SCIENCE

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FOOD VALUES[1]

SUSPICION often attaches the value of the recommendations of the laboratory experimentalist and this reaction may be more or less well founded. In a delightful address to medical students Simon Flexner recently warned his audience not to think of coming to him for medical treatment. A general of the United States Army told me only yesterday that a professor might be able to hold his students to a complete examination upon the subject of the Thirty Years' War, mark each student in accordance with his deserts, and yet the professor might be of the type who would get lost in his own back yard. Such a danger besets the path of him who would speak upon the subject assigned to me to-night. It appears, however, that scientific knowledge of nutrition has sufficiently advanced to make it of some practical service to the people. Dr. Mendel and I would not be speaking together here to-night did we not feel that we had messages to deliver, and yet it must be evident that in this country such messages are merely personal opinions susceptible to challenge and that they carry little weight with the community.

Many are familiar with the report of the Eltzbacher Commission which concerned itself with the food situation in Germany at the outbreak of the war. The commission was intended to bridge the chasm between helpless specialization and superficial versatility. Fifteen of the foremost scientific men of the land approved the report. Mistakes were made, such as overestimates of

[1] Address delivered before the Home Economics Association and the Society of Chemical Industry, March 23, 1917.

the food available and underestimates of the food required by women who took up the work of men and underestimates of the food required during adolescence. The American investigations of Du Bois and of Gephart, which demonstrated the increased food requirement of growing boys, were not there available, and the increase in the rations for such children was not made in Germany or in Belgium until October, 1916.

It was unfortunate that the carrying out of the recommendations of the Eltzbacher Commission was left to politicians, farmers and middlemen. The scientists of the country were not represented and the result was chaos.

Dr. Alonzo E. Taylor has recently published a very complete account regarding the food supply of blockaded Germany. He points out the fact that, in spite of all exhortations and of all regulations, it is the farmer's wife who gets the egg.

In a pamphlet published in June, 1916, Rubner described how the prices of foodstuffs had been enormously increased by the middlemen. The price of meat and of eggs doubled in a month and this happened, of course, without any regard to the cost of production. Rubner frankly states that the lust for gain produced conditions which had no regard to the political conditions of the country and that the efforts to control prices since August, 1914, had been without results. Bread in Germany was rationed and only half the quantity usually taken in peace time was allotted. This represented the omission of twenty per cent. of the usual ration. Meat and milk were scarce and expensive and in some cities were unobtainable. Green vegetables, as a source of nourishment, were as expensive as meat, and potatoes were also scarce. Conditions were such that in some cities the inhabitants received only a third of the usual food supply. The farmer continued to live as had been his wont, whereas the urban dweller suffered. Families dependent upon the earnings of a physician, for example, suffered acutely not only through the withdrawal of the income of the man who was in the army, but also from the high food prices. The hand of the food dictator was restrained on account of a thousand obstacles put in his way through faults inherent in human character.

It may appear a contradiction of terms to hear in the same breath that there is a shortage of food in Germany and yet that the people are not starving. This is due to the fact that in extreme cases of undernutrition it is possible to reduce the requirement of food to only forty per cent. of its former level. The under-nourished and emaciated may, therefore, live on much less food than those who are well fed and are up to normal weight.

The popular idea that "most people eat too much," which one hears expressed in common table talk, is not true. People who do not change in weight eat just enough to maintain the condition in which they have established themselves. They may, however, lose their surplus fatty tissue by restricting their diet.

Another popular formula which has been elevated to the height of dogma is, "it is not what you eat but what you digest that is of importance." Since the normal person very completely digests all the common food-stuffs, there is little to concern one in this saying. Repeated ignorantly from mouth to mouth, such a remark, even though true, comes to cloak many dietetic absurdities.

An English scientific commission, of which Gowland Hopkins, Noël Paton and others were members, published on February 1 of this year a report of British food conditions. They found that during the five years preceding the war the average annual consumption of food in Great Britain amounted to the equivalent of 51

million million calories, or 3,091 calories per person per day. They assume that the food requirement of 100 men, women and children is the same as that of 77 "men." Therefore each "man" received 4,000 calories daily in a diet containing 113 grams of protein, 571 grams of carbohydrate and 130 grams of fat.

The distribution of this food fuel for the British nation appears in the following table:

TABLE SHOWING ANNUAL YIELD OF CALORIES OF THE CHIEF CLASSES OF FOOD-STUFFS IN THE YEARS 1909–13 IN GREAT BRITAIN

	Energy Value in Millions of Calories	Percentage
Cereals	17,712,000	34.7
Meat	8,890,000	17.4
Dairy produce (including lard and margarin)	8,253,000	16.2
Sugar (including cocoa and chocolate)	6,633,000	13.0
Vegetables	4,812,000	9.4
Cottage and farm products	2,655,000	5.2
Fruit	1,077,000	2.1
Fish	531,000	1.0
Poultry, eggs, game and rabbits	461,000	0.9
	51,024,000	99.9

The commission points out that 30.8 per cent. of the energy in the diet of the people is derived from wheat. Meat yielded 17.4 per cent.; sugar, 13. The three food-stuffs together yielded 61 per cent. of the total energy in the diet. Dairy products and vegetables furnished 25 per cent., and all the rest of the food 13.4 per cent. of the total energy.

The commission emphasizes the fact that if the workers do not get enough to eat they can not do the same amount of work; that a man may by grit and pluck work hard on a low ration, but he is living on himself and soon his work will fail. Stress is laid upon the fact that "in buying food the laboring population is buying energy" and that "a slight reduction of food below the necessary amount causes a large diminution in the working efficiency of the individual." Thus, the troops in the field receive 4,300 to 4,600 calories because they must accomplish hard work and are much exposed to cold. Dr. Murlin has calculated that the "garrison ration" of the United States Army contains 4,400 calories, while the "field ration" contains only 3,800.

The food controller of Great Britain on February 1, 1917, asked the population to voluntarily restrict the consumption of flour, meat and sugar to a measured quantity of these materials per week. This ration would yield about 1,750 calories per "man" daily and leave the individual to supply an equal quantity from other available sources. The individual allotment for each individual each week is 3 lbs. flour, $2\frac{1}{2}$ lbs. meat and $\frac{3}{4}$ lb. of sugar. The distribution per "man" appears in the following table:

RATION PER "MAN," ADVISED BY BRITISH FOOD CONTROLLER, FEBRUARY 1, 1917

Food per Week, Lbs.	Food per Day					
	Oz.	Grams	Calories	Protein Grams	Carbohydrate Grams	Fat Grams
Flour, 4	9.1	258	939	29	194	3
Meat, $3\frac{1}{2}$	7.6	216	540	41		40
Sugar, 1	2.3	65	267		65	
Total			1,746	70	259	43

This allotment ensures a safe protein ration.

Valuable data are given for the relative cost of production of milk and various meats. Thus, 2.9 pounds of "starch equivalent" in the fodder will produce milk containing 1,000 calories. Three pounds of starch equivalent are required to produce 1,000 calories of pig meat and 4.7 pounds and 9 pounds, respectively, to produce 1,000 calories in veal and in beef. Dairy products, pig meat and veal are therefore far cheaper sources of protein than is beef. The increased production of milk is highly desirable, but it is pointed out that changes in the condition of agriculture take time.

England has already restricted the area of land which can be devoted to promotion of the beer industry. The commission states that repeated experience shows that alcohol is unfavorable to the marching powers of troops.

It is of especial significance that in the stress of war the British state recognizes that the laborer, in buying food for himself, is in the main buying energy to support himself as a machine. It seems to be the crying need of the times that those who purchase food shall be able to know what food is, what they are getting for their money, and whether in asking for bread they are in reality receiving stones.

Murlin was the first to suggest that the government compel manufacturers to place upon each can, or package, or barrel of food sold, the caloric content available as food fuel. Only in this manner can the housewife be informed regarding the relative nutritive value of the beautiful packages she sees in the grocer's window. In my judgment the time is ripe for this procedure. One knows, furthermore, that different proteins have different values, and to this knowledge Dr. Mendel has contributed not a little. I wish to repeat what I said before the Washington Academy of Sciences a year ago:

> The proteins of meat, fish, eggs and milk will replace body protein part for part. Such proteins may be classified as proteins of Grade *A*. Gelatin has practically no power to replace body protein and should be classified as protein of Grade *D*. Wheat contains a mixture of proteins of Grades *A* and *D* in which those of Grade *A* predominate, so that wheat may be classified as containing protein of Grade *B*, whereas from analogous reasoning corn may be said to contain protein of Grade *C*.
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> An ordinary dietary with a liberal allowance of protein contains 15 per cent. of its calories in that form. A can containing 15 per cent. of its calories in protein should have a star placed with the letter determinative of the grade of protein. For example the label on a can of corn should read, "This can contains *x* calories, of which *y* per cent. are in protein of Grade *C*." A further desirable statement would be as to whether the food-stuff sold contained the natural mineral constituents from the organic source from which it was derived.
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> I have repeatedly emphasized the desirability that the government should give this information with regard to all food-stuffs sold in packages. The determination of the heat of combustion of a dried sample of food takes fifteen minutes. Probably three hours would suffice to make a complete analysis by a government expert. The manufacturer should send his sample can to the Bureau of Chemistry at Washington, declaring that to be his standard and requesting information regarding his label. He should pay for this analysis as a patentee pays for his patent. If at any time the government should find the manufacturer selling on the market a material of different character than the standard deposited with the government, the manufacturer should be heavily fined.

It seems that these doctrines might be powerfully forwarded at the present time. I believe that they are sound doctrines, potent for accomplishing immeasurable good. It has passed unnoticed that during the current year the cereal products, such as wheat flour, oatmeal, hominy and rice, are all selling on the basis of the same value per thousand calories. The world's necessity has caused this.

A year ago I prepared a table representing the cost of 2,500 calories in various foods and a comparison of the cost of these to-day is presented in the following table:

WEIGHTS OF VARIOUS FOODS NECESSARY TO FURNISH 2,500 CALORIES AND COST AT 91ST STREET AND SECOND AVENUE, NEW YORK CITY

(A man of sedentary occupation requires 2,500 calories daily.)

Articles	Weight		Cost	
	Lbs.	Oz.	1916	1917
Cornmeal	1	8	\$0.04½	\$0.08
Hominy	1	8	0.04½	0.08
Oatmeal	1	5½	0.05¼	0.07
Flour	1	8	0.06	0.09
Sugar	1	5½	0.06⅜	0.09
Rice	1	8½	0.07¼	0.08
Day-old bread	2	1	0.08¾	0.09
Beans	1	9	0.14	0.21
Potatoes	8	1	0.16	0.40
Apples	11	5	0.38	0.57
25,000 calories	31	11	\$1.11	1.76

Experiments from my laboratory with R. J. Anderson have recently demonstrated that the same amount of energy is used by a dog in running three miles in an hour whether the work be done eighteen hours after food ingestion, that is to say, after the food has been digested and absorbed, or whether it is done immediately after the ingestion of glucose in large quantity. If, however, meat in large quantity is given, the extra heat production following upon work amounts not only to the quantity demanded for the work accomplished, but also there is added the considerable quantity of heat produced by the stimulation of metabolism through the substances formed in the breakdown of protein. Meat, therefore, is not the great provider of energy for the accomplishment of mechanical work, but rather carbohydrate food, such as bread, macaroni and rice, all of which are found in the dinner pail of the laborer. These furnish fuel without waste, fuel for accomplishment of the day's work. Fat undoubtedly behaves in a similar fashion, though experiments to demonstrate this have not yet been instituted. Meat in quantity is not necessary for the maintenance of vigorous muscular power. It is gratifying to the palate, but Chittenden has been justified in his belief that small quantities only are essential to repair the wear and tear on the protein content of the organism.

During the recent rise in the cost of foodstuffs I compiled, at the request of an officer of the State Board of Health, the following low-cost meatless dietary of high caloric value designed for a family of five persons, the father at work and the mother doing household work. Potatoes, with their valuable alkaline salts, had to be excluded from the diet because of their prohibitive price. The diets were based on menus given in the excellent book, "Feeding the Family," recently published by Mrs. Mary Swartz Rose. The cost amounted to $1.16 daily for 14,400 calories, or eight cents per thousand calories, which is not a high price.

LOW-COST MEATLESS DIETARY OF HIGH EFFICIENCY VALUE FOR A FAMILY OF FIVE PERSONS, FATHER AT WORK AND MOTHER DOING HOUSEHOLD WORK

Essentials.—Do not buy meat until you have bought *three quarts of milk a day.* Milk contains valuable tissue-building food, valuable salts and invaluable *vitamines* which help to sound health.

If you buy bread remember that day-old bread is much cheaper than freshly baked bread and is just as good a food.

The menus may be arranged as follows:

Breakfast

Corn meal mush,[2] fried (+ milk for children and corn syrup for adults).
Bread (or toast).
Oleomargarin.
Coffee (for adults).
Stewed prunes.
Orange juice for baby.

Luncheon or Supper

Pork and beans[3] (bean soup for young children).
Bread.
Oleomargarin.
Tea with milk and sugar for adults.
Milk for youngest children.
Cereal coffee or cocoa for older children.
Sliced bananas with sugar.[4]

Dinner

Lentil soup.[5]
Boiled rice.[6]
Tomato catsup.

[2] Or oatmeal, or hominy, or farina, or buckwheat cakes.

[3] Or creamed dried beef on toast.

[4] Or stewed dried peaches or the bananas may be boiled in their skins.

[5] Or potato, or bean, or pea soup.

[6] Or spaghetti, or macaroni (with cheese) or baked split peas with bacon.

Bread.
Oleomargarin.
Tea for adults.
Milk for youngest child.
Dried apple pie with cheese for adults.
Dried apple sauce for others.

THE APPROXIMATE COST PER DAY AND THE NUTRITIVE VALUES IN CALORIES APPEAR BELOW

	Amount	Calories	Cost in Cents
Coffee	2⅓ ounces		3
Tea	½ ounce		2
Milk	3 quarts	1,800	27
Bread	2 pounds	2,500	9
Cereal	½ pound	800	4
Oleomargarin	⅜ "	2,500	19
Corn-syrup	⅛ "	650	2
Sugar	¼ "	450	2
Rice or macaroni	1 "	1,600	8
Dry navy beans	10 ounces	1,000	7
Fat pork	6½ "	1,000	6
Dry fruit (prunes)	1 pound	325	12
Flour, lard, etc., for pie or other extras		1,800	15
		14,425	116

As cheaper meats, pork sausages, braised chuck rib of beef, salt cod or herring may be added if finances allow.

This is one method of giving scientific advice. I believe that it may be also possible to arrange in convenient locations throughout a town grocery stores with milk stations adjoining, and that here baskets may be exchanged daily, an empty one for a full one, the baskets varying somewhat from day to day but containing 5,000, 10,000 or 15,000 calories of basic food fuels.

We are told that Joseph fed the Egyptians with grain stored during seven years of plenty. Whether the municipality of the future will purchase wheat and ration bread in quantities sufficient for its inhabitants is a serious question. The railroads of the country receive three thousand million dollars for the service which they render. They must pay high wages and must not increase their charges for what they have to sell. The food problem involves a national expenditure of at least six thousand million dollars a year. The food problem is a national problem which more directly affects living expenses of the very poor than any other problem. The railroads do not enhance the cost of food more than four per cent. of its total cost. The cost of food is, as has been shown, not always dependent upon the cost of production. The cost of gas is regulated by the state and yet the gas companies pay dividends. The cost of bread may some day be lowered by reducing the number of middlemen and by some sort of state control. It is important, also, to find some means to increase the supply of milk. This might be encouraged by a tax on steers of ten dollars each, payable every six months, a procedure which would enhance the price of beef but would induce the farmers to feed their fodder to milch cows or to pigs.

This has brought me to the point where I started—that the professor may get lost in his own back yard. However, it does seem to me that this is a proper time for an American commission to consider these subjects and to report to our government what elemental advice the commission might agree to give. Surely, some consensus of opinion might be arrived at by a commission meeting in Chicago and composed of Mendel, Taylor, McCollum, Folin, Levene, Sherman, Armsby, Langworthy and Benedict. This would mean the submergence of the individual for the instant, in an attempt at welfare work for the nation at large. It would be an experiment worth trying.

Graham Lusk

New York City

GRAVITY AND ISOSTASY

There has recently been issued from the government printing office a volume of 196 quarto pages, known as Special Publication No. 40 of the Coast and Geodetic Survey, bearing the title, "Investigations of Gravity and Isostasy," written by Mr. William Bowie.