice, etc., are cooked in water; dry beans are soaked and then cooked in various ways, or, like dry peas and other legumes, are made into soups or different dishes which contain more or less water.

The fruitarians did not cook their food, and did not dilute their concentrated foods (nuts and evaporated fruits).

The results of the dietaries are summarized in Table 9 below. For purposes of comparison they are given as determined, that is, the amount eaten per woman or per child per day, as the case may be. They are also recalculated to show the equivalent amounts per man per day. In making the calculations it was assumed that the woman

would consume seven-tenths as much as a man at moderate muscular work. The usual factor for women is 0.8. It is believed the factor used is fairer in this particular case, as the women were small of stature, weighed less than the average, and had light exercise. The usual factors have been used in calculating the results for children, namely:

1 meal of child 6 to 9 years old equivalent to 0.5 meal of man.
1 meal of child 13 years old equivalent to 0.7 meal of man.

The table also includes for purposes of comparison the results of Voit's study with a man living on bread, fruit, and oil; the average results of a number of American dietary studies, and the commonly accepted standards for a man at light and moderate muscular work and a woman at light work.

TABLE 9.—*Comparison of daily dietaries of fruitarians with commonly accepted standards.*

	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.	Nutritive ratio, 1 to—
VALUES AS DETERMINED.						
	Cents.	*Grams.*	*Grams.*	*Grams.*	*Calories.*	
Woman, 33 years old, dietary No. 328	23.7	33	59	150	1,300	8.6
Woman, 30 years old, dietary No. 329	17.2	25	57	99	1,040	9.1
Girl, 13 years old, dietary No. 330	19.0	26	52	157	1,235	10.5
Boy, 9 years old, dietary No. 331	19.9	27	56	152	1,255	10.3
Girl, 6 years old, dietary No. 332	17.0	24	58	134	1,190	11.1
Girl, 7 years old, dietary No. 333	27.5	40	72	134	1,385	7.4
VALUES CALCULATED TO BASIS OF MAN AT MODERATE MUSCULAR WORK.						
Woman, 33 years old, dietary No. 328	33.9	47	84	214	1,850	8.6
Woman, 30 years old, dietary No. 329	24.6	36	81	141	1,480	9.0
Girl, 13 years old, dietary No. 330	27.1	37	74	224	1,760	10.6
Boy, 9 years old, dietary No. 331	39.8	54	112	304	2,510	10.4
Girl, 6 years old, dietary No. 332	34.0	48	116	268	2,375	11.1
Girl, 7 years old, dietary No. 333	55.0	80	144	268	2,765	7.4
OTHER DIETARY STUDIES.						
German vegetarian *a*	.....	54	22	573	2,775	11.6
Average of 53 studies of well-to-do families in the United States	.....	103	138	436	3,500	7.3
DIETARY STANDARDS.						
Man with light muscular work (Atwater)	.....	112	.....	.....	3,150	5.8
Man with moderate muscular work (Voit)	.....	118	56	500	3,055	5.3
Man with moderate muscular work (Atwater)	.....	125	.....	.....	3,500	5.8
Woman with light muscular work (Atwater)	.....	90	.....	.....	2,250	6.1

a Voit, Ztschr. Biol., 25 (1889), p. 232.

The studies as a whole show very small amounts of protein and energy, the largest amounts—40 grams protein and 1,385 calories of energy—being found in No. 333, the dietary of a child 7 years old. When the results are expressed per man per day they are seen to be much below the figures for persons in the United States in comfortable circumstances and engaged in moderate muscular work. These latter figures are based on the results of a large number of actual studies, and it seems fair to assume that they show about what is consumed on an average. The standard above referred to for a man at light muscular work calls for 112 grams protein and 3,150 calories of energy.

The fruitarians consumed much less than this. There are, however, a number of dietary studies on record in which persons on an ordinary mixed diet have consumed as little protein and energy.

The amounts of protein and energy in the dietary of the fruitarians did not differ very materially from similar values in Voit's study of a vegetarian, though they consumed more fat and less carbohydrates. The German vegetarian studied by Voit ate bread and no nuts. Otherwise his dietary was similar to that of the fruitarians. He ate no warm cooked food. His average daily diet consisted of 131 grams pumpernickel, 438 grams graham bread, 777 grams apples, 114 grams dried figs, 247 grams dates, 66 grams oranges, 8 grams olives, and 21 grams olive oil.

It will be noted that while the nutritive ratio of the standards ranges between 5 and 6, that of the dietaries here reported varies between wide limits, with a minimum of 7.4 and a maximum of 11.1.

As may be seen by reference to the dietary tables, nearly three-fourths of the protein and fat consumed were derived from nuts, which form, however, less than 10 per cent of the total quantity of food used, and the outlay for which was only about 25 per cent of the entire cost of the food. The main bulk of the total food and of the carbohydrates was furnished by the fresh fruit, which also caused the largest item of expense.

The amount of crude fiber in the different dietaries ranged from 8 grams per day in No. 333 to 50 grams in No. 331, and was on an average 42 grams. Whether these values are higher or lower than the crude fiber content of the average American diet can not be said with certainty owing to a lack of data for comparison. In a number of foreign dietaries summarized in a previous publication of this Office[1] the crude fiber ranged from 3.9 to 17.4 grams per person per day, the larger amount being found in a diet composed of rice, barley, and vegetables. Judging by these values the amount of crude fiber in the fruitarian dietaries was large.

It is a difficult matter to draw any general conclusions from the foregoing dietaries without being unjust to the subjects.

It would appear upon examining the recorded data and comparing the results with commonly accepted standards that all the subjects were decidedly undernourished, even making allowances for their light weight. But when we consider that the two adults have lived upon this diet for 7 years, and think they are in better health and capable of more work than they ever were before, we hesitate to pronounce judgment. The three children, though below the average in height and weight, had the appearance of health and strength. They ran and jumped and played all day like ordinary healthy children, and

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 64.

were said to be unusually free from colds and other complaints common to childhood.

The youngest child and the only one who has lived as a fruitarian almost from infancy, was certainly undeveloped. Her bones were very small, although she showed no tendency toward rhachitis. She looked fully 2 years younger than she was. Still, there are so many children who are below the average in development, whose dietaries conform to the ordinary standards, that it would be unfair to draw any conclusions until many more such investigations are made. It seems quite possible, however, that her condition may have been due in part at least to her having been placed upon this diet at so early an age.

So far as can be learned the claim for the superiority of raw food is a matter of opinion or conjecture, as there are few if any trustworthy experiments on the subject. There is one benefit from cooking which should not be overlooked, namely, the destruction of harmful bacteria and parasites if they are present. Both animal and vegetable foods, if not handled and stored under sanitary conditions, may become contaminated and communicate disease to man.

The cost per day as seen in Table 9 varies from 17 cents in dietary No. 332 to 27.5 cents in No. 333, the average as determined being 20.7 cents per person per day. The values as given per woman or per child per day do not seem high; but when the results are recalculated to the basis per man per day the cost varies from 24.6 to 55 cents, averaging 35.7 cents. The results of a large number of dietary studies made in the United States show that the cost was on an average not far from 25 cents per man per day. In many cases it was lower and in many others higher. As compared with this amount the average cost of the fruitarian dietaries per man per day is seen to be quite high. Furthermore, it must not be forgotten that most of the investigations were made in the late summer, when fruit was cheap. In the spring prices are higher, and consequently the outlay is correspondingly greater, as shown in dietary No. 333, which was made at this season. It is claimed by those who live on a fruit and nut diet that the average daily outlay throughout the year is about 25 cents, which corresponds quite closely with the cost per man per day of the average conventional diet as given above. It will be remembered that the fruit, nuts, etc., were eaten raw and that therefore there was no expense for fuel, etc., for cooking, which is an important item in the cost of the ordinary diet. Some years ago Rutgers[1] compared a vegetarian and a mixed dietary. The vegetarian diet was not limited to fruits and nuts, but was made up of beans, peas, bread, etc.; some butter was also eaten. The chief difference this author noted was in

[1] Ztschr. Biol., 25 (1888), p. 379; see also abstract in U. S. Dept. Agr., Office of Experiment Stations Bul. 45.

the cost of the two diets, the vegetarian being a little cheaper, as less fuel was required to prepare it.

Waste.—A very interesting point brought to light by these studies is that there was practically no waste. When first-quality food is purchased, the refuse only has to be taken into account; although in the case of poor fruit there is always some paid for which can not be eaten, and must be regarded as waste.

DIGESTION EXPERIMENT WITH A GIRL.

The objects and value of digestion experiments have been explained in a previous bulletin[1] of the Department of Agriculture and need not be discussed in this report. While there have been some digestion experiments,[2] and determinations of the income and outgo of nitrogen, conducted with vegetarians or with those consuming vegetable foods for experimental purposes, very few data are at hand regarding the digestibility of fruits. The experiment here reported shows the digestibility of the fruit and nut diet eaten by the child in dietary No. 333. The experiment began March 23, 1901, and continued for 10 days. The average daily food consisted, as previously stated, of 476 grams apples, 111 grams bananas, 848 grams oranges, 3 grams dates, 1.5 grams honey, 9 grams olive oil, 53 grams almonds, 65 grams pignolias, and 50 grams walnuts.

Lampblack was taken by the subject in gelatin capsules in order to facilitate the separation of the feces due to the foods experimented with. The line of demarcation between the portions of the feces colored by the lampblack and that not so colored was not as sharp as could be desired, but sufficiently so to enable the separation to be quite accurately made. The feces were passed about noon every day.

The total weight of the feces excreted during the period of 10 days was 1,370 grams, or 260 grams water-free. The feces were collected and were analyzed separately, the usual methods being followed. On an average the fresh feces contained 5.1 per cent protein, 6.9 per cent fat, 3.6 per cent sugar, starches, etc. (nitrogen-free extract), 1.2 per cent crude fiber, and 2.6 per cent ash, the fuel value being 1.1 calories per gram.

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

[2] U. S. Dept. Agr., Office of Experiment Stations Buls. 21, p. 53, and 45, p. 21.

Table 10 shows the total nutrients consumed, the amounts of each excreted in the feces, and the amounts and percentages of the different nutrients digested:

TABLE 10.—*Result of digestion experiment (No. 241) with child on fruit and nut diet—quantities for entire period, 10 days.*

	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.	Heat of combustion.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Food eaten	400	720	1,261	80	67	14,840
Feces	70	95	50	16	31	*a* 1,973
Digested	330	631	1,211	64	36	12,867
Coefficient of digestibility (per cent)	82.5	86.9	96.0	80.0	53.7	86.7

a Including 1,560 calories from the feces and 413 from the unoxidized organic matter of the urine.

Generally speaking, the food was quite thoroughly assimilated, the coefficients of digestibility being about the same as are found in an ordinary mixed diet. It is interesting to note that according to the methods followed 80 per cent of the crude fiber appeared to be digested. In a previous publication of this Office[1] the results of a number of foreign experiments on the digestibility of crude fiber by man are summarized. The coefficient of digestibility ranged from 30 to 91.4 per cent, the former value being found in a diet consisting of bread made from mixed wheat and rye, and the latter in a diet made of rice, vegetables, and meat. The digestibility of the protein was rather less than has been found in the ordinary mixed diet, owing to the presence in the latter of considerable animal food. Many experiments have shown that on an average the protein of animal food is more readily digestible than that of vegetable food.

METABOLIC NITROGEN.

In determining the digestibility of protein the usual method was followed—that is, the amount digested was assumed to be the difference between the amount taken into the body in the food and the amount excreted in the feces. In addition, however, the nitrogen was determined after extracting the so-called metabolic products in the feces by treatment with ether, alcohol, hot water, and cold limewater, according to the method described by Woods and Merrill in a previous publication of this Office.[2]

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 64.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 85, p. 35.

The total nitrogen in the untreated feces, in the treated feces, and the metabolic nitrogen in the foregoing experiment is shown in Table 11:

TABLE 11.—*Total nitrogen in feces and nitrogen corrected for metabolic products.*

Day.	Feces.	Nitrogen in untreated feces.	Nitrogen in treated feces.	Metabolic nitrogen.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*
First day	82	1.0	0.6	0.4
Second day	256	.6	.3	.3
Third day	208	.7	.4	.3
Fourth day	44	1.9	1.2	.7
Fifth day	242	.9	.5	.4
Sixth day	129	.6	.4	.2
Seventh day	92	1.1	.6	.5
Eighth day	118	.8	.4	.4
Ninth day	111	.9	.5	.4
Tenth day	88	.7	.4	.3
Total	1,370	9.2	5.3	3.9
Average	137	.9	.5	.4

It has been pointed out that the feces are not made up entirely of undigested residue of food, but contain quite large amounts of other waste materials, usually designated by English writers as metabolic products. This term as ordinarily used includes not only the metabolic products, strictly speaking—such as the residues from the bile, mucus, saliva, gastric juices, pancreatic juices, and other digestive secretions—but also worn-out particles from the mucous membrane lining the intestines, and other débris from the walls of the stomach, etc. The results of recent investigations indicate that the digestion of food materials is more complete and the proportion of metabolic products in the feces is larger than was formerly supposed.

The average amount of metabolic nitrogen—that is, nitrogen removed by the solvents used—in the daily feces in the above experiment was 42 per cent. The amount of undissolved nitrogen—that is, the nitrogen which was derived from undigested residues of the food eaten—was not far from one-half of the total shown in the untreated feces. In their experiments with a man on a bread diet Woods and Merrill[1] found that on an average 68 per cent of the total nitrogen of the feces was undissolved by similar treatment, thus suggesting that about one-third of the nitrogen in the feces was from metabolic products and two-thirds from undigested food. By use of different methods these latter investigators got other results indicating much larger proportions of metabolic nitrogen. These determinations, therefore, can not be used as a basis of any definite conclusions.

BALANCE OF INCOME AND OUTGO OF NITROGEN.

In connection with the digestion experiment reported above the urine was collected and its nitrogen content determined. The aver-

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 85.

age amount of nitrogen consumed per day, less that excreted in the urine and feces, showed whether the subject was gaining or losing nitrogen on the fruit and nut diet followed. The total urine amounted to 6,940 grams, containing 29.62 grams nitrogen. On an average the daily food contained 6.4 grams nitrogen, the urine 3 grams, and the feces 1.2 grams. There was, therefore, an average daily gain of 2.2 grams nitrogen, equivalent to 13.7 grams protein.

The subject gained nitrogen, although on a diet containing much less nitrogen than the tentative standard demands. No extended comments can be made on these results, because as before stated there are few if any similar investigations at hand for comparison. Further investigations along this line are needed.

DIETARY STUDIES OF CHINESE.

INTRODUCTION.

We often hear those who recommend a vegetarian diet say, "See how much hard work the Chinamen can do, and they live almost entirely upon rice," and many believe that the Chinese to a great extent are vegetarians. We have, all of us, probably, idly wondered if this were true, but have not had sufficient knowledge to justify us in assenting to or contradicting the assertion.

So far as can be learned, no dietary studies of Chinese have been reported. A number of such investigations have been made, however, with Japanese, Javanese, and Malays.[1] Considerable data are also on record regarding the food consumption of different classes in India.[2] It is generally conceded that the dietary habits of the Chinese resemble those of the Japanese, and the same holds good to a considerable extent for all the other Oriental races. The available data show that rice is a very important article of diet in the East, taking the place which bread and similar cereal foods occupy in the diet of Western races. However, it appears that many foods besides rice are eaten. Thus, in Japan meat and especially fish are consumed by those who have the opportunity and means to procure them, while fresh, dried, and salted vegetables, etc., bean cheese, and other foods comparatively rich in protein which are made from soy beans[3] are eaten in large quantities by all classes.

How far the Chinese dietary actually differs from the Japanese, and the Chinese dietary in America from that in China, it is not possible to say. It is generally true that diet is modified by environment, and it seems probable that although they are conservative in such matters, the Chinese in the United States have, to some extent at least, adopted American food habits. But that the bulk of their food is Chinese is

[1] For summaries of this work see U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 180, and Bul. 45, pp. 59–61.

[2] Food Grains of India. Church. London, 1886.

[3] The manufacture of bean cheese and similar foods is described in U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 193; Bul. 68, p. 35; Farmers' Bul. 58, p. 20; and in Sanitary Home, 2 (1900), p. 55.

shown by a visit to the Chinese markets in any American city where there is a considerable colony of them.

Whatever the diet of the Chinese in America, the presumption is that it must be suited to their needs and must supply the energy necessary for a large amount of physical work. No Californian can doubt that the Chinaman is capable of great physical exertion, for it has been clearly demonstrated.

While it is generally conceded that a strong white man accustomed to the same kind of work can do 20 per cent more work than a Chinaman where the conditions are favorable, it has been found that under adverse circumstances, such as long hours, great heat, or exposure to cold and dampness, a Chinaman can not only do more work, but can stand the strain better. In California it appears that he can be depended upon to work through the season, while the white man is often obliged to rest at the most important time.

As regards their work in the cities, we are all familiar with the sight of the Chinese fruit and vegetable peddler with his baskets suspended by ropes to the pole that he carries across one shoulder. Few Americans could walk as he does for hours at a stretch, often up and down hill, burdened with a load of from 300 to 400 pounds in the baskets. It must not be supposed that the ability to perform the task is due entirely to physical strength; much is owing to training, probably also to inheritance, since for ages the muscles employed have been developed by this kind of work. But at all events there is a great amount of energy required, and it must necessarily, like all energy for the work done by the body, come from the food eaten. And what is that food? Is it, as so many affirm, almost entirely rice? It was to answer such questions that the present investigation was undertaken.

In choosing subjects for the dietary studies reported herewith it was thought best to select men engaged in different kinds of work, so that comparisons with the commonly accepted dietary standards for Caucasians performing different amounts of work could be made. The studies were made with (1) the family of a Chinese dentist, (2) employees in a Chinese laundry, and (3) the laborers on a truck farm, styled in California a vegetable garden. The first represents a professional man, with little muscular work; the second, men at moderate indoor work; and the third, men at severe outdoor work.

COMPOSITION OF FOOD MATERIALS.

In connection with the dietary studies a number of analyses of food materials were made, the analytical methods adopted by the Association of Official Agricultural Chemists being followed.[1] A number of foods were not analyzed, as it was believed their composition could be accurately calculated from former analyses.

[1] U. S. Dept. Agr., Division of Chemistry Bul. 46, revised.

The Chinese in general buy meat in small quantities and endeavor to procure a maximum of edible portion and a minimum of refuse. The beef used in these studies was from the round, and very lean. No bone was included and there was no refuse. The other cuts of meat and the poultry were the usual articles, as were also some of the fish and shellfish. Others (dried shrimp, dried abalone, and dried squid) were Chinese foods. The dairy products, the eggs, bread, rice, cake, vermicelli, oatmeal, bananas, sugar, and many of the vegetables were the usual foods familiar to all. Vermicelli and similiar pastes are ordinarily regarded as typical Italian foods, but it is stated on apparently good authority that a similar product has long been known in the East.[1]

The bean cheese, fresh and dried, the bean sprouts, salted radish, bamboo shoots, algæ, dried fungus, dried lily flowers, and many of the green vegetables were articles which as food materials are known to few, if any, American families. These peculiar vegetable foods have been described in a previous publication of this Office.[2]

In Table 1 is shown the composition of such articles as contained refuse, and in Table 2 the composition of all the materials analyzed which contained no refuse, while Table 3 shows the composition of the articles not analyzed, but whose composition was quoted from previous publications. The figures in the column headed "reference number" refer to corresponding numbers in parentheses after the different items in Tables 4, 5, and 6 and serve to indicate the values used for the percentage composition of the various foods in computing the results of the studies.

TABLE 1.—*Composition "as purchased" of such food materials as contain inedible matter—composition determined.*

Food materials.	Reference No.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.								
Pork:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Fresh	1	12.5	39.5	12.2	35.0	.....	0.8	1,705
Pigs' feet	2	40.0	33.2	10.5	15.8	.....	.5	860
Poultry: Chicken	3	25.0	55.2	17.1	1.9	.....	.8	400
Fish:								
Smelt	4	33.0	50.8	13.4	1.9	.....	.9	330
Salt fish	5	20.0	40.5	25.1	3.1	.....	11.3	600
Shrimp, fresh, cooked	6	62.5	25.9	9.4	.6	0.1	1.5	200
VEGETABLE FOOD.								
Vegetables:								
Potatoes, white	7	15.0	67.1	1.8	.1	15.2	.8	320
White radish	8	8.0	84.6	1.1	.3	5.6	.4	140

[1] A considerable number of samples of Japanese macaroni, vermicelli, and similar products were collected at the World's Fair in Chicago in 1893, and analyzed by Prof. W. O. Atwater and associates, but the results have not been published in detail.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 68.

TABLE 2.—*Composition of edible portion of food materials—composition determined.*

Food materials.	Reference No.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.							
Beef:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Round	9	66.6	24.5	7.9	.....	1.0	790
Do	10	68.5	25.0	5.5	.....	1.0	695
Do	11	69.5	20.5	9.1	.....	.9	765
Pork:							
Fresh pork	12	42.3	15.4	41.6	.....	.7	2,040
Do	13	45.1	14.0	40.0	.....	.9	1,950
Pigs' feet	14	55.4	17.5	26.3	.....	.8	1,435
Lard	15	4.9	1.1	94.0	.....	.....	3,985
Sausage	16	13.6	22.4	55.7	4.2	4.1	2,845
Poultry: Chicken	17	73.6	22.8	2.5	.....	1.1	530
Fish:							
Smelt	18	76.0	20.0	2.6	.....	1.4	480
Squid, dried	19	24.4	63.3	5.4	.....	6.9	1,405
Salt fish	20	50.6	31.4	3.9	.....	14.1	750
Shrimp, cooked	21	69.0	25.0	1.7	.3	*a* 4.0	540
Shrimp, dried	22	21.7	63.1	4.3	.8	10.1	1,370
Abalone, dried	23	10.4	39.9	3.5	40.1	6.1	1,635
Dairy products: Milk	24	87.5	3.3	3.5	5.0	.7	300
VEGETABLE FOOD.							
Cereals:							
Bread	25	32.0	7.7	1.6	58.0	.7	1,290
Do	26	32.7	7.0	1.5	58.0	.8	1,270
Vegetables:							
Bean cheese	27	34.9	35.4	18.8	.4	10.5	1,460
Dried bean cheese	28	3.3	50.8	29.5	13.7	2.7	2,445
Potatoes, white	29	78.9	2.1	.1	17.9	1.0	375
Cabbage, Chinese	30	95.7	1.2	.2	2.4	.5	75
White radish	31	92.0	1.2	.3	6.1	.4	150
White radish, dried	32	5.0	14.2	4.3	72.1	4.4	1,785
Bean sprouts	33	92.0	2.8	.6	4.1	.5	155
Purslane (tong ho)	34	90.4	1.8	1.1	4.7	2.0	165
Arrowroot	35	85.2	1.4	.1	7.8	5.5	175
Taro root	36	75.0	2.1	.3	21.3	1.3	450
Green mustard plant	37	90.0	2.7	.9	4.9	1.5	180
Dried mustard plant	38	20.0	13.0	4.1	53.6	9.3	1,410
Preserved mustard plant	39	80.0	3.3	2.2	8.1	6.4	305
Bamboo shoots	40	90.0	3.2	.2	6.2	.4	185
Vegetable oils: Peanut oil	41	.....	.....	100.0	.....	.....	4,220

a Containing 2.5 per cent salt.

A number of the foods were not analyzed. Their composition was calculated from analyses previously reported. The data used for the computations are shown in the following table:

TABLE 3.—*Composition of edible portion of food materials—composition assumed.*

Food materials.	Reference No.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.								
Fish:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Carp	42	.....	76.9	20.5	1.1	.....	1.5	430
Carp, as purchased	43	37.1	48.4	12.9	.7	.....	.9	270
Perch	44	.....	75.7	19.2	4.0	.....	1.1	525
Perch, as purchased	45	62.5	28.4	7.2	1.5	.....	.4	195
Shad	46	.....	70.6	18.4	9.6	.....	1.4	745
Shad, as purchased	47	43.9	39.6	10.3	5.4	.....	.8	420
Crabs	48	.....	77.1	16.6	2.0	1.2	3.1	415
Crabs, as purchased	49	52.0	37.0	7.9	1.0	.6	1.5	200
Eggs	50	.....	73.5	13.4	12.3	.....	.8	770
Eggs, as purchased	51	10.8	65.6	11.9	11.0	.....	.7	685
Dairy products: Butter	52	.....	11.0	1.2	84.6	.....	3.2	3,590
VEGETABLE FOOD.								
Cereals:								
Rice	53	.....	12.3	9.0	.4	78.0	.3	1,035
Flour	54	.....	13.8	7.9	1.4	76.4	.5	1,625
Oatmeal	55	.....	10.4	13.7	6.7	67.6	1.6	1,270
Vermicelli	56	.....	11.0	10.9	2.0	72.0	4.1	1,625
Cake, sponge	57	.....	15.3	6.3	10.7	65.9	1.8	1,795
Sugars, etc.: Sugar	58	.....	.....	.....	.....	100.0	.....	1,860

TABLE 3.—*Composition of edible portion of food materials, etc.*—Continued.

Food materials.	Reference No.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
VEGETABLE FOOD—continued.								
Vegetables:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Cabbage, American	59	.....	91.4	1.7	0.3	5.6	1.0	150
Cabbage, American, as purchased	60	15.0	77.7	1.4	.2	4.8	.9	125
Lettuce	61	.....	94.7	1.2	.3	2.9	.9	90
Lettuce, as purchased	62	15.0	80.5	1.0	.2	2.5	.8	75
Onions	63	.....	87.7	1.6	.3	9.9	.5	225
Onions, as purchased	64	10.0	78.9	1.4	.3	8.9	.5	205
Do	65	51.0	42.6	.5	.1	5.5	.3	115
Peas, green, as purchased	66	45.0	40.8	3.6	.2	9.8	.6	255
Spinach	67	.....	92.3	2.1	.3	3.2	2.1	110
Arrowhead tuber, *Sagittaria latifolia* (t'sz ku)	68	.....	66.9	4.4	.8	25.9	2.0	595
Dried lily flowers, *Hemerocallis fulva* (kam cham t'soi)	69	.....	15.7	10.1	3.4	67.2	3.6	1,580
Dried fungus, *Peziza auricula* (mo eh)	70	.....	10.4	4.2	1.4	81.9	2.1	1,660
Water-lily root	71	.....	84.3	1.6	.2	13.1	.8	280
Yam-bean root (fan ko)	72	.....	82.3	1.1	.3	14.5	1.8	305
Algæ	73	.....	10.6	20.9	1.2	59.8	7.5	1,550
Leprosy gourd, *Memordica charantia* (fu kwa)	74	.....	93.6	1.2	.2	4.7	.3	120
Water chestnut	75	.....	77.6	1.4	.4	19.4	1.2	405
Fruits:								
Bananas	76	.....	81.6	1.5	.5	15.8	.6	345
Bananas, as purchased	77	31.0	56.3	1.0	.4	10.9	.4	240

DIETARY STUDY OF A DENTIST'S FAMILY (No. 325).

The dentist's family lived in comfortable circumstances near the business center of Chinatown, San Francisco, and is believed to be fairly typical of the families of Chinese professional men of the region. Besides the dentist and his wife there were a number of boarders, men and boys, who were students. None of these persons were engaged in active muscular work. It is believed that the family may be fairly compared with that of the average American professional man. The dietary study began February 21, 1899, and continued 14 days. The members of the family included in the study were the husband, 39 years of age, weighing 116 pounds; the wife, 33 years of age, weighing 105 pounds; a cook (male), 28 years old, weighing 134 pounds; 2 adult boarders, students, 30 and 20 years old, and weighing 140 and 110 pounds, respectively; 4 boys, boarders, also students, 3 of them 16 years old and one 15, weighing, respectively, 95, 96, 84, and 84 pounds. All these persons were natives of China. The family was in good health. There were guests (men) for 5 meals. The men and boys of the family were absent from a number of meals.

The number of meals taken was as follows:

	Meals.
Five men	205
One woman (42 meals × 0.8 meal of man)	34
Four boys (152 meals × 0.8 meal of man)	122
Five visitors, men	5
Total number of meals	366

Equivalent to 1 man for 122 days.

In the following tables are recorded the kinds and amounts of the different foods purchased, wasted, and eaten, together with their composition and cost.

TABLE 4.—*Weights and cost of food and nutrients consumed in dietary study No. 325.*

Kinds, amounts, and cost of foods consumed.[1]	Cost and composition of food per man per day.				
	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.					
	Cents.	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Round, 4,045 grams, 89 cents (9)	0.7	8	3	.....	60
Pork: Fresh pork, 14,264 grams, $3.10 (12); sausage, 454 grams, 30 cents (16); pigs' feet, 2,497 grams, 25 cents (2); lard, 2,860 grams, 40 cents (15)	3.3	21	76	.....	795
Poultry: Chicken, 6,681 grams, $2.10 (3)	1.7	9	1	.....	45
Fish: Smelt, 6,363 grams, $1 (4); salt fish, 1,589 grams, 45 cents (5); dried squid, 681 grams, 70 cents (19); crabs, 2,043 grams, 15 cents (49); shrimp, 499 grams, 10 cents (6); dried shrimp, 499 grams, 20 cents (22)	2.1	18	2	.....	95
Eggs, 2,361 grams, 65 cents (51)	.5	2	2	.....	25
Butter, 681 grams, 35 cents (52)	.3	.....	5	.....	45
Milk, 17,706 grams, $1.80 (24)	1.6	5	5	7	95
Total animal food	10.2	63	94	7	1,160
VEGETABLE FOOD.					
Cereals: Oatmeal, 2,724 grams, 20 cents (55); rice, 29,510 grams, $3.25 (53); flour, 1,135 grams, 10 cents (54); bread, 4,313 grams, 45 cents (25); sponge cake, 1,135 grams, 25 cents (57); vermicelli, 272 grams, 5 cents (56)	3.5	29	4	239	1,135
Sugars, etc.: Sugar, 3,519 grams, 45 cents (58)	.4	.....	.....	29	120
Vegetables; Bean cheese, 5,676 grams, 30 cents (27); dried bean cheese, 817 grams, 20 cents (28); bean sprouts, 1,634 grams, 15 cents (33); lettuce, 681 grams, 5 cents (62); onions, 150 grams, 2 cents (64); potatoes, 4,313 grams, 12 cents (7); spinach, 1,362 grams, 10 cents (67); white radishes, 4,540 grams, 25 cents (8); dried radish, 136 grams, 3 cents (32); green mustard plant, 6,356 grams, 25 cents (37); preserved mustard plant, 454 grams, 5 cents (39); taro root, 908 grams, 5 cents (36); purslane, 2,406 grams, 15 cents (34); dried fungus, 408 grams, 15 cents (70); dried lily flowers, 499 grams, 20 cents (69); algæ, 136 grams, 5 cents (73); leprosy gourd, 1,135 grams, 20 cents (74); bamboo shoots, 1,407 grams, 25 cents (40); arrowroot, 1,679 grams, 20 cents (35)	2.3	25	12	24	310
Vegetable oils: Peanut oil, 408 grams, 10 cents (41)	.1	.....	3	.....	30
Fruits: Bananas, 1,362 grams, 25 cents (77)	.2	.....	.....	1	5
Total vegetable food	6.5	54	19	293	1,600
Total food purchased	16.7	117	113	300	2,760
WASTE.					
Animal	.1	1	.....	.....	5
Vegetable	.2	1	.....	11	50
Total food wasted	.3	2	.....	11	55
Total food eaten	16.4	115	113	289	2,705

[1] The numbers in parentheses after each food material in this and Tables 5 and 6 refer to corresponding numbers in the second column of Tables 1–3, pp. 27–29.

It will be seen that while this family consumed a large number of foods which are familiar and found on the tables of most American families, there were many which are practically unknown to the average housekeeper. The familiar foods include, among other things, meat, poultry, fish, dairy products, eggs, rice, flour, bread, cake, potatoes, lettuce, spinach, radishes, and bananas. Of the unfamiliar articles, dried crabs and dried shrimp are noticeable among animal

foods, and arrowroot, taro root, dried radishes, bean sprouts, bean cheese, dried fungus, lily petals, algæ, and bamboo shoots among vegetable foods. Purslane has been long used as a pot herb in this country, though its use is by no means common. It is much used by the Chinese. Another vegetable used in this dietary, which, though eaten by others than the Chinese, is not generally known in the United States, is the leprosy gourd (*Momordica charantia*). This is largely used throughout the Tropics as a condiment in the preparation of curries, etc. The Chinese use it as a salad and in other ways.

Both tea and coffee were used as beverages. During the study some condiments (salt, etc.) were used, but the total expenditure for such things was small. The foods were cooked and served in ways different from those familiar to American families. The diet as a whole was reasonably varied, and was relished by the family.

DISCUSSION OF RESULTS.

When the amounts of different foods are considered it appears that the main meat supply was pork, which yielded about one-third of the animal protein. Fish ranks second, furnishing between one-third and one-fourth of this nutrient, or 15 per cent of the total. Chicken and beef rate, respectively, third and fourth as regards the animal protein content of the dietary.

The main vegetable food was rice, although less was consumed per man in this dietary than in either of the other two studied. Considerable bread and other cereal food products besides rice were used, as well as large quantities of cheap green vegetables. In fact, the latter amounted to nearly one-half the total vegetable food materials. The greater part of the vegetables were Chinese varieties.

A total of $7.87 represents the amount spent for vegetable food materials. With the exception of rice there was no one article of vegetable food whose cost exceeded 45 cents, the majority ranging below 25 cents.

The two large items of expense were $3.10 for pork and $3.21 for rice, the outlay for each being almost identical. More was paid for poultry ($2.10) than for beef, for which but 89 cents was spent during the two weeks. The amount expended for fish was $2.60. The average price per pound paid for meat was 10 cents. The cost of the animal food was $12.44, or over 60 per cent of the total expenditure.

The amounts of nutrients actually consumed per man per day by this Chinese family agree very closely with the tentative standard for a man with light muscular work, viz, 112 grams protein and 3,150 calories of energy, while the average of fourteen dietary studies of families of professional men in the United States shows less protein (103 grams), but a higher fuel value (3,465 calories). This fact is of more than passing interest, and would seem to warrant further investigation along this line in order to see whether the Chinese in comfortable

circumstances (professional men and the like) generally select a diet which conforms to the commonly accepted standards or whether this is merely an exceptional case.

The waste in this dietary was very small, and compares favorably with that found in the average American family studied.

It is interesting to note that while the dietary is well balanced and up to the standard, the cost per man per day, including beverages and condiments, was 17.3 cents, which is about 50 per cent of the sum which has been found in the average of the dietary studies of professional men in the United States. There was a daily expenditure of 0.5 cent per man for beverages. The value of the food wasted was about 0.3 cent. The cost of the food actually eaten was 16.4 cents.

While the expenditure per man per day was small in this Chinese family, it is possible for an American family in similar circumstances to live comfortably on about the same sum, as is shown by the results obtained in a dietary study made with a teacher's family in Indiana.[1] This family had a reasonably varied and attractive diet at a cost of 18 cents per man per day.

DIETARY STUDY OF A CHINESE LAUNDRY ASSOCIATION (No. 326)

The laundry employees whose dietary was studied are believed to represent, as regards food habits, a large class of Chinese laborers. The laundry selected is typical of its kind in California. The business is generally conducted in wooden buildings of one story, containing only a small number of rooms. The main room serves as ironing room, dining room, and, in many cases, more particularly in San Francisco, also as sleeping apartment for the employees, bunks being constructed immediately below each ironing table. In inclement weather the clothes are also dried in the room on wires suspended near the ceiling. The men employed at these laundries begin work early in the morning, and, when necessary, continue until late at night. Previous to the passage of the State law regulating the hours of labor, etc., it was not at all uncommon for the Chinamen to keep at their ironing tables until 1 and 2 a. m., and on Saturday nights, if many clothes remained unironed, work was continued until daylight on Sunday. The work performed by the men studied was regarded as moderately severe.

The pay varies according to ability and experience. The highest wages, $7 to $8 per week, are paid to those who are expert at ironing shirts; also to the chief washer. Other employees receive from $4 to $6 per week. These figures include board and lodging. Before a man can become a journeyman he must have served an apprenticeship of at least three months, during which time he must perform any sort of labor requested of him connected with the business. Usually the

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 32.

cook of the establishment belongs to this class, although quite often the principal cook is a man who is out of work and cooks and does odd jobs for his board and lodging until such time as he secures a permanent position, when his place is taken by an apprentice or some unfortunate looking for a temporary home.

The dietary study made with the laundry employees commenced April 3, 1899, and continued 14 days.

The group consisted of 10 men (Chinese), from 25 to 42 years of age, weighing from 125 to 148 pounds. During the study the men missed a total of 10 meals.

The number of meals taken was 418, equivalent to 1 man for 139 days.

In the following tables are shown the amount and composition of the food purchased, wasted, and eaten, together with its cost.

TABLE 5.—*Weights and cost of food and nutrients consumed in dietary study No. 326.*

Kinds, amounts, and cost of foods consumed.	Cost and composition of food per man per day.				
	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Round, 21,338 grams, $4.70 (11)	3.4	31	14	.....	255
Pork: Fresh, 19,749 grams, $4.35 (1)	3.1	17	50	.....	535
Poultry: Chickens, 3,632 grams, $1.20 (3)	.9	5	.....	.....	20
Fish: Perch, 6,810 grams, $1.50 (45); salt fish, 1,135 grams, 25 cents (5); fresh shrimp, 114 grams, 3 cents (6); dried shrimp, 681 grams, 25 cents (22); dried squid, 908 grams, 40 cents (19); abalone, 454 grams, 40 cents (23)	2.0	14	2	1	80
Eggs, 454 grams, 15 cents (51)	.1	1	.....	.....	5
Butter, 454 grams, 25 cents (52)	.2	.....	3	.....	30
Milk, 4,994 grams, 50 cents (24)	.4	1	1	2	20
Total animal food	10.1	69	70	3	945
VEGETABLE FOOD.					
Cereals: Rice, 73,982 grams, $8.15 (53); bread, 16,344 grams, $1.80 (26); vermicelli, 908 grams, 10 cents (56)	7.1	57	4	488	2,270
Sugar, etc.: Sugar, 5,448 grams, 60 cents (58)	.5	.....	.....	39	160
Vegetables: Bean cheese, 1,135 grams, 10 cents (27); dried bean cheese, 227 grams, 5 cents (28); bean sprouts, 4,086 grams, 25 cents (33); onions, 681 grams, 7 cents (65); green peas, 1,362 grams, 6 cents (66); white radish, 1,362 grams, 6 cents (8); dried radish, 908 grams, 10 cents (32); green mustard plant, 7,037 grams, 40 cents (37); dried mustard plant, 908 grams, 20 cents (38); preserved mustard plant, 4,540 grams, 25 cents (39); taro root, 10,669 grams, $1.17 (36); dried fungus 681 grams, 35 cents (70); dried lily flowers, 908 grams, 20 cents (69); algae, 227 grams, 5 cents (73); arrowhead tuber, 5,675 grams, $1.05 (68); water-lily root, 908 grams, 20 cents (71); Chinese cabbage, 13,847 grams, 78 cents (30); yam-bean root, 3,178 grams, 40 cents (72); water chestnut, 681 grams, 6 cents (75)	4.2	15	5	61	360
Total vegetable food	11.8	72	9	588	2,790
Total food purchased	21.9	141	79	591	3,735
WASTE.					
Animal	.2	2	2	.....	25
Vegetable	.7	4	1	25	130
Total food wasted	.9	6	3	25	155
Total food eaten	21.0	135	76	566	3,580

DISCUSSION OF RESULTS.

This dietary is not so varied as that of the dentist's family. Thirty-five food materials were used, one-third being animal foods and two-thirds vegetable foods. As before, a number of common foods—beef, pork, dairy products, rice, bread, sugar, vegetables, etc.—were eaten, and many foods which were typically Chinese. These included among others dried shrimp, dried squid, water-lily root, bean cheese, algæ, preserved green mustard tops, etc. As regards amounts, fully 25 per cent of the total food consisted of meat and fish, of which about 10 per cent was round of beef, supplying over 22 per cent of the total protein and not far from 50 per cent of the total animal protein. Pork, in this instance, though approaching quite close to beef in total amount, furnishes only about one-half as much protein. Owing to the large amount of pork eaten, 88 per cent of the total food fat was animal fat. Some 20 per cent of the animal protein was obtained from fish. The total protein in the dietary is almost evenly divided between animal and vegetable foods, there being 49.1 per cent of the former and 50.9 per cent of the latter. Of the vegetable protein about two-thirds was supplied by rice. In other words, one-third of the entire protein of the dietary was derived from this important food material, which also forms about the same proportion of the total food. In this dietary bread was served each day at the noon meal, thus decreasing the amount of rice consumed. Between 5 and 6 per cent of the vegetable protein was supplied by soy-bean cheese, an article of food quite common among the Chinese.

Green vegetables were largely used, and with two or three exceptions they were Chinese varieties.

The standard to which we would naturally refer this study is that of a man at moderate work, namely, 125 grams protein and 3,500 calories. The food actually eaten per man per day in the study furnished 134 grams protein and 3,585 calories, amounts which agree quite closely with the commonly accepted American standard for a man at moderately severe work.

Cost.—The outlay for rice, $8.15, in this dietary was not far from twice that for any other single item. The cost of beef and pork together, $9.05, exceeds that of rice by about 11 per cent.

That the Chinese in this instance appreciated the importance of animal foods is evinced by the fact that 46 per cent, or nearly one-half, of the total sum expended ($30.43) was paid for this kind of nourishment. The average cost of a pound of meat in this and the other dietaries reported was 10 cents.

Referring to the expenditure for food per man per day it will be seen that the total cost was, including beverages, 23.2 cents, and the cost of food actually eaten 21 cents, which is 1.3 cents more than noted

DINNER AT CHINESE TRUCK FARM, CALIFORNIA.

for dietary No. 327 and 4.6 cents in excess of the corresponding cost in dietary No. 325. The cost of wastes is slightly less in this case than in dietary No. 327. (See p. 37.)

DIETARY STUDY OF EMPLOYEES ON A CHINESE TRUCK FARM (No. 327).

The truck farm, called locally a "vegetable garden," where the dietary study was made, is situated in Berkeley, Cal., and is similar to hundreds of others in the State conducted entirely by Chinese. In some cases only one crop is grown, but generally all kinds of vegetables are raised, and sometimes small fruits in addition. The size of these farms, which are usually leased, varies from a small patch to hundreds of acres, and the fields, almost without exception, are maintained in a very high state of cultivation.

The farm in question contains 45 acres, for which a yearly rental of $685 was paid. It was very intelligently managed. The number of employees depends upon the season, varying from 12 to 18. The men commenced work about 6 a. m. and continued, with an interval of one hour for dinner, until 7 p. m. The men studied performed severe outdoor work. No distinction was made in wages, each man receiving $1.10 per day. The proprietor of the truck farm boarded the laborers at the rate of $1.10 per week, which was less than the actual cost of the food eaten. When asked the reason, he stated that if he charged more for food the men would demand higher wages. The house, or more properly shanty, where the men live is typical of those found on similar farms throughout the State. The barn and dwelling house are under the same roof, being separated only by a board partition. Some of the products of the garden were sold to the residents of Berkeley and the remainder shipped to the San Francisco market.

This dietary study commenced February 24, 1899, and continued 18 days.

The group consisted of 12 men, varying in ages from 25 to 50 years and in weight from 120 to 150 pounds. Some of the men were absent from a number of meals. The number of meals taken was 568, equivalent to 1 man for 189 days.

The results of the study are recorded in the following tables:

TABLE 6.—*Weights and cost of food and nutrients consumed in dietary study No. 327.*

Kinds, amounts, and cost of foods consumed.	Cost and composition of food per man per day.				
	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Fresh, 6,583 grams, $1.45 (10)	0.8	9	2	.....	55
Pork: Fresh pork, 38,045 grams, $8.38 (12)	4.4	31	84	.....	910
Poultry: Chicken, 3,632 grams, $1.20 (3)	.6	3	.....	.....	10
Fish: Carp, 2,724 grams, 60 cents (43); shad, 8,172 grams, $1.80 (47); salt fish, 4,086 grams, 90 cents (5); dried shrimp, 772 grams, 22 cents (22); dried squid, 1,362 grams, $1.40 (19); abalone, 1,362 grams, 50 cents (23)	2.9	22	4	3	140
Total animal food	8.7	65	90	3	1,115
VEGETABLE FOOD.					
Cereals: Rice, 154,496 grams, $17 (53); vermicelli, 590 grams, 10 cents (56)	9.0	74	3	640	2,955
Vegetables: American cabbage, 2,724 grams, 15 cents (60); Chinese cabbage, 41,314 grams, $2.28 (30); bean sprouts, 1,816 grams, 10 cents (33); bean cheese, 2,724 grams, 60 cents (27); potatoes, 17,025 grams, 60 cents (7); taro root, 454 grams, 5 cents (36); radishes, 21,792 grams, 96 cents (8); dried fungus, 908 grams, 40 cents (70); dried lily flowers, 1,317 grams, 50 cents (69); water-lily root, 545 grams, 10 cents (71); water chestnut, 227 grams, 2 cents (75)	3.1	12	4	36	235
Total vegetable food	12.1	86	7	676	3,190
Total food purchased	20.8	151	97	679	4,305
WASTE.					
Animal	.3	2	2	.....	25
Vegetable	.8	5	.....	39	180
Total food wasted	1.1	7	2	39	205
Total food eaten	19.7	144	95	640	4,100

DISCUSSION OF RESULTS.

This is perhaps the most interesting study of the three. Here we have conditions obtaining which we do not find in either dietary studies Nos. 325 or 326. In the first place, excepting a little vermicelli, rice is the only cereal consumed and is also the only concentrated carbohydrate food appearing in the list of the 22 foods used. As in the other dietaries studied, some foods familiar in American households were found, including beef, pork, chicken, fish, rice, cabbage, radish, vermicelli, and potatoes. However, these articles can not be called peculiarly American, but are the same as foods which are used in China or resemble them closely. The proportion of peculiarly Chinese foods is larger than in the other dietaries, and, as before, the list includes dried squid, dried shrimp, bean cheese, taro root, dried day-lily petals, etc.

The results given above show that in this study the diet furnished 144 grams protein and 4,100 calories per man per day, values which

quite closely accord with the commonly accepted standard for a man at active work, namely, 150 grams protein and 4,500 calories. In this and the other dietaries reported herewith, the Chinamen seem to have selected a well-balanced one, suited to their wants. One-half the total food consumed in this dietary was rice, which is a far larger proportion than was shown for either of the other two studied. Chinese cabbage, radishes, and potatoes were the principal vegetable foods besides rice.

Less animal food was consumed in this dietary than in either of the others, as evidenced by the following statement:

TABLE 7.—*Percentage of animal and vegetable food in Chinese dietaries.*

	Animal food.	Vegetable food.
	Per cent.	*Per cent.*
Dietary No. 325	44.4	55.6
Dietary No. 326	28.1	71.9
Dietary No. 327	21.3	78.7

Milk, butter, eggs, and sugar were not used during the study, and according to the information furnished were very rarely eaten by the men. Pork formed about 60 per cent and fish not quite 25 per cent of the animal food eaten. Both fresh and salt fish were used, the former predominating. Shrimp, fresh and cured, and dried oysters (abalone), were also used to some extent.

The Chinese are great lovers of fish of all descriptions, and large quantities of dried fish and dried shrimp are annually exported from the Pacific coast to China, where, it is said, they furnish no inconsiderable part of the nitrogenous foods consumed by the residents of the cities. When the proprietor of the truck farm was asked how the food in California compared with that in China, he stated that the same kinds of food were eaten except that more chicken was used in China, as it is cheaper there. In the opinion of trustworthy Chinese familiar with the subject the average workingman in the cities in China lives just about as the men on this truck farm, while men in the same circumstances in the villages eat more taro roots and Chinese sweet potatoes, yams, etc., and have less meat and less rice, the latter being considered a luxury.

Cost.—The amount spent for animal foods, $16.45, very nearly equals the amount expended for rice. The cost per man per day for food actually eaten was 19.7 cents, as against 21 cents in dietary No. 326. Not only in this dietary is the cost less, but more nutrients were obtained per man per day. Here we have 4,100 calories for 19.7 cents as compared with 3,580 calories for 21 cents in dietary No. 326.

The cost of the food wasted, 1.1 cents per man per day, in this study exceeds that in Nos. 325 and 326.

Beverages.—Tea is the universal beverage of the Chinaman and the men on this truck farm drank practically no water, flasks of tea being carried to the fields and there partaken of as desired.

SUMMARY.

It is interesting to compare the results of the dietary studies of the Chinese professional man's family and laborers with the results of similar studies made elsewhere. Of the Chinese dietaries as a whole it may be said that while many of the foods eaten were unknown to American households, they were wholesome and nutritious and were combined to form a reasonably varied diet. Kellner and Mori, Eijkmann, and others[1] who have studied the diet of Oriental races, also report the use of many different foods, resulting in a varied diet. In addition to the peculiar Chinese foods a considerable number of articles which were common American foods—such as bread, cake, cabbage, etc.—were used. In other words, the Chinese diet had apparently been influenced by environment.

A similar change has been observed in other dietary studies made under the auspices of this Department, and is to be expected. Thus the Italians, Bohemians, and Jews studied in Chicago[2] were found to conform to a greater or less extent to ordinary American food habits, and in general the influence of former dietary habits was less marked the longer the residence in this country.

The diet of the Chinese truck-farm laborers contained practically no foods which were not such as are generally used by the Chinese in their own country. In other words, these men living in the country were less affected by American food habits than those living in the city.

Cost.—As regards cost, the sum expended (19 cents on an average) per man per day in the Chinese dietaries was doubtless below the average in American families, but not below that recorded in some instances where the diet was regarded as satisfactory. For instance, a teacher's family in Indiana[3] had a reasonably varied and attractive diet at a cost of 18 cents per man per day.

Waste.—The figures given in the tables reporting the details of the studies show that the total waste averaged about 4 per cent of the total food supplied. About 75 per cent of the total waste and two-thirds of the protein waste occurs in the vegetable foods. However, the total amount purchased and not eaten was very small and bears testimony to excellent management.

Table 8 summarizes the results of the three studies made with the Chinese and also, for purposes of comparison, quotes the results of a

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[1] U. S. Dept. Agr., Office of Experiment Stations Buls. 21 and 45.
[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 55.
[3] U. S. Dept. Agr., Office of Experiment Stations Bul. 32.

number of foreign dietary studies, and the average results obtained in studies carried on with American professional men, mechanics, and farmers. The commonly accepted dietary standards are also given.

TABLE 8.—*Comparison of Chinese and other dietaries.*

	Protein.	Fat.	Carbohydrates.	Fuel value.	Cost.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Cents.*
Chinese dentist's family	115	113	289	2,705	16.4
Chinese laundry association	135	76	566	3,580	21.0
Chinese truck-farm laborers	144	95	640	4,100	19.7
Japanese (vegetable diet) (*a*)	71	12	396	2,026	.....
Japanese (medium mixed diet) (*a*)	109	20	461	2,423	.....
Japanese (abundant mixed diet) (*a*)	123	21	410	2,405	.....
Employee's in retail store, Tokyo (*a*)	55	6	394	1,895	.....
Europeans in Java (professional men) (*b*)	100	84	264	2,470	.....
Malays, professional men (*b*)	73	30	472	2,512	8
Java village, World's Fair, Chicago (*c*)	66	19	254	1,490	.....
Japanese professional man (4 studies) (*d*)	63	3	481	2,258	.....
SUMMARIZED RESULTS OF AMERICAN DIETARIES.					
Professional men (average of 14 studies)	104	125	423	3,325	.....
Mechanics' families (average of 14 studies)	103	150	402	3,465	.....
Farmers' families (average of 10 studies)	97	130	467	3,515	.....
DIETARY STANDARDS.					
Man with light work (Atwater)	112	.....	.....	3,150	.....
Man at moderate work (Atwater)	125	.....	.....	3,500	.....
Man at severe work (Atwater)	150	.....	.....	4,500	.....

a Ztschr. Biol., 25 (1889), p. 102; U. S. Dept. Agr., Office of Experiment Stations Bul. 21.
b Virchow's Arch., 131 (1893), p. 170; U. S. Dept. Agr., Office of Experiment Stations Bul. 45, p. 66.
c U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 180.
d Virchow's Arch., 116 (1889), p. 381; U. S. Dept. Agr., Office of Experiment Stations Bul. 45, p. 59.

The dietaries of the Chinese family and groups studied in California compare very favorably with those quoted of Japanese, Javanese, Malays, and European residents of Java. In general they contain somewhat more protein and energy. Whether the Chinese in California consumed habitually more food than persons of similar employment in China it is impossible to say. When compared with the average results of similar studies in American families it will be seen that the Chinese dietaries agree quite closely with the corresponding averages as regards both protein and energy.

As regards total nutrients and energy, the Chinese dietaries also compare favorably with the tentative American standards. The diet of the professional man's family corresponded to the standard for a man at light muscular work as regards protein, but the energy was a little below this standard. The laundrymen received on an average a little less protein and energy than the standard for a man at moderately active muscular work, while the farm laborers obtained rather less protein and energy than the tentative standard for a man at hard work prescribes. In all cases it may be said that the variations are not great enough to be of much significance, and it is more than likely that the diet would vary more from week to week than the recorded figures vary from the standards. It should be borne in mind that it

is not considered necessary for a diet to conform exactly to the standard, but rather to approximate it through long periods, as a small deficiency on one day may be made good by an abundance the next. Moreover, the standards themselves are more or less arbitrary and do not necessarily represent exact physiological demands, though they are, it is believed, the best which can at present be proposed.

Rice.—As rice is frequently said to be almost the sole food of the Chinese, it seems entitled to special discussion. As shown by the tables recording the details of the individual dietaries, rice was used in large amounts, but was far from being the only food eaten. On the contrary, the diet was about as varied as that in the ordinary American households, although many of the foods eaten were different. Table 9 shows the proportion of nutrients supplied by rice as compared with those supplied by the total vegetable food and the total food in the three dietaries studied.

TABLE 9.—*Relation of nutrients supplied by rice to total nutrients in Chinese dietaries.*

	Total food.	Total protein.	Total fat.	Total carbohydrates.
Nutrients in rice compared with those in total food:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Dietary No. 325	20.7	18.3	0.8	62.7
Dietary No. 326	49.4	48.8	3.3	93.9
Dietary No. 327	34.2	34.1	2.7	70.2
Average	34.8	33.7	2.3	75.6
Nutrients in rice compared with those in vegetable food:				
Dietary No. 325	37.3	39.9	.5	64.3
Dietary No. 326	62.8	85.5	43.9	94.3
Dietary No. 327	47.5	66.9	23.1	70.6
Average	49.2	64.1	22.5	76.4

It will be seen that the maximum proportion of rice was used in dietary No. 326 and the minimum in No. 325. On an average about one-third of the total nutrients, one-third of the total protein, and three-fourths of the total carbohydrates in the daily diet were supplied by rice. Considering only vegetable foods, the percentages of nutrients supplied by the rice are somewhat larger.

In the account of Japanese dietaries referred to above, Kellner and Mori quoted figures which show that rice constituted about 50 per cent of the total vegetable food of the Japanese.[1] Next to rice stand barley and wheat, which together furnish 27 per cent, these being followed by millet, buckwheat, etc., furnishing 13.9 per cent, while green vegetables, roots, tubers, etc., make up the remainder of the vegetable portion of the diet. In three experiments reported by these authors 1,000 to 1,200 grams of cooked rice (or a mixture of rice and barley) was eaten daily.

[1] Ztschr. Biol., 25 (1889), p. 105.

In the dietary study made at the Java village at the World's Fair in Chicago in 1893, the food consisted mainly of rice and lean beef. The former furnished nearly seven-tenths, and the two together nearly five-sixths of the total nutrients. In addition to these articles, chicken, fish, eggs, bread, green vegetables, and fruit were eaten. It is believed that the diet did not differ greatly from that of the same persons in Java. In the dietaries reported by Eijkmann of Malay and European residents of Java, rice was a staple article, being eaten with eggs, fruit, etc.

Of course the data thus available are wholly inadequate to show what is the actual dietary practice of people of different classes and regions of either of the Oriental countries named. They may, however, be taken as general indications.

It seems not improbable, therefore, that the opinion commonly held regarding the extended use of rice by Oriental peoples is justified. It must not be forgotten, however, that in all the dietaries referred to many other foods were eaten and that foods rich in protein were always found. These included meat, poultry, fish, and eggs, as well as bean cheese and other products made from soy beans.

It is generally believed, and may be the case, that the diet of the Chinese in China is much the same in character as that of persons of similar employment and circumstances in Japan or Java. This is certainly true of the Chinese in California whose food habits were studied. While rice was here also the principal cereal, it was combined with other foods, animal and vegetable, rich in protein.

A question well worthy of consideration is, Did rice actually bear the same relation to the dietaries of the Chinese studied as bread and other cereal products do to the food of the average American family? It will be seen that in only one of the dietary studies, No. 326, is rice practically the only cereal or cereal product eaten. In dietary No. 327 bread was served once each day, and in dietary No. 325 bread, flour, and oatmeal were used. Table 10, which follows, shows the proportions of total nutrients and of the several nutrients furnished by rice in the diet of the Chinese farm laborers, and in the average of the three Chinese dietaries as compared with the amounts furnished by bread or other similar cereal foods, and by cereals and sugar in the average of a number of American dietary studies which were made in Connecticut and Pennsylvania, and are believed to be fairly representative.

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TABLE 10.—*Proportion of total food and total nutrients furnished by rice and by other carbohydrate foods in Chinese and American dietaries.*

	Total food.	Protein.	Fat.	Carbohydrates.
RICE.				
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Average of Chinese dietaries	34.8	33.7	2.3	75.6
Chinese truck-farm laborers	49.4	48.8	3.4	93.9
CEREALS.				
Average of 6 Connecticut families	14.9	26.3	4.4	43.8
Average of 5 Pennsylvania families	27.0	37.8	5.0	59.1
Average of 185 families in the United States	21.8	30.5	7.0	54.7
CEREALS AND SUGAR.				
Average of 6 Connecticut families	22.2	26.6	4.4	71.3
Average of 5 Pennsylvania families	32.3	37.9	5.0	76.4
Average of 185 families in the United States	27.4	30.5	7.0	75.9

The comparison shows that in the American dietaries cereals furnished two-thirds as much of the total food and total carbohydrates as did rice in the average of the three Chinese dietaries. The figures for protein in the two cases show only a slight difference. In view of the fact that in only one study, No. 326, was rice found to be the only cereal, it is perhaps fair to consider the results there found rather than the average results of the three studies. Such a comparison shows that while one-fifth of the total food and one-third of the total protein in the American dietaries studied is furnished by cereals, one-half is supplied by rice in the Chinese dietaries. As regards carbohydrates, rice furnished 94 per cent as compared with 50 per cent furnished by cereals in the American dietaries.

By reference to the preceding pages it will be seen that aside from rice and a little macaroni, no sugar or other concentrated carbohydrate food was used in the dietary of the truck-farm laborers. It is therefore interesting to compare the proportion of total food and total nutrients furnished in these dietaries by rice with similar values for cereal foods and sugar together in the American dietaries. The figures in Table 10 show that even the cereals and sugar together furnish a smaller proportion of total food and total carbohydrates in the American dietaries than did rice in the Chinese dietaries.

Nonalbuminoid nitrogen.—In the study of dietaries as ordinarily conducted no distinction is made between albuminoids and amids, the total nitrogen being multiplied by the factor 6.25, and called protein. It is generally conceded that none of the food materials commonly eaten, except green vegetables and possibly fruits, contain any appreciable proportion of amid nitrogen. The large amount of green vegetables consumed by the Chinese might, therefore, suggest that considerable of the total protein reported in the dietaries consists of amids rather than albuminoids, and that the diet was therefore less valuable than the results quoted above would indicate.

In a previous publication of this Office heretofore referred to[1] the proportion of amid nitrogen in the greater number of the vegetable foods used in these studies was recorded. On the basis of these and other figures the amids in the green vegetables was calculated. Considering all such materials used, the amids amounted to 0.8, 2, and 2.3 grams, respectively, per man per day in the three studies, or an average of 1.7 grams. This amount is not great enough to materially lower the nutritive value of the diet, which on an average contained 131 grams total protein per day.

Some nonalbuminoid nitrogen is also furnished by the extractives of meat and fish. This was not taken into account in the above discussion, as the proportion of animal food in the Chinese dietaries did not differ much from that observed in American families in similar circumstances, while the proportion of green vegetables was larger. If corrections are introduced for the nonalbuminoid nitrogen of meat, similar corrections should also be made in the results of the dietaries quoted for purposes of comparison.

CONCLUSIONS.

The review of the foregoing tables and discussion leads to the following general conclusions: The Chinese studied, who are believed to be fairly representative of Chinese residents in California in similar employment, did not, as is often supposed, live almost entirely upon a vegetable diet. Indeed, they approached no nearer to such a diet than does the average American, who has no thought of doing without animal food. The diet was varied and the dietaries were well balanced, approaching quite closely to the commonly accepted dietary standards. Many of the foods eaten were unfamiliar to most Americans, but nevertheless can not be regarded as other than wholesome and nutritious.

The Chinese dietary is commonly believed to be very inexpensive and limited in amount. As shown by these studies, it was quite cheap, but was neither scanty nor inferior.

Rice on an average constituted between one-half and one-third of the total food consumed and held much the same relation to the total food of the Chinese as do bread and other cereals, starches, etc., to the total food of the ordinary American family. The amount of amid nitrogen in the dietaries was so small that it can be disregarded.

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 68.

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