

SCIENCE

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SOME PROBLEMS OF NUTRITION IN THE ARMY¹

Food has been defined as a well-tasting mixture of materials, which, when taken in proper quantity into the stomach, is capable of maintaining the body in any desired state. The choice of these mixtures in the form of menus, their preparation for the plate, their digestion and fate in the body, is the science of nutrition. If we had a complete knowledge of every food substance and the transformation it undergoes in the body; how it is prepared for usefulness, just what purpose it fulfils, how it fulfils this purpose and what becomes of it afterward—if we knew all this for every food-stuff; every class of substance we can use as food—we should have a *completed* science of nutrition.

A person is satisfactorily nourished when he is maintained in a physical and mental status—and we all know that food plays a part in maintaining mental as well as physical status—best fitted for the task he has to perform. We can begin now in view of the military situation in Europe to grasp the size of the task our army is destined to perform. What is the most desirable status, physical and mental, for our army? Very few of our soldiers have been in a fight, and none practically speaking, have lived the trench life—the life of the modern soldier. We have now under arms well on to a million and a half men who, six months ago, were leading peaceful pursuits—the majority of them, perhaps, sedentary, or at least unmuscular pursuits. In spite of

¹ Address delivered before the College of Physicians, Philadelphia, April 3, 1918.

the great part played by athletics in our national life, relatively few of our soldiers were athletes. The first requisite therefore was to create a body of well-muscled men. If you could see the great bodies of these men as I have seen them, you would agree that this aim is being rapidly achieved. The average soldier has gained both in weight and in height (a part of the latter is mere straightening up, but not all). Flabby muscle has given way to sinewy muscle. Fat has been reduced in many, and its place taken by active tissue. Such a change requires good food and, in the muscle-up period, a plentiful amount of muscle-forming materials, the best of which in the world is beef.

To gain a fighting spirit also requires good food—and plenty of it—to make the soldier contented, to make him feel well fed and “full of fight.” This objective, also, I am sure, is being attained. Does any one grudge the soldier an abundance of food, even a little superabundance to be on the safe side, if these objects are being attained? I shall speak later of the element of waste which I know has been in your minds.

Army regulations define the ration as the allowance for subsistence of one man for one day. You will be interested in certain facts regarding the history of the ration as thus defined. The first legislation fixing the components of the army ration is dated November 4, 1775. The Continental Congress fixed at that time one pound of beef and one pound of bread as the allowance for each man per day, “3 pints of beans or peas at a price not to exceed \$1.00 per bushel, one pint of milk, half a pound of rice or one pound of Indian meal per week, one quart of Spruce beer or cider for each man or nine gallons of molasses for each company of men per week.” The ration also included candles and soap. The ration

fixed July 16, 1798, is in some respects the same as we have to-day. At that time the allowance of beef was raised to 1½ pounds or 20 ounces, the allowance of bread or flour to 18 ounces, rum, brandy or whiskey one gill, and the other items the same as in previous rations. In 1799 the issue of rum was placed at the discretion of the commander. In 1802 a provision was made for the conversion of strong liquors into wine and beer, otherwise the ration was the same as above. This ration continued through the War of 1812.

From time to time there was much controversy over the liquor component. In 1818 the following recommendation was made: “in a southern climate give molasses in lieu of whiskey or beer, and only one half pint of peas, beans or rice.” Calhoun who was Secretary of War at this time, recommended that the liquor components of the ration be discontinued. This was concurred in by General Lovell, who was Surgeon General of the Army at that time. Congress, however, failed to act, and the liquor continued as a component of the ration until 1838.

During the War of 1812 there was much agitation on account of the failure of the contractor system. This system had prevailed previously, although much trouble had been experienced with it. In 1814 it broke down completely and the House of Representatives asked Monroe, then Secretary of War, for suggestions concerning a revision of the method of provisioning the army. A new system was worked out, but, peace having been signed with England, Congress adjourned and left the bill on the calendar. In 1817 the Seminole Indian outbreak in Georgia gave still another opportunity to show the weakness of the contractor system. Andrew Jackson, who was Commander of the Army, became so impatient with this system that he finally or-

ganized a commissary department for his own army entirely without authority from Congress and demonstrated that the army itself could handle the matter of supplies much better than outside contractors. This resulted in legislation dated April 11, 1818, which laid the foundations of our modern Subsistence Department. It should be explained here that the Subsistence or Commissary Department, which was separate and independent up to 1912, is now a part of the Quartermaster Corps.

The agitation for discontinuance of the liquor component in the ration came up at almost every session of Congress between 1812 and 1838. In 1832 coffee was for the first time made a part of the ration, and it was provided that six pounds of coffee and twelve pounds of sugar per 100 rations, that is, for one company of men, could be used in lieu of whiskey or rum at the rate of one gill a man each day. Nothing further was done with the army ration until 1856, when some agitation was started to increase the coffee and sugar components; after four years this modification was made, just before the outbreak of the Civil War. The ration which prevailed throughout the Civil War fixed by legislation dated August 30, 1861, was as follows:

Beef, 20 ounces,
Bread or flour, 22 ounces,
Potatoes, 16 ounces three times a week,
Beans, rice or hominy "in proportion with above."

Then for each company of men or 100 rations:

10 pounds coffee,
15 pounds sugar,
4 quarts vinegar,
4 pounds soap,
1½ pounds candles.

The peace-time ration, differing from the last named only in the absence of potatoes, beans, rice, hominy, etc., was returned to in

1865. These articles were restored by legislation dated 1892. Other minor changes were made which were continued in new legislation dated January 11, 1911. The "garrison ration," as it is known, as fixed by this last Act, is as follows:

20 ounces beef, or bacon 12 ounces,
18 ounces flour, or corn meal 20 ounces,
20 ounces potatoes,
2.4 ounces beans,
1.28 ounces prunes,
1.12 ounces coffee,
3.2 ounces sugar,
.32 gill syrup,
.50 ounce evaporated milk,
.50 ounce butter,
.64 ounce lard,
.16 gill vinegar,
.62 ounce salt,
.04 ounce pepper,
.014 ounce cinnamon,
.08 ounce baking powder,
.014 ounce flavoring extracts.

Besides this garrison ration, the American Army has three other rations. The *reserve ration* consists of hardtack or army bread, bacon, sugar, coffee, salt and pepper. This, according to regulations, forms the basis of field rations, but at the present time in France is being considerably modified according to the available supply. The so-called *travel ration* contains soft or hard bread, canned corned beef or corned beef hash instead of bacon, as in the reserve ration, baked beans, canned tomatoes, jam, coffee, sugar and evaporated milk. There is an allowance also for coffee already prepared when it can be obtained at railroad stations. The regulations provide for an *emergency ration* which has been well defined as simply "a substitute for nothing." This might also be called a tide-over ration. Many attempts have been made to concentrate into small space, so that it can be carried in the pack in a sealed parcel, the nec-

essary nutrients to maintain a soldier for twenty-four hours. The American Army has tried out half a dozen or more emergency rations but none of them have proved wholly successful. In conference with medical officers of the Navy and a representative of the Bureau of Home Economics of the Department of Agriculture, the Food Division of the Surgeon General's Office has reached the conclusion that no satisfactory emergency ration has yet been proposed and has taken the ground that the most satisfactory form of concentrated ration is hard bread supplemented by potted beef or ham, dried beef or sardines, and, when there is opportunity for the use of a portable cooker, three ounces of sliced bacon should be added.

Returning to the subject of the garrison ration, which forms the basis of feeding in all of our training camps, it should be explained that this ration as fixed by law does not prescribe what the men shall eat. It is merely used as the basis of the money allowance for the ration. A long list of substitutive articles is carried by the Quartermaster Corps, and the soldiers are allowed to eat anything they choose from this list, but they must not spend more than the amount of money represented by the cost of the garrison ration, with certain definite percentages of substitutions, at the time and place where they are stationed. For example, the value of the ration for this month at Washington Barracks is about 41 cents. This amount of money multiplied by the number of men in the organization is the amount which the mess sergeant may spend for food each day for his company. As a matter of fact, meat, bread and potatoes form the backbone of the ration now as always. The allowance of meat, $1\frac{1}{4}$ pounds including bone, for each man per day is purposely placed high, so as to cover all emergency requirements. The actual con-

sumption of meat, as our food surveys have recently determined, is much lower than this. The average, I should say at this time, is not in excess of $\frac{3}{4}$ pound of meat for each soldier.

The list of substitutes makes provision for a considerable elasticity and variety in the diet. More than this, however, if the men do not like what the quartermaster has in store, they are at liberty to take money from the quartermaster in lieu of rations and buy materials outside. This is at the discretion of the commanding general. Where local market facilities are good, there is no objection to this method, provided the food supplied is carefully inspected. With an inexperienced mess sergeant, there is likely to be a waste of funds from this cause, but it sometimes happens that the local market is cheaper than the Quartermaster Department.

Let me now explain the actual workings of the mess system in vogue in our army. The soldiers are fed by companies or equivalents of companies, such as batteries of artillery, troops of cavalry, ambulance companies, field hospital companies, etc. According to the new tables of organization, an infantry company consists of 250 men. In the Civil War, remember, a company was only 100 men. Companies now, therefore, are practically the equivalent of battalions in those days, and a battalion of 1,000 men now is nearly the equivalent of the old regiment.

Each company in camps such as those now in existence in this country has an individual mess-hall with its appropriate kitchen equipment. When the cantonments were started, the company consisted of only 152 men, and some of the mess-halls were constructed on this basis, but they have since been enlarged in most camps, so that now it is possible to seat the entire company of 250 men at one time. The mess

conditions are under the supervision of a commissioned officer of the company designated by the captain and known as the mess officer. The purchasing agent of the company is a sergeant, known as the mess sergeant. It is his business to keep the mess accounts with the Quartermaster and to draw the rations for his organization. Staple articles, except meat and bread, which are issued every day, are drawn in "10"-day periods. This has been found by experience to be the most convenient period of time for a company. Each company has an adjoining store room which is supposed to be large enough to contain supplies for a 10-day period. At the beginning of this period the mess sergeant learns from the first sergeant of the company the number of men on the ration list. He multiplies this number by the value of the ration in money for the current month and multiplies this by ten to find the amount of his credit with the quartermaster for the ensuing period.

In conference with the company cook, the mess sergeant makes out menus for some days in advance and calculates the amount of each article required for the preparation of these menus. Such menus are supposed to be approved by the mess officer or the company commander and by some medical officer. You will be interested, I think, in knowing how these menus run. I quote from one for Company A, 301st Field Signal Battalion, November 5, 1917, at Camp Devens:

Breakfast

Oatmeal, milk and sugar,
Pork sausages,
Fried potatoes,
Bread and butter,
Coffee.

Dinner

Roast pork or roast beef,

Baked potatoes,
Bread and butter,
Cornstarch pudding,
Coffee, milk and sugar.

Supper

Beef stew,
Corn bread,
Karo,
Prunes,
Tea.

SUNDAY, NOVEMBER 4, 1917

Breakfast

Corn-meal mush, sugar and milk,
Hash,
Potatoes,
Bread and butter,
Karo,
Coffee.

DINNER

Roast pork,
Baked potatoes,
Celery,
Turnips,
Peas,
Cranberry sauce,
Mince pie,
Ice cream,
Cocoa.

Supper

Cold pork sandwiches,
American cheese,
Crackers,
Cocoa.

On the whole it must be said that the mess system in vogue in the American Army works well. Its weak points at this time are obviously the inexperience of the mess officer and the mess sergeant, the fact that good cooks are not available, and the absence of an adequate system of inspection. It was the realization of these weak points in our system together with the importance of conservation of our food re-

sources and the concern of the Surgeon General for the nutritional interests of the army, that led to the organization of the Food Division of his office. The object of this division might be expressed briefly in this way: to apply the science of nutrition to the problems of feeding the army. We wish to secure for the soldier perfect nutrition with the least possible waste of food. The government is not in the least niggardly with the army: indeed, we must not conserve to the point of denying the soldier anything he should have.

It should not be understood that it is the work of the Food Division of the Surgeon General's Office to supply food for the army. As already explained, this is done by the quartermaster. The Quartermaster Corps conducts practically all of the business of the army, and the quartermaster attached to the camp or to a tactical division is, so to say, the business agent of that unit. He purchases all the food, transports it and places it in storage at some place available for the camp or army. Upon requisition by the different organizations, he issues the food, as already explained, and carries in stock the entire list of articles prescribed in the garrison ration and in the list of substitutes. He may also have what is known as a "Sales Department" which contains a considerably wider range than the list of substitutes. For example, the patent breakfast foods—Post Toasties, Puffed Wheat, Puffed Rice, and other package foods—can be purchased through this sales department.

The work of the Food Division is largely of an advisory or inspectorial nature. We have been authorized now by the Secretary of War to do three things: First, to inspect all the food of a camp with reference especially to its nutritive value; Second, to seek to improve the mess conditions (cooking and serving of the food) to the end that a

properly balanced menu will be employed and the food served in palatable form; third, to determine the actual consumption of the food and the amount of waste and report these facts to the Division Commander. The division contains now 65 officers and some 50 enlisted men. A Nutritional Survey Party, as it is called, consists of four officers and several enlisted men. This party visits a camp and spends from two to four weeks studying food conditions and making recommendations through the chief surgeon to the commanding officer of the camp. We have nine such parties operating at the present moment. Each party makes a tour of from four to six camps and then goes back over the same ground to observe especially what improvements have been made.

A first contingent of six officers under the leadership of Major Philip A. Shaffer, dean of the medical department of Washington University, has gone abroad to report to General Pershing for similar service in France. Their duties will be to aid in proper nutrition and messing of troops and supervising the conservation of food so that it shall be consistent with adequate feeding of soldiers in campaigns.

Already the Food Division has been able to improve food conditions in a considerable number of camps. Our officers have caught at the subsistence stores spoiled meats and spoiled canned goods and have condemned them. They have suggested improvements in mess arrangements, in menus, and have given systematic instruction to the mess officers and mess sergeants in food values and the proper uses of foods. In many instances their recommendations, having the full force of recommendations from the Surgeon General himself, have been adopted without question. In addition, we have already gathered a considerable body of information regarding the ac-

tual consumption of food and the amount to stock during the period, and third, an inventory at the end of the period. The of waste.

TABLE I
Page from Statistical Report of Food Consumption in the Training Camps.

Food per Man per Day								Consumed Distr. of Fuel Value, Per Cent.	Wasted, Per Cent.	Per Man per Day
Nutrients	Sup- plied	Wasted	Con- sumed							
Camp Travis										
0042 90th Div., Caisson No. 1, 11/7-13/17	Protein, gm.	117	15	102	14	13	Consumed cost, 37 c.			
	Fat, gm.	101	18	83	25	18	Waste cost, 5 c.			
	Carbohydrate, gm.	519	54	465	61	10	Total waste, .50 lb.			
	Fuel value, cal.	3,547	450	3,097	100	13	Edible waste, .22 lb.			
0043 90th Div., Co. A, 357 Inf., 11/8-14/17	Protein, gm.	135	5	130	13	4	Consumed cost, 37 c.			
	Fat, gm.	185	6	179	40	3	Waste cost, 1 c.			
	Carbohydrate, gm.	505	16	489	47	3	Total waste, .50 lb.			
	Fuel value, cal.	4,345	142	4,203	100	3	Edible waste, .15 lb.			
0044 90th Div., Co. B, 357 Inf., 11/8-14/17	Protein, gm.	85	3	82	15	4	Consumed cost, 31 c.			
	Fat, gm.	68	3	65	26	4	Waste cost, 1 c.			
	Carbohydrate, gm.	346	10	336	59	3	Total waste, .37 lb.			
	Fuel value, cal.	2,399	81	2,318	100	3	Edible waste, .13 lb.			
Ft. Sam Houston										
0040 Base Hosp. Det. Mess, 11/4-10/17	Protein, gm.	112	4	108	17	4	Consumed cost, 40 c.			
	Fat, gm.	105	6	99	34	6	Waste cost, 2 c.			
	Carbohydrate, gm.	333	12	321	49	4	Total waste, .36 lb.			
	Fuel value, cal.	2,801	121	2,680	100	4	Edible waste, .19 lb.			
Wadsworth										
0068 27th Div., Bat. E, 106 FA, 12/5-11/17	Protein, gm.	170	4	166	16	2	Consumed cost, 49 c.			
	Fat, gm.	187	7	180	38	4	Waste cost, 2 c.			
	Carbohydrate, gm.	507	15	492	46	3	Total waste, .82 lb.			
	Fuel value, cal.	4,515	143	4,372	100	3	Edible waste, .46 lb.			
0069 27th Div., Co. I, 12 NY Inf., 12/6-13/7	Protein, gm.	151	8	143	14	5	Consumed cost, 42 c.			
	Fat, gm.	126	5	121	26	4	Waste cost, 3 c.			
	Carbohydrate, gm.	674	42	632	60	6	Total waste, .95 lb.			
	Fuel value, cal.	4,554	252	4,302	100	6	Edible waste, .68 lb.			
0070 27th Div., Co. I, 106 Inf., 12/6-12/17	Protein, gm.	118	9	109	14	8	Consumed cost, 36 c.			
	Fat, gm.	89	4	85	25	4	Waste cost, 3 c.			
	Carbohydrate, gm.	516	38	478	61	7	Total waste, .90 lb.			
	Fuel value, cal.	3,428	230	3,198	100	7	Edible waste, .58 lb.			

The accompanying table shows one page out of our statistical report of actual feeding conditions in individual mess houses (Table I.). As shown on this page, in three messes in Camp Travis, Fort Sam Houston, Texas, and base hospital mess and three messes at Camp Wadsworth, Spartanburg, South Carolina, the food consumption is expressed on the man-per-day basis. This is obtained by first making an inventory of the amount of food on hand in the company storehouse, at the beginning of a definite period, second, a list of accessions

second inventory subtracted from the sum of the first, plus accession to stock gives the amount of food used. Concurrently with this, the garbage is separated into several cans, one for spent bone, one for peel and other inedible refuse such as coffee grounds, egg shells and the like, and one for table or edible waste. This last fraction is weighed, sampled and analyzed. The total nutrients contained in the edible waste subtracted from the total nutrients contained in the food as supplied, gives the actual consumption of food. This table gives a good idea

of the very high variation of food consumption, ranging as noted from 2,300 to 4,300 calories per man per day. One reason for this large variation is the availability of extra foods at camp exchanges and adjacent restaurants. The table shows also a high variation in the amount of waste and is fairly typical of the difference we have found between the National Army Camps and the National Guard Camps. This difference is largely due to the fact that, in the National Army Camps, schools for cooks and bakers have been in operation from the very beginning and at the time these surveys were made, the cooks in the National Army Camps, although having had only a couple of months' experience, were already much more efficient than the cooks in the National Guard Camps who had not received instruction in such schools. It should be stated, however, that the National Army Camps are much better equipped as regards their kitchens, they have better ranges, better storehouses and more conveniently arranged mess halls than have the National Guard Camps.

The general public is naturally very much interested in this matter of waste. Numerous reports from civilians who have visited the camps have reached our office to the effect that there is gross and wanton waste of food. These observations, as a rule, are purely casual, and in many instances, at least, are incorrect. In the construction period of the camps, the construction contractor was responsible for a great deal of the visible waste of food. The ordinary civilian visiting such a camp and seeing evidence of waste did not distinguish between the civilian contractor and the army. Whole heads of cabbage, whole potatoes, spoiled hams, joints of beef, etc., could be seen in the garbage pails, in the garbage wagons, or garbage cans, and a hasty conclusion was reached that the army

was thus wasting food. Our officers have now visited all of the large military camps, numbering altogether in the neighborhood of forty. They have very rarely seen in any of the camps any such evidence of waste as reported in these private letters, which unfortunately have found their way to the public press. It is a great exception to see whole potatoes or large pieces of bread, or bones with meat attached in any considerable amount in any of the garbage cans from the army mess houses. I have personally visited 22 camps, and have looked into thousands of garbage cans, and bear witness that in the great majority of these cans one does not see more waste proportionately than can be seen in the garbage of an ordinary household.

We have recently had reports from Camp Funston and Camp Sevier which show that the waste has been reduced to such a point that it is practically negligible. For example, in one mess house in Camp Funston where more than 200 men were fed, the total edible waste from three meals was only six ounces; at Camp Sevier the report of our party working there at the present time is that, in a considerable number of mess houses, the total waste from a meal is not over one half pound. This means satisfactory discipline and, especially, it means inspection of plates at the end of the meal. Conservation has been made a subject of division orders in these camps and others, the instructions being that men shall not take on their plates more than they can eat, violation of this order being made a cause for punishment. Company commanders at their discretion can compel a man to eat at the next meal anything he has left on his plate. It means also satisfactory serving arrangements. It has been the experience of our officers that the most economical way of serving men in large numbers is by what we call the squad system. If possible, men

should be seated by squads and should be served by their own squad leader. The essence of the system is, however, that the squad leader shall have authority over the serving of his men. He either serves the food himself on their plates or at least sees to it that no man takes more food than he can eat, and reports him if he does.

It should be remembered that these company households are still very young. None of them in the National Army are more than six months old. To take a body of 250 men at random from the civilian population and train them in six months in the handling of this large quantity of food, so that there should be no undue waste, is indeed a fine accomplishment.

Many problems are arising constantly in connection with our work. We were faced at the start with the fact that there is very little exact information on the amount of food required by the army in training or in the field. Such information as exists is obtained from the record of purchases in the Quartermaster Corps, or the corresponding departments of other armies, and not from the estimation of food consumed directly. We have, I believe, the first instance in the history of warfare, where the actual amount of food consumed is estimated directly in the camp and in the field where the troops are operating. This is made possible by our system of feeding men by companies. In this way, it is possible to check up closely also on the relative cost of the different foods. We find, for example, that where more meat is used the cost of the ration is always higher. Meat, so far as we can learn yet, represents the most expensive article of diet, but meat is also one of the most important articles of food, especially for soldiers in the muscling-up period of their training. Experiments by Thomas and others show that the nitrogenous waste of the body is most read-

ily replaced by the nitrogenous constituents of meat. Meat, then, is the most economical repair material for muscle and other active tissues. Next to meat comes the protein of milk and eggs, and below these the proteins of cereals, legumes, beans, peas, etc. It has been proposed by Professor Lusk to call these most economical proteins, proteins of Class A, meaning that they are most valuable for the purpose of repair and restoration of tissue, and hence also for the growth of tissue, in the whole list of food stuffs.

We were faced also at the beginning with the question of what should be the optimum amount of protein in the ration. Authorities now generally agree that muscular work does not involve a breakdown of muscle tissue, rather the contrary. A man who has not been accustomed to work, when he begins actual muscular exercise instead of breaking down muscle will build up muscle and it has been abundantly proved by numerous experiments that the breakdown of nitrogenous material in the body does not increase in muscular work over the amount broken down in complete muscular rest. This is a surprising fact, but it is now quite incontrovertible. Muscular work is done at the expense of potential energy in the form of carbohydrate and fat. There is much evidence also that this energy can be derived most economically from carbohydrate food, especially from sugar, and this doubtless explains the craving of men in muscular training for sweets. These facts would indicate that a relatively small amount of protein or meat in the diet would be sufficient for muscular work. It is quite possible that our soldiers could get along with considerably less than they are using, although our investigations show that they are actually using much less than the government allowance. There are some facts, however, which deter us at present from

recommending a radical reduction in the amount of meat in the ration. First of all is the fact that meat stimulates heat production in the body more than any other food stuff, and therefore assists in keeping the body warm in severe weather. There is some evidence that for a quick delivery of maximum energy, such as may be necessary in getting "over the top," a high protein diet is necessary. We certainly desire that the American soldier shall have plenty of "punch" to his fight, and if a high protein diet will insure this punch, nobody, I am sure, will grudge him all the meat he feels like eating.

United States rations, both for ordinary encampment training and for field uses. The British field ration is the ration used in the training camps in France. When the men go into the trenches or engage in active operations, this is supplemented by the addition of pea soup, butter and sugar amounting to 300-500 calories. The Canadian diet No. 40 is taken from an actual weekly diet sheet as used in the Canadian training camps in England last September. The French normal ration is the training ration, the reserve ration corresponds very closely to our own reserve ration and their strong ration is their campaign ration.

TABLE II
Comparison of Allies' Rations

Ration	Weight				Fuel Value			Distribution			
	Total	Protein	Fat	Carbo- hydrates	Protein	Fat	Carbo- hydrates	Total	Protein	Fat %	Carbo- hydrates
	Gm.	Gm.	Gm.	Gm.	Cal.	Cal.	Cal.	Cal.	%	%	%
British Field.....	1,461	143	154	440	586	1,432	1,804	3,822	15.3	37.5	47.2
British Field and Trench....	1,893	144	174	463	590	1,618	1,898	4,106	14.3	39.4	46.3
Canadian, Oct. 1, 1917.....	1,860	151	182	460	619	1,693	1,886	4,198	14.7	40.3	45.0
Canadian Diet No. 40.....	622	132	127	363	541	1,181	1,488	3,210	16.9	36.8	46.3
French, Normal.....	1,261	141	89	467	578	828	1,915	3,321	17.4	24.9	57.7
French, Reserve.....	1,091	112	114	385	460	1,063	1,580	3,103	14.8	34.3	50.9
French, Strong.....	1,362	152	97	509	623	902	2,087	3,612	17.2	25.0	57.8
Italian Combating.....	1,366	142	67	519	582	623	2,128	3,333	17.5	18.7	63.8
Italian Territorial.....	1,116	94	50	415	385	465	1,701	2,551	15.1	18.2	66.7
U. S. Garrison.....	1,935	175	125	671	718	1,163	2,751	4,632	15.5	25.1	59.4
U. S. Garrison, Modified....	1,803	166	178	657	681	1,655	2,694	4,809	13.5	32.9	53.6
Average, 87 messes.....	1,940	139	130	536	570	1,209	2,198	3,997	14.3	30.4	55.3

Other armies are getting along on less meat than allowed by the government to our army. The British army allows 1 pound per man per day, the French army $\frac{3}{4}$ pound, the Italian army only $\frac{1}{2}$ pound. Our allowance, you will remember, is $1\frac{1}{4}$ pounds, but the actual consumption by our army up to the present time in the camps in this country does not exceed $\frac{3}{4}$ pound. It would therefore seem that $\frac{3}{4}$ pound of meat provides a sufficiency of protein of this class.

Table II. exhibits a comparison of the British, Canadian, French, Italian and

Corresponding rations for the Italian army are the territorial and combating rations. The United States garrison ration as laid down by the regulations, provides as shown here 4,632 calories per man per day. When, however, this ration is made the basis of money allowance, certain substitutes are made, for example, 30 per cent. of meat is issued as bacon, 20 per cent. of the allowance for potatoes is issued as onions, and 10 per cent. as tomatoes. With these substitutes made throughout, the garrison ration, "modified" as we call it, provides 4,809 calories. Now, the average con-

sumption in the training camps as shown by our surveys is to date just a little less than 4,000 calories. On this diet, supplemented of course by a certain consumption of food from the camp exchanges, the men have gained in weight on an average of about 9 pounds since entering the training camps. Some organizations even show an average gain of as much as 20 pounds, others only 2 or 3 pounds, but the average throughout the army, according to the best

closely compared with the work of a farmer. According to an article published recently in *Nature*, the average consumption of food among the English munition workers for 1917 where more than 18,000 observations were taken, is 3,463 calories. Summarizing again, we may say the average American farmer uses about 3,500 calories, the average English munition worker very nearly the same, the average soldier of the Allies, considering British, Canadian, French,

TABLE III
Family Dietary Studies

	No. of Fam.	Average Income	Days per "Man"	Cost	Per "Man" per Day			
					Protein, Gm.	Fat, Gm.	Carbo., Gm.	Calories
Garment makers	7	\$ 724	168	.38	109	80	494	3,130
Professional men	17	2,208	434	.564	99	149	438	3,490
Teachers	32	2,150	620	.473	88	126	428	3,200
Farmers	12		384	.436	101	130	503	3,585
Engineers (professional)	5	2,252	97	.526	85	124	395	3,035
Laborers	6	1,497	205	.35	94	102	481	3,220
Salesmen	5	2,527	121	.449	88	111	405	2,970
Mechanics	10	1,303	309	.44	95	113	444	3,175
Mother wage earners	12	923	326	.33	105	66	440	2,955
Retired	5	1,647	130	.48	81	121	420	3,095
Clerks	11	1,934	225	.50	90	119	417	3,040
Weighted averages	122	1,799 ⁴	3,019	.438	94	117	438	3,180

information we can obtain to-day, is in the neighborhood of 9 pounds per man. Compare with this army ration, the average consumption of food as shown by recent family dietary studies made by the Bureau of Home Economics under Dr. Langworthy at the Department of Agriculture (Table III.).² Note that the consumption of food per man per day in farmers' families is quite similar to that as already shown for the average allied soldier in training. The work of the soldier in training, therefore, so far as its intensity is concerned, may be

² Through Dr. Langworthy's courtesy I am permitted to show these figures for the first time.

³ "Man" = all members of the family reduced to the basis of men.

⁴ Average 110 families.

Italian and American forces, in training camps about the same amount and in actual campaigns some 500 calories more.

Another problem in which we have been greatly interested is whether the soldiers should be given all the sweets they crave. Our survey parties in the military camps have determined the actual consumption of food from the exchanges or "canteens," as they used to be called, as well as from the mess house. In one camp where there was but a single exchange, it was possible to determine the average consumption with a high degree of accuracy. In these canteens or regimental exchanges, the foods which are bought by the soldiers are for the most part candies and light drinks (the food value of which is represented entirely by a

syrup), cakes, pies, ice cream, etc., in other words, articles of food which would be classified as sweets. In this particular camp it was found that the average soldier bought in the neighborhood of 500 calories of energy every day in the form of sweets. This represents fairly typical conditions. Wherever it has been possible to estimate with any degree of accuracy at all the consumption of food from these exchanges, we have found figures ranging in the neighborhood of those just quoted. We may say, then, that the average soldier craves in the form of sweets, which represent quick energy in much the same way that alcohol in small quantity represents quick energy for the body, food amounting to about one eighth of his total daily requirements. The question may fairly be asked whether the government would not be well advised to reduce the quota of meat and replace the amount thus saved with sweets, provided as a part of the ration.

Still another question of great interest, not only for the army but for the entire civilian population, is the question of dehydrated vegetables. As a means of preservation and therefore of conservation of our food supply, dehydration or drying has already proved its place. By means of improved appliances, this measure may now be extended to classes of food stuffs not ordinarily preserved by drying. Potatoes, cabbage, spinach, strawberries and many other articles usually preserved by other means may now be dehydrated much more effectively than by ordinary means of drying, and may be preserved in this dehydrated condition for a considerable length of time, if not indefinitely. The importance of this measure for the army lies in the saving of tonnage or cargo space in transportation of food materials across the country and across the water. Major Samuel C. Prescott, of the Food Division, has pre-

pared an exhaustive report on the subject of dehydration covering all phases of the subject from the saving in the space to the chemical composition and microbiology of the product. Immediately after this report was submitted to the Quartermaster Department, that department began placing orders for dehydrated vegetables such as potatoes, onions and carrots for the use of General Pershing's army. As yet the tonnage contracted for is not large, but in all probability in the very near future dehydrated vegetables will become a staple article in our army rations, as they have already become in the ration of the British army. Thousands of tons of dehydrated vegetables are being prepared in Canada, some also in the United States for the British army. By simply soaking in water and boiling in the same water, these vegetables are brought back to the condition of fresh vegetables so perfectly that very often they can not be distinguished from the fresh vegetables themselves. Another advantage of such products is the very high saving of time in the company kitchen. Dehydrated vegetables put up in packages are ready for the kettle; this saves the work of one or two men a day.

It is fairly safe to predict that before very long methods will be found for the dehydration of meat as have already been found for the dehydration of milk. Such measures remove many dangers of food poisoning. Meat spoilage is almost entirely due to imperfect refrigeration, but if the water is taken out of the meat, it does not need to be refrigerated. Bacteria can not grow without water. The Food Division through investigation made at the Harri-man Research Laboratory in New York, has already found a satisfactory method of making meat powder, by dehydration at low temperature and a high vacuum. This can be used as a component of soup

stock or dried hash which requires only a short soaking in water and boiling to make a very delicious dish. The Bureau of Chemistry under the direction of Dr. Alsberg is also working on this problem, as is also the Bureau of Animal Industry under Dr. Mohler. There should be, as a result of these studies, in time a very large saving in the cost of living. Imagine the difference in the cost of transportation of milk with and without its water content, quite aside from the saving in the cost of refrigeration. Milk is 88 per cent. water, meat is about 70 per cent. water. Practically all of the water can be extracted from milk, leaving a powder which will go into solution readily and, by combining with sweet butter, can be turned out as a product of any desired composition. Already it is possible to deliver milk of this kind, which at current retail prices costs 14 cents a quart, for less than 9 cents a quart. There should be a corresponding saving in the cost of meat, for two of the largest factors in the cost of meat to-day are refrigeration and freight charges. In the case of milk, the reconstituted article is just as palatable as the original milk and is very much safer, for it can be pasteurized twice, once just before powdering, and again just after reconstitution with little extra cost. In the case of meat in the form of soup stock, hash and stew, which form the bulk of meat consumption in the army, the product again is just as palatable as the original meat.

There are many other aspects of the problem of nutrition of the army which would interest you had I the time to take them up in detail. One of the most interesting to us in the office has been the preparation of some special rations for the use of our own American prisoners in Germany and for the use of sick soldiers and prisoners. One of the first things the Food Division was asked

to do after its organization early in September was the preparation of an American Prisoners' ration. This request came from the American Red Cross, and after a few days we had prepared for them a ration which could be shipped in bulk to the Red Cross Headquarters at Berne, Switzerland, and packed in parcels not to exceed 11 pounds in weight, according to the specifications required by the German government, and sent three times every two weeks to the American prisoners held in Germany. It was our task to see that such a parcel contained enough food value for the American prisoner to last him until the next parcel should be due to arrive. Articles had to be selected which could be packed in small cartons, and which would be certain to keep for the necessary length of time. These articles also had to be such as could be prepared readily for eating under the limited facilities of the prison camp. The list as finally made up runs somewhat as follows: rice, sugar, dried beef, pork and beans, peanut butter, soda crackers, evaporated milk, milk chocolate, desiccated strawberry, jam, nutmargarine and dried figs. Provision was also made for variation and substitution such as tea for coffee, marmalade for jam, oleo for nutmargarine, dried apples, apricots, etc., for dried figs, hominy for rice, corned beef for dried beef, etc. I think we may all feel comforted by the thought that if an American soldier is taken prisoner, he will, by this beneficent arrangement of the Red Cross, at least be well fed. Information which seems to be perfectly reliable from the Red Cross representatives at Berne assures us that the British provisions for their soldiers, which are quite similar to ours, are not interfered with, in any way, by the German government at the present time.

The requirements of the sick soldier are very different from those of the healthy

soldier. Considerably more latitude is required in the selection of foods which may tempt the appetite of the soldier, if ill in bed. The realization of these facts led to another request from the Red Cross for a ration to be known as the Invalid Ration. This was designed in the first instance for American prisoners in Germany too ill to be out of bed, but it has been thought that the same ration could be used also by sick soldiers in our own hospitals in this country. This ration therefore has been constructed with the idea that it could be used by sick soldiers anywhere in our own service, or in the prison camp. The ration has been approved by the President and adopted. It follows: unpolished rice, yellow cornmeal, sugar, potted chicken, Julienne or compressed soup tablets, dried milk powder of malted milk, beef extract, minute tapioca or other form of prepared pudding crackers, tea, milk chocolate, marmalade, fresh fruit or fruit juice. These articles, however, are regarded as only supplementary to those of the regular ration, whether prisoners' ration or the garrison ration.

It is comforting just now to remember that the status of the science of nutrition in America is fully equal to its status in the land of our enemies at the beginning of the war. If we fail in the trial that is upon us, it will not be for lack of information. If we fail to keep our civilian population properly nourished, it will not be because we do not know the functions of food, or because we do not know what foods are suitable. Likewise with the army.

Our own government has been foremost in the support of scientific investigations along these lines. The names of Atwater, Chittenden, Lusk, Benedict, Mendel, Osborne, Taylor, McCollum, Alsberg, Armsby are known wherever the science of nutrition is studied, and the completeness of their work is openly admired and envied in Eng-

land, France, Scandinavia, and even in Germany. Immediately preceding the outbreak of the war, no less than a dozen young German investigators of promise had studied in American laboratories, because the work of several of these laboratories was considerably in advance of similar laboratories in Germany or Austria. The support of these laboratories by the national government, by state governments, and by our wealthy benefactors, Carnegie, Rockefeller, Mrs. Sage and others was responsible for their splendid equipment. But the leadership also was not lacking. In fact, the scientific leadership pointed the way to the benefactions and governmental appropriations.

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ICELAND SPAR IN MONTANA

THE existence of large deposits of pure calcite has recently been brought to the attention of the Bureau of Mines. These deposits occur near Gray Cliff, Montana, and have been inspected by Dr. S. C. Lind, of the Bureau. At the present time there is no considerable market for pure calcite. It is used for the manufacture of some kinds of glass. Perfect crystals of calcite are used in certain optical instruments. In the past practically all the optical material has been mined from one deposit in Iceland. The crystals from the Montana deposit appear to be the nearest approach to Iceland spar yet uncovered in any part of the world.

Since the seventeenth century science requirements for optically perfect calcite have been supplied almost wholly from the well-known but small deposit on the east coast of Iceland. This is a very remarkable occurrence, consisting of a cavity in basalt completely filled with enormous crystals of pure calcite. Rhombohedrons and scalenohedrons with diameters as great as three feet have not been uncommon. In recent years, however, the