results of this method for determining carbon and hydrogen simultaneously.

		Per cent. C.	Per cent. H.
Sugar	Theory	42.11	6.43
	I	42.06	6.46
	II	42.28	6.42
	III	42.23	6.57
Benzoic acid	Theory	68.85	4.92
	I	68.97	5.00
	II	68.77	5.11
Urea	Theory	20.00	6.67
	I	19.85	6.77
	II	19.96	6.71
Hippuric acid	Theory	60.34	5.03
	I	60.31	4.93

NUTRITION LABORATORY OF THE CARNEGIE INSTITUTION OF WASHINGTON.
VILA ST., BOSTON, MASS.

THE COMPOSITION OF SOME BENGALI FOOD MATERIALS.

BY HOPE SHERMAN AND H. L. HIGGINS.

Received January 24, 1910.

The importance of a knowledge of the dietetic habits of various nationalities was frequently emphasized by the late Professor W. O. Atwater. In connection with an extensive investigation into the food and diet of different classes of people in America, which was instituted by him and carried out under his direction, considerable material was collected regarding the dietetic habits of other nationalities, especially those of the Chinese and Japanese.[1] These data show that many popular impressions regarding the diet of people in foreign countries are erroneous. Particularly is this true with regard to the relative proportions of animal and vegetable food and with regard to the amount of protein ingested.

While considerable information has been gathered concerning the food and diet of Europeans and Americans, with the exception of the publications previously referred to, but a small amount of data is available regarding the dietetic habits of the swarming population of Asiatic countries. Of especial interest, therefore, is an investigation of the highest scientific accuracy as to the food and diet of various classes of people in India, which has been undertaken within the last few years by Captain D. McCay, of the Calcutta Medical College. Captain McCay first studied

[1] Blasdale, "A Description of Some Chinese Vegetable Food Materials and Their Nutritive and Economic Value," U. S. Dept. Agr., Office Exp. Sta., *Bull.* **68** (1899). Jaffa, "Nutrition Investigations among Fruitarians and Chinese at the California Agricultural Experiment Station, 1899–1901," U. S. Dept. Agr., Office Exp. Sta., *Bull.* **107** (1901). Jaffa, "Further Investigations among Fruitarians at the California Agricultural Experiment Station," U. S. Dept. Agr., Office Exp. Sta., *Bull.* **132** (1903). Oshima, "A Digest of Japanese Investigations on the Nutrition of Man," U. S. Dept. Agr., Office Exp. Sta., *Bull.* **159** (1905).

the dietetic habits of the Bengalis, who are practically vegetarians, living for the most part on rice and dhall (pulse). The results of this study have been published in a memoir,[1] in which Captain McCay points out the noticeable peculiarities in the dietetic customs of the Bengalis, and discusses their bearing upon the physical development and endurance of this class of people.

Inasmuch as the heats of combustion of the typical foodstuffs studied were not determined by Captain McCay, it seemed desirable to secure definite evidence with regard to these values, and arrangements were made by Professor F. G. Benedict, Director of the Nutrition Laboratory, to secure from Captain McCay samples of the food materials used in the investigations. A collection of these samples was sent to the Nutrition Laboratory from India in air-tight cans, and the analyses have been made and the heats of combustion determined by us.

As soon as the samples were received, they were ground and placed in well-stoppered, sealed bottles; determinations were then made of the water, nitrogen, fat, and heat of combustion. All the determinations were made in duplicate, frequently in triplicate, and the results are given in the table herewith.

The water was determined by prolonged desiccation in a high vaccum, according to the method of Benedict and Manning.[2] The nitrogen determinations were made by the Kjeldahl method, which was carefully checked by the determination of nitrogen in pure uric acid. The determinations of the fat were made in a special apparatus designed by Winton. The heat of combustion was determined in a Kröker calorimetric bomb by means of a new form of adiabatic calorimeter, designed by Benedict and Higgins.[3] The hydrothermal equivalent to the calorimeter system was so taken that the heat of combustion of pure cane-sugar was 3959 calories per gram.

For purposes of comparison, the composition of various American food materials, as given by Atwater and Bryant,[4] is included in the table. Thus, wheat and wheat ata (the latter, a flour obtained by grinding wheat) are compared with the ordinary grades of American wheat flour; makkai ata, with corn meal and corn; dhall (pulse), with the dried peas used

[1] McCay, "Standards of the Urine and Blood and the Bearing of the Metabolism of Bengalis on the Problems of Nutrition," Scientific Memoir No. 34. Issued under the authority of the Government of India by the Sanitary Commission with the Government of India, Simla. Calcutta, 1908.

[2] Benedict and Manning, "The Determination of Water in Foods and Physiological Preparations," *Am. J. Physiol.*, 13, 309 (1905).

[3] Benedict and Higgins, "An Adiabatic Calorimeter for Use with the Calorimetric Bomb," THIS JOURNAL, 32, 461 (1910).

[4] Atwater and Bryant, "The Chemical Composition of American Food Materials," U. S. Dept. Agr., Office Exp. Sta., *Bull.* **28** (1902).

in this country; and rice, with the ordinary uncooked rice of commerce. Certain determinations which have been made by Captain McCay on these food materials and published by him in the memoir referred to have also been included in the table under the heading "Calcutta analyses."

ANALYSES OF BENGALI AND AMERICAN FOOD MATERIALS.

Sample number.	Substance.	Water. Per cent.	Nitrogen. Per cent.	Protein.[1] Per cent.	Fat. Per cent.	Heat of combustion. Cals. per g.
	Bengali food materials.					
1	Wheat[2]	10.20	1.96	12.25	2.17	4.010
2	Wheat ata (wheat flour)	9.82	2.33	14.56	3.39	4.093
3	Wheat ata (wheat flour)	10.51	2.02	12.63	2.14	3.949
4	Makkai[2] (corn)	10.00	1.77	11.06	5.03	4.132
5	Makkai ata (corn meal)	9.94	1.52	9.50	4.41	4.057
6	Arar dhall (pulse)	9.70	3.58	22.38	1.51	4.067
7	Arar " "	9.30	3.58	22.38	1.45	4.072
8	Arar " "	7.99	3.65	22.81	1.82	4.110
9	Gram " "	9.00	3.50	21.88	4.81	4.290
10	Gram " "	8.99	3.54	22.13	5.14	4.293
11	Gram " "	9.48	3.82	23.88	5.14	4.274
12	Kalai " "	9.95	3.96	24.75	0.75	4.026
13	Kalai " "	10.43	3.91	24.44	0.88	4.042
14	Massur " "	9.78	4.23	26.44	0.67	4.063
15	Massur " "	10.19	4.42	27.63	0.70	4.056
16	Massur " "	9.80	4.24	26.50	0.80	4.060
17	Mottar " "	9.82	4.22	26.38	0.90	4.041
18	Mottar " "	9.70	4.87	30.44	1.02	4.110
19	Mung " "	9.80	4.09	25.56	0.85	4.051
20	Burmah rice	8.95	1.26	7.88	0.42	3.823
21	Rangoon rice	11.59	1.29	8.06	0.45	3.818
22	Rice (new)	10.82	1.23	7.69	0.19	3.810
23	Rice (old)	10.69	1.19	7.44	0.29	3.801
	Calcutta analyses.[3]					
	Ata	.....	....	11.50	2.90	.....
	Arar dhall (husked)	.....	....	19.86	3.20	.....
	Massur dhall	.....	....	23.25	2.70	.....
	Rice	.....	....	6.39	0.15	.....
	American food materials.[4]					
	Wheat flour	12.0	....	11.4	1.0	.....
	Corn meal	10.3	....	7.5	4.2	.....
	Peas (dried)	9.5	....	24.6	1.0	.....
	Rice	12.3	....	8.0	0.3	.....

[1] Different factors for computing the protein of the various classes of food materials have been proposed by Atwater and Bryant (see Rept. Storrs, Conn., Agr. Expt. Station, 1899, pp. 76–79), but the factor 6.25 was used here in all cases so as to make the results more nearly comparable with those of Captain McCay.

[2] Received whole, and ground for sampling.

[3] McCay: *Loc. cit.*, pp. 34 and 35.

[4] The values for these food materials were taken from *Bull.* 28 of the Office of Exp. Sta., U. S. Dept. Agr. (1902), and represent the average of a large number of analyses.

The samples sent to the Nutrition Laboratory for analysis were taken from the old crop and packed for shipment during the hot, dry season. Captain McCay also analyzed samples of these food materials from the same crop, but the samples were selected earlier in the year when the crop first came upon the market. The results are as yet unpublished but Captain McCay reports that his analyses agree very satisfactorily with those made by us, allowing for the variations in moisture content occasioned by the difference in time of sampling.

Of special interest in the results here shown is the large amount of fat in the wheat ata. The proportion of fat in wheat flour, as commonly used in this country and as shown by some 200 analyses,[1] is from 0.3 to 1.9 per cent., while for the two samples of wheat ata analyzed by us, it was 3.39 and 2.14 per cent. respectively, and 2.90 per cent. as shown by the Calcutta analyses given in the table. The higher percentage of fat will result in a corresponding increase in the heat of combustion. The proportion of fat in the Gram dhall is also high as compared with the other varieties of dhall, being fully three times that shown for any of the others, and the heats of combustion are likewise higher.

NUTRITION LABORATORY OF THE CARNEGIE INSTITUTION OF WASHINGTON.
VILA ST., BOSTON, MASS.

[CONTRIBUTION FROM THE FOOD RESEARCH LABORATORY, BUREAU OF CHEMISTRY, UNITED STATES DEPARTMENT OF AGRICULTURE.]

AN APPLICATION OF THE FOLIN METHOD TO THE DETERMINATION OF THE AMMONIACAL NITROGEN IN MEAT.

BY M. E. PENNINGTON AND A. D. GREENLEE.

Received January 27, 1910.

The quantity of loosely bound nitrogen which occurs in protein-rich tissues such as meat has long been recognized as an indication of the freshness of the substance. Bacteria have been recognized as energetic agents in the decomposition of these protein-rich tissues, with the formation of relatively large amounts of such loosely bound nitrogen.

The methods for the estimation of the quantity of this nitrogen have been far from satisfactory, though the Folin method has served well for its estimation in such substances as urine.

For the estimation of the so-called ammoniacal nitrogen in meat and meat extracts, distillation with magnesium oxide has been the method most used.[2] This method, however, is unsatisfactory in that, even after hours of distillation, small quantities of ammoniacal nitrogen continue to be evolved and the conditions of the experiment, especially the rate of distillation, markedly affect the amount of nitrogen split off. That

[1] Atwater and Bryant, *Loc. cit.*, p. 58.
[2] Richardson, THIS JOURNAL, 30, 1515.