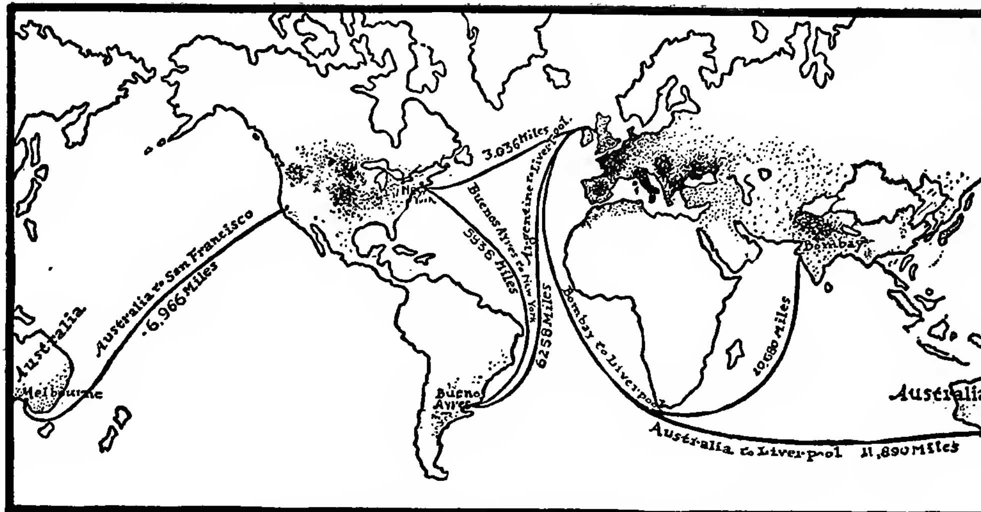
FOOD AND THE WAR

THE UNITED STATES
FOOD ADMINISTRATION



TRADE ROUTES TO EUROPE

The dotted areas show the location of the wheat fields of the world

FOOD AND THE WAR

A Textbook for College Classes

PREPARED UNDER THE DIRECTION OF

THE COLLEGIATE SECTION

OF THE

UNITED STATES FOOD ADMINISTRATION

WITH THE COÖPERATION OF

THE DEPARTMENT OF AGRICULTURE
AND THE BUREAU OF EDUCATION

Price 80 cents. Postpaid

HOUGHTON MIFFLIN COMPANY

BOSTON NEW YORK CHICAGO

The Riverside Press Cambridge

The Riverside Press
CAMBRIDGE . MASSACHUSETTS
U . S . A

FOOD AND THE WAR

UNITED STATES
FOOD ADMINISTRATION

To the Women of the Universities and Colleges:

The United States Food Administration calls you to its service. Our need is so great that we appeal to you to prepare yourselves and to enlist for the great work that must be done.

All our questions now center in food; its production, its distribution, its use, its conservation. The more you know about these things, the more valuable you will be, and the greater will be your service to humanity.

We urge you to pursue those studies which deal with food, and to train yourselves for real leadership.

The time is coming soon when the souls of men will be tried as never before. They must have the truth that will make them free. They will listen to you if you can give them that truth.

To-day your country asks you to resolve to do what you can in this the hour of extreme peril to the democratic peoples of the world.

Faithfully yours,

Herbert Hoover

UNITED STATES
FOOD ADMINISTRATION

To College Men:

If you cannot get into the ranks, you can yet fight with your fellows who have gone. *Will you?*

The battle-field is here. The battle is now.

The struggle for Democracy is within you.

It is as important for you to do your duty at home as it is for the boys to do theirs "over there."

It is as necessary to provide food for our armies, and for the armies and families of the Allies, as it is to face the enemy.

Therefore,

1. Be intelligent; inform yourselves about food.
2. Create more food if you can.
3. Do not waste any.
4. Do not allow others to waste any.
5. Obey the food regulations, — they are the careful and honest work of those who know what they are doing.
6. By every legal means prevent their violation by others.
7. Help every one who is trying to serve in the cause of food.
8. Be aggressive agents of the Food Administration wherever you go.

What you are to be through life will be decided by what you do to-day in this crisis of human history.

Herbert Hoover

FOREWORD

The following pages are a revision of the outlines for three courses prepared for college classes and sent out in weekly installments during the Spring Semester of 1918. In Part I the contents of the first two courses have been combined. The more important statements which should be emphasized, and which should be included in a survey course, are printed in large type. More detailed matter is printed in small type. By this device it is believed that the text is made suitable for courses of varying length and character.

Part I was written by Katharine Blunt, Ph.D., Associate Professor of Food Chemistry, University of Chicago, assisted by Florence Powdermaker, B.S., of the Department of Agriculture. Valuable assistance was also given by Katharine Gallagher, Ph.D., Professor of History, Goucher College; James Ford, Ph.D., Associate Professor of Social Ethics, Harvard University, with chapter xv; Dorothy Reed Mendenhall, M.D., University of Wisconsin and the Children's Bureau, with chapter xiv; and by members of the Food Administration and the Department of Agriculture.

Part II was written by Elizabeth C. Sprague, Professor of Home Economics, University of Kansas.

The authors have had access to the records of the Food Administration. They have consulted freely with those of its officials who are engaged with matters which have been treated in the courses. Statements of methods and policy have been passed upon by those who are responsible for them.

The Food Administration makes grateful acknowledgment of the cordial support of the universities and colleges and the efficient coöperation of the many hundreds of teachers who have made use of these outlines during the past year, and indulges the hope that in this revised form they will be found increasingly useful.

OLIN TEMPLIN
Director of the Collegiate Section

Washington, D.C.,
August 1, 1918.

CONTENTS

PART I

CONTENTS

PART II

PART I
FOOD AND THE WAR

KATHARINE BLUNT
FLORENCE POWDERMAKER

FOOD AND THE WAR

CHAPTER I

INTRODUCTION TO THE WORLD FOOD SITUATION

I. Food resources before the war.

In order to understand the food problem and to realize its full significance in relation to the war, it is necessary to know the many phases of the normal supply and distribution of food, as well as the changes brought about by the war and the measures taken by the different countries to secure an adequate supply for their people. Many countries produce the greater part of their food supply, especially those staples which make up the bulk of the diet — cereals, animal products, potatoes, and beans.

A. Europe.

1. Europe has always been a great agricultural region. France, Germany, and Austria-Hungary produced nearly all the food they required, and Russia produced more than enough for herself. But England and Belgium were so densely populated that even with intensive cultivation they produced only slightly over 50% of their food.
2. The important foods imported were wheat, meat, fats, and sugar.

I. Food resources before the war (*continued*).

a. Part of these was supplied by intra-European commerce; e.g., Russia exported wheat and dairy products to England.

b. But the chief sources of food imports were the United States, Canada, Argentina, and Australia. Wheat was imported from India also, and sugar from Cuba and Java.

3. Though nearly independent of food imports, some of the European countries were dependent upon the importation of certain materials essential for food production—fertilizer and cattle feed. This was especially true of Germany.

B. The United States.

1. Our fundamental available resources are larger than those of any other country. "The United States is the greatest granary, food store, and butcher shop in the world."

2. But these resources had not, before the war, nearly attained their maximum yield. Our food imports even exceeded slightly our food exports in money value.

II. The changes brought about during the war.

A. Low average yield of crops in 1915–16. This happened in nearly all parts of the world and was due chiefly to unfavorable weather conditions.

B. Steadily diminishing production of food in Europe.

II. Changes brought about during the war (*continued*).

1. Due to —
   a. Diversion of men from the farms to the army and the navy.
   b. Decreased importation of fertilizer, which is especially necessary on lands which have been intensively cultivated for centuries.
   c. Decreased importation of cattle feed. More feed could not be grown at home because the land available had to be used for bread cereals.
   d. Devastation of farm and cattle-grazing land. One-fifth of France has been fought over.
   e. Decrease in the available farm machinery in some countries especially because of lack of means for repairing it.
2. Resulted in —
   a. A cereal crop in 1917 for the Allies 525,000,000 bushels below normal.
   b. A decrease in the number of animals in the Allied countries by over 100,000,000 head during the first three years of the war.
   c. A greatly reduced production of fats and sugar.

C. Greatly increased difficulty of importation into European countries due to —

1. The submarine campaign, resulting in —
   a. Decreased tonnage and the consequent

II. Changes brought about during the war (*continued*).

cutting off of distant markets. It takes twice as much tonnage to bring supplies from Argentina as from the United States and three times as much from Australia. About 1,500,000 tons of shipping could be saved if it were possible to withdraw ships now taking food from Australia, India, and South America to Europe. (See the frontispiece.)

b. The sinking of food. Earlier in the war this was perhaps 10% of the shipments of food.

2. Interruption of intra-European commerce.

a. The Western Allies cannot obtain supplies as formerly from Russia. The Balkan countries are themselves in a destitute condition and are separated from the Allies by the enemies' lines.

b. Supplies from surrounding neutrals have been reduced by the demands of Germany.

c. The railroads are in such great demand for military purposes that their normal pre-war functions are greatly limited.

D. Therefore, the main burden is thrown upon North America, which must export much more than ever before. "Ours is the splendid burden of feeding the world." This obligation has been met in part by increased production and in part by conservation by the people of the United States and Canada.

II. Changes brought about during the war (*continued*).

E. This shortage has resulted in one food crisis after another in the warring countries of Europe, with actual starvation in large parts of Roumania, Russia, Poland, and Belgium. In

Reproduced by courtesy of National Geographic Society

II. Changes brought about during the war (*continued*).

England, France, and Italy there is enough to live on, but the margin is so small that at times the situation threatens to be of vital military importance. The responsibilities of the United States are very heavy and are of peculiarly personal significance, as it is only by the realization and sharing of this responsibility by each one of us that it can be fully met.

III. Need for some kind of food control because of these extraordinary conditions.

A. To provide an equitable distribution between the different groups to be supplied, the civilian population, the Army and Navy, and neutral nations.

B. To limit consumption of special foods when necessary.

C. To prevent exorbitant prices due to hoarding, to speculation, to excess profits, and to the breaking down of the law of supply and demand.

D. To effect coöperation between diverse yet closely related activities, such as those of grain production and the railroads.

E. To educate the public to the need and method of food conservation.

IV. Methods of food control.

A. Control of the food industries.

1. Partially, by setting a price; by making agreements with the members of the industry as

IV. Methods of food control (*continued*).

to the distribution of their output; by making a government license a necessity for doing business, and if the regulations are not obeyed, by taking away the license, etc.

2. Completely, by the taking over of the industry by the Government.

B. Restriction of sale of food by dealers. This is the method usually first adopted as interfering less directly with the personal freedom of consumers. Some illustrations of the methods are:

1. Prohibition of the sale of certain articles; e.g., through the closing of meat shops in France for three days each week; the prohibition of the sale of cream in England except in special cases.
2. Control of the quantity and character of the food sold. This method has been adopted for one commodity or another in all the countries at war; e.g., the composition of baker's bread; the 50–50 rule for the purchase of cereals in this country.
3. Limitation on the amount and kind of food sold in hotels and restaurants. This is in force in all the warring countries.

C. Rations — the restriction of purchase by the consumer.

1. Adopted early in the war by the Central Powers, gradually forced upon most bellig-

IV. Methods of food control (*continued*).

erents and neutrals, at least in regard to a few staples. All individuals or family groups are registered and issued some form of purchasing license showing the quantity of the rationed food allowed. These are usually in the form of a card or a book of coupons and must be presented to the dealer before the rationed article can be bought. Strict control of the distribution of rations is maintained, providing a more equitable distribution between rich and poor.

2. The adoption by the United States of compulsory rationing as it is known abroad bristles with difficulties.

   a. Fifty per cent of our population are either producers or live in direct contact with the producer, and their consumption cannot be restrained by any rationing system.

   b. The population varies greatly in its food habits in different sections of the country. For example, the Southern worker consumes perhaps not more than two pounds of wheat per week, whereas the Northern worker sometimes consumes eight pounds. Any rationing of wheat, therefore, might increase consumption in the South and unnecessarily decrease it in the North.

   c. A compulsory system would be undemocratic because it would put the burden on those who could bear it least well.

IV. Methods of food control (*continued*).

d. Very intricate regulations are necessary to meet different cases; e.g., the variations in the rations allowed persons doing different kinds of physical labor, provisions for meals taken away from home, etc.

e. The cost of instituting and administering a rationing system would approximate $10,000,000 to $15,000,000 annually, and would require the services of a small army to carry it out.

D. High prices as a method of limiting consumption. The national tendency in war-time toward heavy inflation of prices, unless kept down by control, results in conservation by the poor but has no effect on the rich.

E. Voluntary regulation of individual consumption under government direction. This may take the form of —

1. Omission or general cutting down of certain foods, or the substitution of other foods, wholly or at specified times; e.g., wheatless or meatless days or meals.

2. Voluntary rationing — limiting the quantity of certain staples which an individual will consume per week.

V. Food control abroad. (Details of the regulations are given under the different commodities.)

The Allies, as well as Germany and Austria-Hungary, have had to establish a Ministry of Food

V. Food control abroad (*continued*).

with a Food Controller in charge. They have all adopted a compulsory rationing system for one food or another and all exercise a large measure of control over food industries and dealers in food, including hotels and restaurants. The baking industry is especially subject to careful and often detailed regulation.

A. Until recently, Great Britain, more than any of the Continental countries, relied on voluntary coöperation. But in November, 1917, a scale of voluntary rations of bread, cereals, meat, fats, and sugar was introduced and widely adopted. Later the consumption of meat, fat, and sugar was limited by compulsory rations.

B. France made no attempt at government control of consumption during the first years of the war. Then sugar and bread were rationed. Both meat rations and compulsory meatless days have been enforced at different times.

C. The European neutrals have not escaped the food shortage, and most of them have rationed the most important food staples.

D. Germany's foods of almost every variety are rationed. The system is carried farther than in any other country, and in addition all the food industries are working under the strictest government control and supervision. Besides the ordinary staples — meat, fat, bread, and sugar — such foods as potatoes, eggs, cheese, and jam, and even coffee substitutes, artificial

V. Food control abroad (*continued*).

honey, and sauerkraut, are rationed in some cities.

E. Belgium has its food supply more entirely controlled than any other country and it is this control that is saving Belgium from starvation. The Commission for Relief in Belgium imports the necessities — mostly wheat, fats, bacon, sugar, dried beans, and peas — and divides them equitably among the millions of people. The whole business of flour milling and baking, as well as the distribution of bread and the profits of the men handling it, is under the immediate control of the commission.[1]

VI. Food control in the United States — the United States Food Administration.

A. President Wilson, on May 19, 1917, outlined the food control program and asked Mr. Hoover to become the Food Administrator. Mr. Hoover accepted on condition that Congress grant powers on which a competent administration could be set up.

B. The Food Control Bill was passed by Congress on August 8 and signed by the President on August 10.[2] The act authorized government control of food, feeds, and fuel, from the time they leave the producer to the small retail shop.

[1] Kellogg, V. *Fighting Starvation in Belgium.* Doubleday, Page, 1918.

[2] See text of Bill: H.R. 4961. See also Van Hise, Charles R., *Conservation and Regulation in the United States*, p. 51 (1917); Kellogg, Vernon, and Taylor, A.E., *The Food Problem*, p. 20. Macmillan, 1917.

VI. Food control in the United States (*continued*).

C. The policy of the Food Administration.

1. To accomplish its work in accordance with our democratic traditions and therefore as much as possible by voluntary coöperation rather than by autocratic control.

2. To use compulsion only on those individuals or organizations that refuse to coöperate.

D. Its great task — so to administrate America's food resources that the American and Allied morale will not be lowered through lack of food.

E. Organization.

1. National headquarters in Washington consisting of the Food Administrator and his aids. The Food Administrator calls to his assistance experts to deal with various problems as they arise.

2. Federal Food Administration in the States.

This is designed to decentralize the work of the Food Administration and to coördinate the state and federal activities. The organizations vary according to local needs, but, in general, each Federal Food Administrator has among other members of his staff a Home Economics Director, and has appointed County Food Administrators who also have their staffs.

3. Coöperation with established agencies such as the government departments, state agencies,

VI. Food control in the United States (*continued*).

educational institutions, commercial houses, religious and fraternal organizations, etc.

F. The work of the Food Administration — a few of its accomplishments. (Details are given in later chapters.)

1. The teaching of the people.

In order to secure intelligent coöperation in its work a large amount of education was necessary to acquaint the people with the details of the situation, and to keep them informed of the constantly changing conditions. Many of the results which the Food Administration has accomplished have been made possible because of the knowledge spread broadcast throughout the country by the newspapers and magazines, by Food Administration speakers, and by the effective coöperation of the women of the country and the managements of hotels and dining-cars.

2. The maintenance of an even distribution of food and the keeping down of prices.

Food riots due either to lack of food or high prices are a mark of failure of a food administration. The Food Administration has not only accomplished an even distribution of food through such agencies as the Grain Corporation, but it has prevented the rise in price of indispensable commodities such as bread and sugar, and it has done this in the face of an unprecedented demand.

VI. Food control in the United States (*continued*).

3. The shipping of food abroad.

During our first year as a belligerent (April 1, 1917, to April 1, 1918) we exported fifteen billion pounds of food — an increase of more than 200% over the pre-war average. The food shipped was enough to ration completely over 21,000,000 men, and to supply a considerable surplus of protein-rich foods and fats besides. Much of this surplus was the result of the saving of the American people. This was done in spite of the fact that the estimated total production of the country for the fiscal year, in terms of nutritional units was from 7% to 10% below the average of the previous years. In a letter written on July 11, 1918, to President Wilson, Mr. Hoover says that he is "sure that all the millions of our people, agricultural as well as urban, who have contributed to these results should feel a very definite satisfaction that in a year of universal food shortages in the northern hemisphere all of those people joined together against Germany have come through into sight of the coming harvest not only with health and strength fully maintained, but with only temporary periods of hardship. The European allies have been compelled to sacrifice more than our own people but we have not failed to load every steamer since the delays of the storm months last winter. Our contributions to this end could not have been

VI. Food control in the United States (*continued*).

accomplished without effort and sacrifice and it is a matter for further satisfaction that it has been accomplished voluntarily and individually. It is difficult to distinguish between various sections of our people — the homes, public eating places, food trades, urban or agricultural populations — in assessing credit for these results but no one will deny the dominant part of the American women."

REFERENCES

American Academy of Political and Social Science. *Annals*, November, 1917. *The World's Food*, part 1, pp. 1–34.

Kellogg, Vernon, and Taylor, A. E. *The Food Problem*, chaps. 1 and 3. Macmillan, 1917.

Smith, J. R. *Industrial and Commercial Geography*. Holt, 1913.

United States Food Administration, Bulletins 1 to 16.

Van Hise, Charles R. *Conservation and Regulation in the United States*, 1917, part 1; part 2, chaps. 5 and 6. (Part 1, published by United States Food Administration. Part 2, published by University of Wisconsin, Madison, Wisconsin.)

CHAPTER II

THE COMPOSITION AND FUNCTIONS OF FOOD

THOSE now in charge of the feeding of a nation are thinking of food not only as part of a meal, but as so much protein, fat, carbohydrate, mineral matter, and water and as a source of the necessary vitamines. Exports are frequently spoken of in terms of tons of protein or millions of calories. The private citizen is no less interested in the constituents of food and the food needs of the body. Such knowledge is the first essential of intelligent economy and conservation.

The brief general survey of the composition of food in this chapter is given as a preliminary to more detailed study in later chapters. Students who have studied foods will probably be able to omit this chapter.

Many foods contain most of the food constituents mentioned above. Some few, such as sugar or oil, contain only one. Students in connection with this work should look up the composition of numerous foods, raw and cooked and group them according to the predominating constituent.

I. Carbohydrates — the most important constituents of our food in point of bulk.

A. The important kinds.

1. Starch. This is eaten chiefly in grain products — in flours and meals made from wheat,

I. Carbohydrates (*continued*).

corn, barley, and the other cereals. They all contain from 60% to 70% starch. Bread is about one-half starch and potatoes and sweet potatoes are approximately one-fifth starch. Some other vegetables and green fruit contain small quantities.

2. Sugars. Several of them are found in food — the ordinary sugar from cane or beet (chapter IX), glucose made from corn starch, and the sugar (lactose) in milk, all of which are similar but not identical. Fruits and many vegetables contain considerable amounts of the various kinds of sugar; e.g., a large orange or one-fourth cup of raisins may contain as much as two tablespoons of sugar.

3. Cellulose or crude fiber. This carbohydrate occurs in foods in much smaller quantities than starch or sugar. It is found in most vegetables and fruits and in such flours and other cereal products as contain bran.

B. Elements in carbohydrates.

Carbon, hydrogen, and oxygen. When carbohydrates, therefore, burn inside or outside of the body the products are carbon dioxide and water.

C. Fate of starch and sugar in the body.

1. Digestion: — Both are practically completely digested especially if the starch is cooked. If raw starch is eaten, however, such as that in

I. Carbohydrates (*continued*).

uncooked green bananas, some of the starch may escape digestion and utilization.

a. Starch is acted on by the saliva in the mouth, the action is continued for a time in the stomach, and the process is completed in the small intestines. The large starch molecule is broken up until the simple sugar, glucose, is obtained as the end-product.

b. Sugars are digested mostly in the intestines, giving glucose or similar simple sugars. Thus starch and sugars are ultimately changed to practically the same products in the body.

2. The products of digestion are absorbed into the blood. They are carried to the muscles or elsewhere and burned as fuel to maintain body temperature and to give energy for the body's movements. That which is not needed for fuel may be changed to fat and stored in the body.

D. The function of cellulose.

Cellulose is scarcely changed at all in going through the body. It serves as the indigestible residue or "roughage" of the food. A certain amount is desirable, as a diet which would be completely digested would be apt to cause constipation.

II. Fats.

A. Source in the diet.

They are obtained from isolated fats like butter, oleomargarine, and oils, and from foods containing fat like fat meats, cheese, milk, fried foods, rich cakes, and pastries. (See chapter VIII.)

B. Composition.

They contain the same elements as the carbohydrates — carbon, hydrogen, and oxygen, — but in different proportions. The composition of all fats is very similar, whether liquid or solid, highly flavored or "bland."

C. Fate in the body.

They are digested and absorbed in the intestines. They may be stored in the body or burned to carbon dioxide and water.

III. Protein (see chapter V).

A. Examples of nearly pure proteins. No food is composed only of protein, but some contain only water and mineral matter beside the protein.

1. Cottage cheese made from skim milk is protein plus a fairly large amount of water and some mineral salts (21% protein and 74% water).

2. Egg white is also almost entirelv protein and water (12.5% protein and 87.1% water).

B. Other protein-rich foods.

Among the more important of such foods are lean meat, poultry, fish, legumes (peas, beans,

III. Protein (*continued*).

peanuts), and cheese. Cereals, while containing somewhat less protein than these foods, are a very important source of supply because of their large quantity in the diet.

C. Elements in proteins.

Nitrogen is the element of the proteins which gives them their value as distinct from other food constituents. Proteins also contain carbon, hydrogen, oxygen, sulphur, sometimes phosphorus and a few other elements, including iron.

D. Fate in the body.

1. They are digested in the stomach and intestines to small units (called animo acids).
2. The digestion products are absorbed into the blood and used for —
   a. Growth or repair of all parts of the body. During the entire life of the body its constituent cells multiply to provide for growth and to replace the cells which degenerate and die. Proteins are important constituents of cells and must be supplied to them by the food.
   b. Manufacture of the various body secretions.
   c. Fuel.
   d. Proteins, therefore, have a double function — they are fuel foods like the carbohydrates and fats and they are necessary for the body's repair and growth.

IV. Mineral constituents or the ash of foods.

A. The inorganic elements in food.

These are calcium, sodium, potassium, iron, magnesium, sulphur, iodine, phosphorus, and chlorine. Compounds of them are left as ash when the food is burned.

B. Source in the diet.

1. They are present in all foods in the natural state, but sometimes are removed during processes of refinement, such as sugar and the oils undergo.
2. The quantities in food are small, but they are none the less important. The vegetables and fruits are among the most important sources, the content being highest in the leafy vegetables like spinach and cabbage. Milk is also important especially as a source of calcium. Egg yolks, meat, whole cereals, and many vegetables are high in iron. (See chapter XIII.)

C. Function.

1. They are essential for growth as a necessary constituent of the cell structure; e.g., of bones, teeth, nails, etc.
2. They must be present in proper amounts in the body fluids.

V. The "vitamines."

These are recently discovered and little known substances. They are as necessary for

V. The "vitamines" (*continued*).

health and growth as the other better known constituents of foods.

A. It is believed that there are two, both of which are present in various foods in minute quantities.

1. The fat-soluble A, so called because it is soluble in fats, is present in milk, in butter, in beef fat, especially in the fat within the organs, in egg yolk, cod liver oil, and in the leaf vegetables.

2. The water-soluble B is found in many products, milk, vegetables, fruits, meat, and whole cereals, but is absent from fats, sugar, and cereal products like white flour from which the outer parts of the grain have been removed.

B. A diet limited in either of these may cause a generally unsatisfactory nutritive condition, stunting of growth, disease, and even death. This is discussed further in connection with milk (chapter XII).

C. The ordinary mixed diet of the American people, provided it contains milk or butter and vegetables, is not likely to be low in these vitamines.

VI. Water.

A. The largest part of the majority of foods is water. It varies from about 90% in such vegetables and fruits as cucumbers, lettuce, apples,

VI. Water (*continued*).

etc., to about 10% in dry crackers and cookies and practically none in sugar and oils.

B. Water helps maintain the proper dilution of the body fluids and the cells. It assists in the elimination of body excretions. The drinking of considerable water is desirable. The old idea that drinking water with meals is harmful has been proved incorrect.

VII. A very useful and simple way to teach the proximate composition and use of foods is to divide them into five groups which emphasize similarities in composition and function (compare chapter XIV). Some overlapping is, of course, unavoidable.

A. Vegetables and fruits. Useful chiefly for mineral matter and the vitamines, and therefore for the growth, repair, and regulation of the body.

B. Meat and other protein-rich foods including milk. Their main function is as body-building foods.

C. Cereals. Primarily fuel foods.

D. Sweets. Eaten for flavor as well as fuel.

E. Fats. Fuel foods.

VIII. The digestibility of food.

The above brief statement of the constituents and digestion of foods does not take into consideration the completeness of the digestive process. Most foods are almost, but not entirely quite digested. A small, varying quantity is lost.

A. The coefficient of digestibility is the percentage of the food eaten which is actually lost.

VIII. The digestibility of food (*continued*).

B. Digestibility in this scientific sense must not be confused with ease of digestion, which depends to a large extent on the rapidity with which food passes through the digestive tract, especially the stomach, on the amount of food eaten, and on slight irregularities causing discomforts, such as the formation of gases. Ease or difficulty of digestion may have no relation to the amount ultimately digested, although it may have an importance of its own.

C. To determine the coefficient of digestibility of a food, — e.g., butter — a weighed amount of it is fed in conjunction with a mixed diet in which it forms the only source of fat, and the amount of fat in the feces is determined. Coefficients for carbohydrate and protein in food are obtained similarly, by comparing the amount of the food fed with the amount in the feces. Coefficients for all three constituents of a food may be determined simultaneously.

D. The values for the coefficients of digestibility.

1. For a general summary for proteins, fats, and carbohydrates from animal and vegetable sources, see table in Sherman's *Chemistry of Food and Nutrition*, p. 76. Note especially that —
   a. There is very little loss in digestion of the common foods, less than is popularly supposed.
   b. Healthy individuals differ very little in their power to utilize foods.
   c. The animal foods, especially the animal proteins, are digested somewhat more completely than the vegetable — an average of 95% of the animal protein and 78% to 85% of the vegetable protein.
2. Coefficients for individual foods.
   a. Look up the digestibility of various foods — as given, for example, in Sherman's *Food Products* — milk, meat, cheese, cereals, potatoes, beans, etc.
   b. Note the similarity of different kinds of fat — e.g., butter and oleomargarine — except the few fats of

VIII. The digestibility of food (*continued*).

high melting point, and also the similarity of wheat flour and its substitutes.

c. Read, if possible, accounts of some of the most recent work on digestibility. (See References.)

REFERENCES

Bateman, W. G. "The Digestibility of Egg White." *Journal of Biological Chemistry*, 26, pp. 263–291. 1916.

Langworthy, C. F., and Holmes, A.D. "Digestibility of Young Veal." *Journal of Agricultural Research*, 6, pp. 577–588. 1916.

Langworthy, C. F., and Holmes, A. D. *Digestibility of Some Animal Fats*. U. S. Department of Agriculture, Bulletin 310.

Langworthy, C. F. and Holmes, A. D., *Studies on the Digestibility of Some Vegetable Fats*. U.S. Department of Agriculture, Bulletin 505.

Lusk, G. *The Elements of the Science of Nutrition*, chap. 13. Saunders, 1917.

McCollum, E. V. *The Newer Knowledge of Nutrition*. Macmillan, 1918.

Mathews, A. P. *Physiological Chemistry*, chaps. 2, 3, 4. Wood, 1915.

Pease, M.C., and Rose, A. R. "The Banana as a Food for Children." *The American Journal of Diseases of Children*, 14, p. 379. 1917.

Rose, M. S. *Laboratory Manual of Dietetics*, chap. 1. Macmillan, 1917.

Sherman, H. C. *Chemistry of Food and Nutrition*, pp. 99–103. Macmillan, 1918.

Sherman, H. C. *Food Products*, chap. 1. Macmillan, 1917.

Stiles, P. G. *Nutritional Physiology*. Saunders, 1916.

CHAPTER III

THE FUEL VALUE OF FOOD

I. Food as fuel.

On burning, food, like everything else, liberates energy whether the burning takes place within or without the body. It is due to this energy from burning food that the body has —

A. The power to do physical work, the mechanical energy needed to make all the necessary voluntary and involuntary movements — the beating of the heart, the movement of the lungs in respiration, the movement of the body when walking, and muscular work in general.

B. The heat necessary to keep the body at the temperature of 98.6° F., considerably above the usual temperature of the surrounding air.

II. Measurement of the fuel value of food.

When a food burns inside or outside of the body, a definite amount of heat is given off. This heat can be measured by causing it to raise the temperature of a given weight of water. In accordance with the law of the conservation of energy, mechanical energy as well as heat can be measured in terms of heat.

A. The unit for measuring fuel value. The large calorie is the amount of heat necessary to raise the temperature of 1 kilogram of water 1° C.

II. Measurement of the fuel value of food (*continued*).

This is commonly referred to merely as the calorie by the physiologist, but must be distinguished from the physicist's calorie, the small calorie, one-thousandth the size of the large calorie.

This can be better grasped if it is realized that 100 calories of heat (the amount of fuel available from the ordinary serving of many foods) would raise the temperature of 1000 c.c. of water from the freezing to the boiling point, provided the heating was done in an apparatus devised to prevent any loss of heat to the surroundings.

B. The method of measuring the calorie value of foods.

1. The apparatus — the bomb calorimeter. A tightly closed vessel or "bomb" surrounded by a known weight of water. The whole is insulated so that the heat produced in the bomb is absorbed by the water. A weighed quantity of food is ignited in the bomb and the rise in the temperature of the water noted.
2. Results observed. With correction for the little differences between burning in the bomb calorimeter and in the body, it is found that a gram of pure protein or carbohydrate each gives the body 4 calories of heat, and a gram of fat, 9 calories.

C. The method of calculating the fuel value of a food. If the percentage composition of the food

II. Measurement of the fuel value of food (*continued*).

is known — i.e., the grams of protein, fat, and carbohydrate in 100 grams of food — the fuel value may be computed by multiplying the percentages by 4, 9, and 4 calories respectively, and the sum gives the total calories obtainable from the 100 grams of food. The use of the bomb calorimeter is thus not necessary for every food.

D. Relation between the elementary composition of a food material and its heat of combustion.[1]

E. Differences between burning food in the calorimeter and in the body.

1. Food is completely burned in the calorimeter. In the body a small amount is left undigested and thus lost.[2]
2. The end products of combustion of protein are slightly different —
   a. In the calorimeter, the end products are nitrogen and nitric acid.
   b. In the body, the final product is urea, a compound which is burned in the calorimeter with the production of heat. Therefore, slightly less energy is obtained from protein burned in the body than from protein burned in the calorimeter.
3. There are thus two corrections to be made to the heat of combustion as obtained in the calorimeter.

F. The old and the new physiological fuel values — the calories produced by the burning of one gram of protein, fat, or carbohydrate in the body.

1. The old factors, 4.1, 9.3, 4.1, used in U.S. Department of Agriculture, Bulletin 28, *The Chemical Composition of American Food Materials*, and in most of the older works are higher than the new, because

[1] See Sherman, *Chemistry of Food and Nutrition*, p. 141.
[2] See coefficients of digestibility in chapter II.

II. Measurement of the fuel value of food (*continued*).

only the first of the above corrections was made, and no allowance was made for losses in digestion.

2. The new factors, 4, 9, 4, used in practically all of the newer work, include both corrections.

III. The 100-calorie portion — a dietetic unit for comparing the fuel value of food.

A. A convenient method of comparing the fuel value of foods. It happens that the average serving of many of the ordinary foods has a fuel value of 100 calories. If the size of these portions is learned, it is comparatively easy to count up the total calories in a meal. For example, 100 calories are obtained from two slices of bread about 1/2 inch thick and 3 1/2 inches square, an inch cube of butter, a banana, orange, a large apple, a generous portion of oatmeal (five heaping tablespoons). It takes a larger portion of foods which contain much water, such as lettuce, to furnish 100 calories and a much smaller portion of dry or fat foods, such as butter or nuts. (For other 100-calorie portions see References.)

B. Calculation of the weight of 100-calorie portions. It is suggested that students compute the weight for half a dozen foods.

1. Find the calories in 100 grams of the food; call this a calories. Compute from this the number of grams giving 100 calories.

a calories : 100 grams : : 100 calories : x grams.

This gives the weight of the portion in grams.

2. Convert these grams into ounces if desired. Since the gram is the easier unit of weight and is used in labora-

III. The 100-calorie portion (*continued*).

tories, and the pound and the ounce are the units for market and household use, it is necessary for the student to be able to convert one into the other readily.

1 ounce = 28.4 grams.
1 pound = 454 grams.

C. Suggestions for comparing the size of 100-calorie portions of different foods by exhibits grouping the portions in various ways.

1. Group together foods which are similar in composition; e.g., bread and other cereals or vegetables and fruits.
2. Compare foods which the Government is asking us to save with those which we may use freely. Note especially the comparison between meat and meat substitutes, such as fish, cheese, legumes, and nuts, and between wheat foods and their substitutes.
3. Group those foods for which the 100-calorie portion is smaller than an average serving (concentrated foods) and also those for which the 100-calorie portion is larger than an average serving (bulky foods).
4. Make combinations of portions or fractions of portions which would constitute a serving and count up the calories of your combinations; e.g., bread, butter or margarine, and meat for a sandwich; lettuce, celery, and oil for a salad.
5. Combine portions or fractions of portions in a breakfast, a luncheon, a dinner. Count the total calories in each case.

III. The 100-calorie portion (*continued*).

D. Cost of 100-calorie portions — a very useful method of comparing the cost of equal amounts of fuel. This is a more sensible way to compare foods than to make a comparison of the cost of equal quantities. We must recognize that if we buy the more expensive foods it is because we like the flavor and not that we are getting more or physiologically better food.

1. Method of calculation.

Find the number of 100-calorie portions of a food in the unit which you usually buy, then calculate the cost of this fraction; e.g., since the 100-calorie portion of flour or other cereal is 28.4 grams or 1 ounce, there are 16 of these portions to a pound costing x cents. Therefore the 100-calorie portion of flour costs $x/16$ cents.

2. Average price for 100 calories of a few foods.

(*American Food Journal*, July, 1918. The prices of various foods in different parts of the country and the average price of 100 calories are given each month in this journal.)

	Cents
Cereals	
Corn meal	0.43
Wheat flour	0.40
Macaroni	0.87
Bread	0.83
Crackers	1.18
Meats	
Beef, roundsteak	5.86
Chicken broilers	18.23
Salt mackerel	2.47
Salmon, canned	4.48
Fats	
Bacon	2.29
Creamery butter	1.48
Oleomargarine (uncolored)	1.00
Cottonseed oil	0.93

III. The 100-calorie portion (*continued*).

Vegetables	
White potatoes	1.27
Split peas	0.95
Canned peas (No. 2 standard)	5.40
Navy beans (dried)	1.06
String beans (canned No. 2 standard)	15.88
Peanuts	1.21
Fruits	
Evaporated peaches	1.30
Canned peaches	6.57
Raisins	0.96

3. The students should investigate prices in various neighborhoods and compare the cost of fresh, canned, and dried fruits and vegetables, bulk and package cereals; various kinds and cuts of meat and fish; various kinds of fat; granulated sugar, corn sirup, maple sirup, and honey.

4. Compare the cost of similar foods, not those of unlike function. Comparisons of the cost of calories from different kinds of foods — e.g., from vegetables and from cereals — may give mistaken ideas of relative values. We must have vegetables even though they are often expensive as a source of fuel.

IV. General statement of methods of comparing the calorie value of different foods.

A. The number of calories given by an equal weight or bulk of various foods are compared:

1. Calories per 100 grams of food.

2. Calories per pound. This is a common and useful method of comparison. It is used in the U. S. Department of Agriculture, Bulletin 28 (computed by the old factors) and in numerous recent food advertisements.

3. Calories per "serving." Interesting but less useful than the 100-calorie portion because there are more figures to remember and because of variations in servings.

IV. General statement of methods of comparing the calorie value of different foods (*continued*).

B. The weight or quantity of various foods necessary to give the same number of calories.

1. The 100-calorie portion.
2. The portion equal in calorie value to a pint or quart of milk. (See the Laboratory Manual, Section I, III, B.) Useful especially for emphasizing the value of milk.
3. The 2500-calorie portion which is about a day's requirement. Sometimes used for comparing larger quantities of food.[1]

C. Some advantages of the use of the 100-calorie portion.

1. The portions are fairly easy to remember, since for many foods they are roughly an average serving.
2. It is a graphic way of showing the low fuel value of watery foods and the high fuel value of dry and fat foods.

D. A possible danger of this and other methods of teaching calorie value, if they are not wisely used, lies in an over-emphatic presentation of the fuel value of food at the cost of an appreciation of the other factors of an adequate diet.

V. The present necessity for learning the fuel value of foods:

A. Because of shipping conditions: — With the present shortage of ships, it is obvious that only foods of the most concentrated sort can be sent abroad, such as fats and oils which contain little water and have therefore a high fuel value. For example, flour must be shipped rather than potatoes, which are 80% water, and dried instead of fresh vegetables.

[1] Gephart, H. C. and Lusk, G. "Analysis and Cost of Ready to Serve Foods. *American Medical Association*, 1915.

V. The present necessity for learning the fuel value of foods (*continued*).

B. For economic reasons: — A wise expenditure for food demands knowledge of how much in actual fuel value the money spent for food is buying. The cost of food in calories, not only in pounds or quarts, should be thought of.

REFERENCES

Lusk, G. "Food in War-Time." *Scientific Monthly*, 5, p. 289. 1917.
Lusk, G. "Food Values." *Science*, 45, p. 345. 1917.
Lusk, G. *The Fundamental Basis of Nutrition*, chaps. 2 and 6. Yale University Press, 1915.
Lusk, G. *The Elements of the Science of Nutrition*, chaps. 1 and 21. Saunders, 1917.
McCollum, E. V. *The Newer Knowledge of Nutrition*. Macmillan, 1918.
Mathews, A. P. *Physiological Chemistry*, chap. 6. Wood, 1915.
Mendel, L. B. *Changes in the Food Supply and their Relation to Nutrition*. Yale University Press, 1916.
Rose, M. S. *Laboratory Manual of Dietetics*. Macmillan, 1917.
Rose, M. S. *Feeding the Family*, chap. 1. Macmillan, 1917.
Sherman, H. *Chemistry of Food and Nutrition*, chap. 6. Macmillan, 1918.

CHAPTER IV

THE BODY'S FUEL REQUIREMENTS

THE animal body is constantly producing energy (heat and energy of motion), and therefore has to be constantly supplied with fuel.

I. Apparatus for measuring the body's energy production or fuel needs.

There are several kinds of apparatus in use. One of the most important is called a respiration calorimeter. It is a large box or small room large enough for a bed or chair or in some cases large enough for a man to do various exercises. It is double-walled and insulated so that there is no loss or gain of heat from the outside room. Heat produced by the subject in it is carried off by a weighed amount of water which circulates in pipes on the inside walls and the amount of this heat is measured by the rise in temperature of the water. A properly regulated draft carries away the carbon dioxide and water vapor produced by the subject and forces in oxygen. These gases are all measured.[1]

II. What does the body burn to produce its energy?

A. It burns either itself or its food. By studying the end-products of combustion — the excretions of the body in the form of carbon dioxide

[1] For pictures and diagrams, see Sherman, H. C., *Chemistry of Food and Nutrition*, pp. 161, 163, 167.

II. What does the body burn to produce its energy (*continued*).

and water vapor, and the nitrogen in the urine — it is possible to know whether fat, carbohydrate or protein is being burned, and how much of each.

B. The body's energy production and the body's need for fuel are one and the same thing. The two expressions may be used interchangeably.

III. How much energy does the body produce; i.e., what are its fuel needs as shown by the calorimeter?

A. At rest the requirement is at a minimum.

A man lying quietly in bed, without food, is still producing energy because his heart is beating, he is breathing, etc. This is his minimum energy production — called his "basal metabolism."

1. The basal metabolism for different individuals of the same size varies only slightly and is equal on the average to 1 calorie per kilogram. (1 K. = 2.2 lbs.) Students should compute their energy production for the hours they usually spend in bed.

2. It varies more with —

a. Size. The basal metabolism of different individuals is roughly proportional to their size. Size is usually expressed as weight, but such expression is slightly inaccurate. The fat person, because his fat deposits

III. How much energy does the body produce (*cont'd*).

are not an active part of the body, has a slightly lower basal metabolism for his weight than the thin person. Women have on the average a very slightly lower basal metabolism than men of the same weight, probably because they often have larger fat deposits.

b. Age. Children have a higher metabolism per kilogram than adults. Boys of 12 to 16 years average 25% higher than grown men. This does not include their greater energy production when active, but is due to their quickened life processes. Old people have a slightly diminished metabolism.

B. Activity greatly increases energy production.

Variations due to activity are much greater than those due to any other cause.

1. Even the simplest muscular tensions or motions bring increased energy production. Sitting as one usually does in a chair with ordinary movements adds about 20 calories per hour. Even sitting perfectly quiet requires about 5.6 calories per hour more than lying in bed. A ten-mile walk may increase the energy production by 600 calories.
2. It is thus easy to see that a person may vary from day to day in fuel demands and also that for two persons supposedly living the same life, the greater restlessness of the one may cause a somewhat greater energy pro-

III. How much energy does the body produce (*cont'd*).

duction. These differences between individuals are not so great, however, as is popularly supposed. Ideas of differences in fuel demand and food consumption are apt to be exaggerated and often depend upon high intake of some one conspicuous food which may be balanced by the low intake of other foods.

3. Extreme muscular activity may increase energy production (fuel needs) up to 10,000 calories for 24 hours. This excessive amount has been observed for a professional bicyclist working hard on a stationary bicycle.

C. Mental work does not require increased fuel.

Students at Wesleyan University were put in the respiration calorimeter to take examinations, and at another time merely to copy printed material. No increased energy production could be observed during the hard mental work done in the first period. This is at least in part explained by the fact that the central nervous system is only 3% or 4% of the body and that only a very small part of it probably increases in activity when mental work is done. Mental fatigue and measurable heat production have no relation to each other.

D. Taking food increases the energy production.

1. We should expect that feeding a starving person would merely result in his burning the food in place of an equivalent amount of body fuel.

III. How much energy does the body produce (*cont'd*).

2. Instead, an extra amount of fuel is burned, a small excess if the food eaten is carbohydrate or fat, a larger excess if the food is protein. The total extra heat production or fuel need with an average diet is about 7 calories per hour or 170 calories per day.

3. This effect of eating protein, called its specific dynamic action, gives it special value in cold climates. An illustration is the usefulness of meat to Esquimos. It also makes inadvisable the eating of too much protein in summer.

E. Fever may increase the energy production.

This has been measured on numerous typhoid patients in the bed calorimeter at Bellevue Hospital. The increase may be 50% above normal. With the old, low-feeding method of treating typhoid, the body burned its own substance. The great emaciation and weakness and much of the discomfort of typhoid were due to this semi-starvation. The newer "high calorie" treatment gives the patient 3000 to 6000 calories per day, and prevents loss of body substances and much of the usual suffering.

F. For details of work on the energy requirement of infants, of men during starvation, of men walking, running, bicycling, of vegetarians, of men compared with women, of athletes compared with non-athletes, of patients with diabetes and other diseases, see References.

G. Average figures for energy production (fuel needs) allow 3000 calories for a man of average weight (70 kilograms) at moderate muscular work, for one at sedentary work, 2500 calories. The woman's requirement is taken as eight-

III. How much energy does the body produce (*cont'd*).

tenths that of the man's since her average weight is 56 kilograms. Figures for children of different ages are given in Sherman's *Chemistry of Food and Nutrition*, p. 197.

H. It is suggested that students compute the calorie requirement for different families. (Compare with the Belgian ration, given in the Laboratory Manual, Section I.)

I. A recent American experiment on reduced diet.

1. A remarkable series of experiments on reduction of diet have recently been carried out at the Nutrition Laboratory in Boston to get data which might be used in case of national food shortage.
2. Twelve young men students of the International Y.M.C.A. College were the subjects. Before the experiments their normal demand ranged from 3200 to 3600 net calories. Their diet was much reduced resulting in a reduction in weight of 12% within 3 to 10 weeks. After the loss in weight they maintained their lower weight on about 2300 net calories, or approximately one-third less than their original requirement. The experiment was continued for four months. The diet was a varied one from the college dormitory.
3. Among the chief results, beside loss in weight, were markedly lower basal metabolism, loss of body nitrogen, astonishingly lowered pulse rate — many as low as 33 in the morning. The young men successfully kept up their college work and their physical vigor. Some said that they lacked "pep," but one won a "hare and hounds" race at the end of the four months' period. (This research will shortly be published by Dr. Benedict and his co-workers in a monograph of the Carnegie Institution of Washington.)

IV. The appetite as a guide to fuel requirements.

A. It is often a fairly good indication of fuel needs.

1. The constancy of the weight of many people at a normal level shows that their fuel supply and demand are approximately equal.

2. Studies of the dietary habit of well-nourished people are on the average in fair agreement with laboratory experiments.

B. It is not trustworthy if personal tastes or idiosyncrasies prevent the consumption of a balanced diet, such as an excess consumption of alcoholic liquors or any particular food. Such indulgence in a food because it is liked rather than because of real physiological appetite is very common.

C. It is a completely reliable indication only when the body is kept in excellent health without interruption for a long term of years. Laboratory experiments with animals on an inadequate diet have shown that they may continue in apparent good health for some time and then suddenly fail, or they may remain in good health and their offspring be abnormal. Therefore scientific knowledge is a most desirable aid to the appetite.

V. Fuel needs (as well as the needs for the food constituents) as shown by food consumption — by studies of dietaries and of the food supply.

A. What a dietary study is.

1. It is a direct quantitative study of the food consumption of an individual or group. In sufficient numbers, die-

V. Fuel needs (*continued*).

tary studies will give a picture of the food habits and nutritive condition of a country. They may be made by weighing all the food eaten by the individual or group, or weighing the food at hand at the beginning and at the end of the study, the food brought in during the study, and all waste. All the foods are analyzed or their composition is computed from published analyses.

2. Note must be made of the social status of the group, of the income, housing conditions, and nationality, the number, age, sex, and occupation of members of the family or group, and the health conditions.

3. The results are usually brought to a uniform basis by using factors representing the ratio between the food consumption of persons of different age, sex, and occupation and that of a man in full vigor, doing moderate muscular work. This is usually called "per man per day basis" or the "man ration" basis. For instance, the food consumption of a woman is taken to be eight-tenths that of a man of corresponding age and activity. (Compare III, G, above.)

4. Conclusions may be drawn in regard to food habits and nutritive conditions and possible improvements in diet.

B. Statement of a few of these studies.

Thousands have been made the world over, more systematically in America than elsewhere.

1. Older work in this country.

   a. The first extensive work was undertaken in 1886 by Professor W. O. Atwater and C. D. Wright, to get information about workingmen's food consumption as part of a study of their budgets.

   b. Since then many other studies have been made of all kinds of people and institutions — families of various nationalities around Hull House, Chicago, professional men's families, students' clubs, negro families, hospitals for the insane, orphanages, etc. Much of

V. Fuel needs (*continued*).

the work was done some years ago under the direction of the Department of Agriculture. (See References.)

2. More recent work includes such studies as those of the food of groups with very limited incomes in Washington, D.C.[1] in New York,[2] and in Boston,[3] and of such diverse groups including Eskimos and East Indians, summarized by Lusk, *Fundamental Basis of Nutrition*, p. 27. An extensive study, just being completed under direction of the Department of Agriculture, includes the dietaries of many families of different nationalities and financial status, and of many institutions.

C. Some conclusions drawn from dietary studies:

1. The close agreement in most cases between the observed food consumption and the needs of the body as computed from calorimeter requirements.
2. The remarkable uniformity in the fuel value of the food consumed all over the world by people of similar size and activity. For example, differences which the season makes in the muscular work done by farmers make greater differences in the energy value of their diet than do nationality or the kinds of food used.
3. The increase in fuel value of the food with increase in physical activity. This is shown by a comparison of the 6600 calories obtained from the food eaten by members of football teams and the 2500 calories for the man of slight muscular activity.
4. The danger that the diet of the very poor may fall below accepted safe standards. In a recent study of the diet of 92 families under the auspices of the New

[1] "Cost of Living in the District of Columbia." *Monthly Review*, U.S. Bureau of Labor Statistics, 5, nos. 4, 5, 6. 1917.

[2] Sherman, H., and Gillett, L. *The Adequacy and Economy of Some City Dietaries*. The New York Association for Improving the Condition of the Poor. New York, 1917.

[3] M. M. Davis. *Food Supply in Families of Limited Means*. League for Preventive Work, 1917.

V. Fuel needs (*continued*).

York Association for Improving the Condition of the Poor (1917), it was found that 59% of the families were getting less than the accepted standard of 3000 calories per man per day.

5. A rather unexpectedly high consumption is shown by some exceptional groups —
   a. The boys at St. Paul's School — a private school where the boys are well fed and very active. Their average consumption was 5000 calories per day.
   b. The rather high diet at some young women's dormitories.[1]

6. Waste in average American families.

   It varies from nothing to 20% with a probable average between 5 and 10%. The rough estimate often given for the value of food wasted per year in the United States is made as follows: value of food consumed per capita, $100; average household waste, 7% of food consumed, or $7.00 per capita; national waste, $700,000,000. This estimate is probably low as regards both cost of food and percentage of waste.

7. Discussion of the consumption of protein and mineral matter is given in later chapters.

D. Study of the food supply by statistical methods.

Almost all the warring nations have found it necessary to know the usual pre-war sources of the food supply and the export and home consumption in order to control their food situation. These have been computed chiefly from agricultural and trade reports and therefore give not the food eaten by groups, as do dietary studies, but the total food used by the whole country.

1. In the United States complete reports are made of the amounts of the different foods in the country and their distribution, and the amount of food imports and the

[1] MacLeod, A. L., and Griggs, M. A. "Dietary Study at Vassar College." *Journal of Home Economics*, 10, p. 97. March, 1918.

V. Fuel needs (*continued*).

prospective crops here and abroad. The amount needed for home consumption is calculated, approximations of the needs of the Allies are made, and in this way a picture of the entire food situation is presented and plans for conservation can be made accordingly.

2. In Germany a minute inventory of the food situation was made in 1914, shortly after the war broke out, by the Eltzbacher Commission. It was particularly necessary, as Germany was a large importer of food and feeds.
   a. The study determined, among other things, the amount of food consumed by Germany in a year; the proportion produced in Germany; the proportion produced in Germany from imported fertilizers and feeding stuffs; the amount which would probably be cut off by the blockade.
   b. Calculations were made of the national per capita consumption of protein, fat, and carbohydrate and the fuel value of the food for 1912–1913.
   c. Some of the findings and recommendations.
      (1) Comparison of the per capita consumption of food before the war with food needs, showed that the country had had a good margin of safety in its food supply and could therefore stand considerable reduction.

	Food consumption 1912–1913	*Calculated food needs*
Protein	93.5 grams	65 grams
Fat	106 grams	
Carbohydrate	530 grams	
Fuel	3642 calories	2380 calories

(Notice that the food consumption is not on the basis of per man per day, but is merely the total consumption divided by the population. It is interesting to recall that German scientists have heretofore advised a ration high in protein and calorie value, but since the outbreak of the war their ideas have been revised).

V. Fuel needs (*continued*).

(2) Control of all luxurious living and the adoption of the above standard of food needs was recommended.

(3) The slaughter of one-third of the swine and 10% of the milch cows was suggested, the numbers to be kept at this level because the feed-stuff production would just support them economically. The fact that this recommendation was not carried out at least partly explains the German meat shortage.

(4) Reduction of use of grain for manufacturing starch, alcohol, and for all other industrial purposes.

VI. Effect of eating too much food:

A. In some cases, chronic digestive disturbances, in others, occasional disturbances with or without permanent results.

B. Increase in fat deposits in the body. The food eaten in excess of the amount needed is converted into fat and deposited as such.

1. Results —

a. Physical and mental efficiency are often decreased.

b. The "expectancy of life," as computed by life insurance companies, is decreased, especially after youth. "After the age of 35 over-weight is associated with increasingly high death-rate and at middle life it becomes a real menace to health."

2. Methods of reducing body fat by lowering the fuel intake below the body's demand.

VI. Effect of eating too much food (*continued*).

a. Increasing the amount of exercise taken without increasing the amount of food.

b. Decreasing the fuel value of the food by decreasing the consumption especially of carbohydrate and fat and substituting bulky foods like vegetables for concentrated foods like sugar and fat.

VII. Effect of eating too little food — malnutrition or undernutrition.

This is seen in occasional careless or neurotic individuals among the well-to-do, but danger of it exists most, of course, among the very poor. The most markedly tragic effects are now being experienced abroad. (No effort is here made to distinguish between a diet inadequate in quantity and inadequate in kind. The two are often associated.)

A. Loss in weight.

The body consumes itself for fuel instead of using food. It burns its fat deposits first and then its protein.

1. For the obese this may be harmless or even advantageous. For the thin or emaciated it is dangerous much sooner because body protein may be burned to supply the necessary energy and it may result in great impairment of the general physical condition — weakness, general lassitude, and mental depression.

2. A diet inadequate in kind may leave a person still fat, but pale and flabby.

VII. Effect of eating too little food (*continued*).

B. Diminished resistance to cold.

This shows the special necessity of adequate diet for people too lightly clothed and for soldiers in camp and in the trenches.

C. Diminished industrial productivity.

1. It has been found necessary in some of the warring countries definitely to increase the food allowances for munition workers in order to keep up their output.
2. The welfare workers in factories in this country are appreciating in increasing numbers the importance of an adequate diet for the health and efficiency of the workers.

D. Impairment of digestive power.

The effects of undernourishment, due to necessity or to individual "notions" about food, are often cumulative, digestive disturbances caused by insufficient food making the taking of food difficult.

E. Increased susceptibility to tuberculosis.

1. Noted recently, especially, in the occupied portions of France where there has been a marked increase of deaths from tuberculosis.
2. Observed, among others in this country, in a Phipps' Institute study of the garment-makers' trade. "Malnutrition is one of the

VII. Effect of eating too little food (*continued*).

most potent causes of tuberculosis that we have among the working classes." [1]

F. Certain diseases directly dependent upon improper diet; e.g., pellagra and beri-beri.

G. In children, stunting, retardation in school, "stupidity," general subnormal conditions. (Further discussion in chapter XIV.)

1. A remarkable improvement in weight, general health, and mental alertness follows the introduction of substantial school lunches in the schools of the poorer districts.
2. The Committee for Relief in Belgium thoroughly appreciated the importance of adequate feeding of children. The result of the "soupes," the children's "cantines," and the school lunches instituted by the Commission has been an actual decrease in the death-rate of the children.

H. Mental effects:

1. Lowering of mental power and initiative, depression.
2. Possible loss of morale. The nightmare of all food administrations is the fear that lack of food may break down the courage of their fighting men.

VIII. How widespread is subnutrition in the United States?

A. "Probably a fair statement to say that at all times five

[1] Landis, H. R. M. "Dietary Habits and their Improvement." *Annals*, American Academy of Political and Social Science, 74, p. 103. 1917.

VIII. Subnutrition in the United States (*continued*).

per cent of the people of this country are on the verge of subnutrition and that in times of industrial distress this proportion may rise much higher."[1]

B. An estimate for the number of undernourished school children is probably at least ten per cent of the school population.

C. It is possible that there has been an alleviation of these conditions since the recent increased demand for labor.

IX. Undernutrition and some of its results in a few of the European warring countries.

A. Germany and Austria-Hungary.

1. The calorie value of the ration has varied.[2] Only the very wealthy can supplement the rations. During the greater part of 1916 the total calorie content was probably up to 2000, but it was lower in the autumn and has not been raised since. In the spring of 1917 the press and various medical authorities put it in some places between 1200 and 1600 calories per man per day. In Dresden, for example, young people and men doing light work get 1200 calories, men doing heavy work, 1600 calories, and those doing the heaviest work, 1900 calories. When potatoes failed the ration at times ran as low as 1050 calories. This does not mean starvation, but results in general weakness, undernutrition, loss in weight, noted by every one coming in contact with the Germans, and an increase in the death-rate. In Prague it increased from 13.1 per 1000 in 1914 to 15.3 in 1916.

A so-called " proletariat sickness" has appeared, the name of which shows that the well-to-do are able to get extra foodstuffs and escape these diseases caused by insufficient food.

2. Some interesting observations have been made by

[1] Kellogg, V., and Taylor, A. E. *The Food Problem*, p. 141. Macmillan, 1917.

[2] Maylander, Alfred. *The Food Situation in Central Europe*. U.S. Bureau of Labor Statistics, Bulletin 242. 1917.

IX. Undernutrition (*continued*).

Dr. Jansen, of the Munich University Medical Clinic, on 13 of his staff, 11 men and 2 women. The dietary provided by the rations on which they had been obliged to live averaged 1614 calories. The average weight of the men was 63 kilograms and they had lost from 2 to 7 kilograms. During the period of observation the loss averaged .28 kilogram per day. The subjects were thin and without much muscular strength. Two of the men were sent on walks on 3 consecutive days of 11 miles, 12.5 miles, and 15 miles in length. They suffered acutely and increasingly from exhaustion and mental depression. When 100 to 150 grams of lactose from the laboratory were added, bringing the dietary up to 2000 and 2200 calories, respectively, it stopped the loss in weight. Dr. Jansen concludes that 1600 calories are not sufficient, but that 2100 calories are.[1] (Compare this 2100 calories with the 2300 calories which maintained the reduced body weight of the young men in Benedict's experiment, III, H, above.)

B. The occupied portions of Northern France.

1. The civil population is fed in part by the Commission for Relief in Belgium. Their daily ration gives 1600 calories and 35.5 grams of protein. The native foods which are to supplement these are mostly available only to the well-to-do and to farmers.

2. The result has been a gradually aggravated impairment of the physical condition shown by a progressive loss of weight, in exceptional cases as much as 50 kilograms and even 60 kilograms. This loss in weight has serious consequences for the thin and has produced weakness and lassitude among those formerly corpulent. As a whole the population suffers from gastric troubles.

[1] "Insufficient Diet of the German Civilian." *National Food Journal*, 1, p. 383. March 27, 1918.

IX. Undernutrition (*continued*).

C. Belgium.

1. For the quantities of food in the Belgian ration provided by the Commission for Relief in Belgium, see the Laboratory Manual, Section I. It gives about 2000 calories, 45 grams of protein and 43 grams of fat. This ration costs about 8 cents a day delivered to the commercial depots.
2. Many Belgians have lived on this ration for three years, some of them doing hard manual labor; others have been able to supplement it with native supplies such as fruits and vegetables, and still others could not even afford all of the ration. "They have not eaten according to their hunger," wrote Maeterlinck.
3. This long period of privation and semi-starvation of such a large part of the population is having its effect. A mining company, employing thousands of men, has found that the mortality was 3½ times as great during the first 4 months of 1917 as the average during the same period of the preceding 3 years. Among 35% of the workers, the weight had been reduced 10 to 40 pounds each. Three times as many men are sick as before. All over Belgium and among all ages, tuberculosis is increasing rapidly.[1]

REFERENCES

Atwater, W. O. *Methods and Results of Investigations on the Chemistry and Economy of Foods.* U.S. Department of Agriculture, Office of Experiment Stations, Bulletin 21.

Atwater, W. O. *Principles of Nutrition and the Nutritive Value of Foods.* U.S. Department of Agriculture, Farmers' Bulletin 142.

Atwater, W. O., and Bryant, A. P. *Dietary Studies of University Boat Crews.* U.S. Department of Agriculture, Office of Experiment Stations, Bulletin 77.

Atwater, W. O., and Woods, Charles D. *Dietary Studies in New York City in 1895 and 1896.* U.S. Department of Agriculture, Office of Experiment Stations, Bulletin 46.

[1] Kellogg, V. *Fighting Starvation in Belgium.* Doubleday, Page & Co., 1918.

Coleman, Warren. "The Influence of the High Calorie Diet on the Course of Typhoid." *Journal of the American Medical Association*, 69, p. 329. 1917.
Goldberger, J. "Pellagra Causation and a Method of Prevention." *Journal of the American Medical Association*, 66, p. 471. 1916.
"Government Control of Food Supplies in Germany." *Monthly Review*, U.S. Bureau of Labor Statistics, 4, no. 5. 1917.
Howell, W. H. *Textbook of Physiology*, chap. 51. Saunders, 1917.
Jordan, W. H. *Principles of Human Nutrition*, chap. 9. Macmillan, 1917.
Kellogg, Charlotte. *Women of Belgium*. Funk & Wagnalls, 1917.
Kellogg, V., and Taylor, A. E. *The Food Problem*, chap. 4. Macmillan, 1917.
Langworthy, C. F. *Food Customs and Habits in American Homes*. U.S. Department of Agriculture, Office of Experiment Stations, Circular 110.
Lusk, G. *The Elements of the Science of Nutrition*, chaps. 2, 18. Saunders, 1917.
Mathews, A. P. *Physiological Chemistry*, chap. VI. Wood, 1915.
Rose, M. S., and Jacobson, H. C. *A Dietary Study in a Children's Hospital*. Columbia University, Teachers' College, Bulletin 13.
Sherman, H. C. *Chemistry of Food and Nutrition*, chaps. 6 and 7. (Note References on energy requirements at the end of chapter VII.) Macmillan, 1918.
Stiles, P. G. *Nutritional Physiology*, chaps. 19, 20. Saunders, 1916.
Taylor, A. E. "The Diet of Prisoners of War in Germany." *Journal of the American Medical Association*, 69, p. 1575. 1917.
Walton, A. C. "The New Feeding in the Treatment of Typhoid Fever." *Journal of Home Economics*, 9, p. 14. 1917.

CHAPTER V

PROTEIN — ITS SOURCE AND IMPORTANCE IN THE DIET

I. Uses of protein in the body.

A. It is essential for life, since it is a requisite constituent of all the cells of the body.

1. It is therefore necessary for cell growth, which is of two kinds:

a. Enlargement of cells; e.g., muscle cells which increase in size.

b. Numerical increase during growth and to take the place of cells whose life is short, such as the blood cells.

2. The quantity required varies according to the condition of the body.

a. More is necessary per kilogram of body weight when there is rapid growth of new cells, as in youth, pregnancy, and convalescence from wasting diseases.

b. Less is necessary after the body attains its full size. Only a comparatively small amount is needed to provide for growth and the replacement of worn-out cells.

B. Proteins in excess of those needed for growth, or not in suitable combination for growth, are burned as fuel just as fats and carbohydrates

I. Uses of protein in the body (*continued*).

are or changed to fats and stored, the nitrogen being excreted in the urine.

C. There is no increased need for protein when the body exercises, merely increased need for fuel.

II. Composition of proteins.

The composition is studied on proteins separated from the other components of food and carefully purified. All proteins are found to be surprisingly alike in composition in spite of marked differences in function in the body and physical properties.

A. Elements in the protein molecule.

Refer to chapter II and look up the percentages of the different elements. Notice that the average for nitrogen is 16%, and that the usual method of determining the quantity of protein in a food is to find the quantity of nitrogen and multiply this by 6.25 or $\frac{100}{16}$. In many tables of analyses $N \times 6.25$ stands for protein.

B. The amino acids.

1. Importance.

Study of the amino acids has thrown much light on the constitution of the proteins. Protein chemistry and physiology is now in large part the chemistry and physiology of the amino acids. It is the constituent amino acids that determine the value of a protein.

2. Description.

There are about twenty of these organic acids into which proteins can be split. They are white crystalline substances, all of which contain nitrogen. Several metaphors are commonly used to make clear the relation between the large protein molecule and the amino acids of which it is composed. For example, the amino acids are called the building stones of the larger protein molecule, or the links in the long protein chain, or the

II. Composition of proteins (*continued*).

letters of the protein alphabet. Some of the best known of the amino acids are glycocoll, tyrosin, tryptophan, etc.

3. Differences in different proteins.

a. Most proteins contain all the amino acids, but in different proportions and probably fastened together in different orders. Tremendous numbers of proteins might result from variations in number and arrangement of the amino acids.

b. The proportions of the amino acids in different proteins vary greatly. Students may be interested in looking up the percentages in various proteins and noting some of the variations; for instance, that the amino acid, tyrosin, is entirely lacking in gelatin and present up to 4.5% in casein, and that glutaminic acid makes almost half (43.7%) of gliaden of wheat and only 9% of egg albumen.

III. Fate of the proteins in the body.

A. Digestion in the stomach and intestines.

It is a "breaking-down" process caused by the digestive secretions. The proteins are gradually split into less and less complex molecules by acids and enzymes until they are resolved into amino acids.

B. Absorption of the amino acids by the blood.

The amino acids are absorbed from the small intestines and are carried by the blood to all parts of the body. After a meal of meat, for example, there is a distinct rise in the quantity of amino acids in the blood.

C. Action in the tissues.

1. Such amino acids as are needed for growth or repair of cells are probably taken from the blood and combined to make body protein.

2. Such as are needed to make digestive and other secretions are probably also removed as needed. Neither of these uses requires a large quantity.

III. Fate of the proteins in the body (*continued*).

3. The excess amino acids cannot be stored for future use as can excess fat and carbohydrate. Instead, they are decomposed giving —

   a. Urea, the nitrogenous compound which is excreted in the urine. Some physiologists believe that the necessity of excreting a large amount of urea and other nitrogen compounds puts a harmful strain on the kidneys.

   b. A non-nitrogenous compound which is burned as fuel or converted into carbohydrate or fat and deposited as such.

4. If the food does not supply the right kind or sufficient quantities of amino acids for 1 and 2 above, body proteins will be broken down, the less important ones, such as those in muscle, in favor of the more important, such as those in nerves. "Nitrogenous equilibrium" is not reached; that is, more nitrogen is being excreted than is supplied by the food.

D. Occasional pathological manifestations.

There is danger in certain more or less diseased conditions that putrefactive bacteria in the intestines may act upon protein or its digestion products with the formation of harmful substances. The result may be a state of "auto-intoxication," with languor, mental depression, headache, and according to some opinions, premature old age. The symptoms may often be removed by lessening the meat consumption.[1]

E. Conclusions. It is thus seen that —

1. When more protein is eaten than is needed for specific bodily functions it is merely decomposed and excreted. Much excess is a form of extravagance in eating.

2. A certain amount of excess is wise, a "factor of safety," in order to be sure to get the right amino acids in sufficient amounts.

[1] See Stiles, *Nutritional Physiology*, chap. 23. Saunders, 1916.

IV. Comparison between the food value of different proteins.

A. Certain protein foods when fed as the only source of protein are found to be thoroughly satisfactory for all the protein needs of the body, the "adequate proteins." Others when fed alone are inadequate; i.e., growth and health cannot be maintained with them alone.

1. Adequate proteins include those of milk and egg. This is to be expected, since these foods are used by nature as the sole nourishment of the young animal. Other adequate proteins are those of meat and fish.

2. Less satisfactory are many of the vegetable proteins and gelatin. But combinations of these poorer proteins may be better than single ones.

B. Differences in different proteins must be due largely to differences in amino acid content.

1. It is most easily studied by experiments on small animals. Rats have been most used.

a. Method. The rats are fed a diet, in which the only protein present is the one to be studied. The diet is complete in other respects. If the rats grow normally and bear normal young, the protein is shown to be "adequate." If the rats do not behave normally some amino acid is lacking in the protein, or is present in too small amounts. Different amino acids can be added until the diet is satisfactory.

b. Some conclusions as to inadequate proteins.

(1) Gelatin. Animals fast losing in weight on gelatin can be made to grow normally when the missing amino acids, tyrosin, tryptophan, and cystin are added. Very striking changes in the animals are noted.

IV. Comparison between the food value of different proteins (*continued*).

(2) Zein, a protein of corn, and gliadin, a protein of wheat. Striking results like those with gelatin are obtained. The other proteins in these cereals are good, so that the mixture which we eat is better than the simple isolated protein, though not so adequate as the animal protein foods.

(3) The proteins of beans and peas. Much larger quantities of these proteins — inconveniently larger quantities — have to be eaten than of a protein like casein, to get an adequate amount.

(4) Two or more inadequate proteins have been found to supplement each other's amino acid deficiencies in such a way as to make an adequate mixture. This is true for example, of the proteins of beans and oats.

2. Some observations on human beings.

a. On account of an enthusiastic report in 1814 of the French Academy of Medicine, gelatin was used largely in the diet of hospital patients. The results were very unsatisfactory.[1] Later work has shown that gelatin fed with certain other poor proteins, themselves of low biological value, is greatly enhanced in value.

b. The harm wrought by pellagra-producing diets may be in part due to the fact that corn is almost the only source of protein.

C. The coefficient of digestibility of animal proteins is slightly higher than that of most vegetable proteins.

D. Some applications of these differences in proteins to our choice of food:

1. Adults with a fairly wide choice of foods seldom need to consider the question of ade-

[1] See Howell, *Textbook of Physiology*, p. 902. Saunders, 1917.

IV. Comparison between the food value of different proteins (*continued*).

quacy of the protein of their diet, though if the total quantity is low it is safer to have part of it animal protein and to have a variety.

2. It is much safer to feed children at least half of their protein from animal sources, especially from milk. They do not need more in quantity than adults, but there should be greater care about the quality. (See chapter XIV.)
3. The old idea of Liebig's that meat proteins are a peculiar source of strength is without foundation. Any unique value that meat may have over other animal protein foods is probably due to its pleasant flavor; its value, that is, is psychological rather than physiological.
4. As all animal proteins are adequate, the amino acids of meat are no better than the amino acids of fish.

V. The quantity of protein in foods.

A. Animal foods are usually rich in protein. Of meat and fish about 20% of the edible portion is protein, of eggs, 12% to 14%, milk 3.5%, cheese, 18% to 35%.

B. Vegetable protein foods usually contain less protein, but more than is popularly realized. Uncooked cereals (flour, etc.) have about half as much as meat (8% to 16%), nuts, about 10% to 30%, legumes — peas, beans, peanuts — 20% to

V. The quantity of protein in foods (*continued*).

25% when dried, and peas and beans, about 7% when fresh. Potatoes contain only 2%, and many other vegetables less.

C. A convenient method for studying quantities of protein in foods and the quantities eaten is the one-half ounce protein portion. This should not be confused with the 100-calorie portion discussed in chapter III.

1. The 1/2 ounce of protein is contained in approximately —

 1 pint of milk, whole or skim.
 2 eggs.
 1/4 cup of cottage cheese, 2 ounces.
 1 1/4-inch cube of American cheese, 2 ounces.
 2 ounces of shelled peanuts.
 A piece of lean meat without bone, about 2 × 2 × 3/4 inches, 2 1/4 ounces.
 A similar piece of fish.
 1 1/2 cups of cooked beans.
 2 1/2 to 3 cups of cooked cereal.
 6 slices of bread 3 1/2 × 3 × 1/2 inch.

2. Notice from these quantities that —

 a. There are many substitutes for meat.

 b. Cheese and nuts are so rich in protein that the half-ounce of protein is contained in a small amount.

 c. Cooked cereals are not high in protein, though a considerable part of the protein of the diet is often furnished by them

V. The quantity of protein in foods (*continued*).

because of the large amounts eaten as breakfast cereals, bread, biscuits, etc.

d. Combinations of these foods, such as cheese and egg dishes, may give a large amount of protein.

3. An exhibit of these portions should be held and students asked to count up the protein of their own diet from the number of one-half ounce portions or fractions thereof that they consume daily, and to notice the distribution of their protein between animal and vegetable sources. Figures calculated from women's dietaries should be divided by 0.8 for comparison with studies below which are on a per man basis. Express the results in both ounces and grams.

4. From what foods do we get our protein? A summary of four hundred studies shows that the protein of the diet, expressed as percentages of the total protein, is distributed as follows:

From meat, 29.7%, fish, 3.5%, eggs, 4.1%, dairy products, 10.0% — a total of 47.5% from animal foods.

From cereals, 43.0%, other vegetable foods, 9.3% — a total of 52.3% from vegetable foods.

The surprising fact to most people in these figures is that more than half of our protein comes from vegetable foods and that the cereals are quantitatively much more important sources of protein than meat.

VI. How much protein is it wise to eat?

No definite statement is possible — it is a matter of balancing and interpreting more or less conflicting studies and experiments. Contrast this with the accuracy of statement possible for the fuel needs of the body.

A. The older views advocated 100 grams (3 1/2 ounces) or even 120 grams (about 4 1/2 ounces) for an average man.

1. They are based on studies of how much protein men actually eat.

a. They show, on the whole, a remarkable similarity in the average consumption over most of the world — somewhat over 100 grams of protein per man per day, for moderately active people. (See the dietary studies of the Department of Agriculture given in the References at the end of chapter IV.) The first tabulations from the dietary study now in progress by the Department of Agriculture also show about this same amount — they range from 81 to 109 grams with an average of 94 grams.

b. Variations.

(1) In general, people of the older, more crowded countries eat less protein than those where there is a large amount of land with many head of livestock per capita. For example, consumption of protein in Australia and New Zealand is high, but it is low in parts of India.

(2) The Esquimo, an almost entirely carnivorous race, eats extraordinarily high amounts, an average of 280 grams daily.

VI. How much protein is it wise to eat (*continued*).

(3) The Bengali, weighing on the average only 50 kilograms and usually of inferior physical physique, eats 52 grams of protein. This would correspond to 73 grams for the man of average weight (70 K.). The Bengali's low vitality may be due to the presence of intestinal parasites instead of to the low protein of his diet.

2. Weaknesses of this "biological argument."

a. The argument that, since throughout the development of the race, men who could get it have tended toward a fairly high protein diet, this quantity must therefore be what they need, is almost equally applicable to the tendency to consume alcohol, which mankind is better without.

b. "The meat-eating races are the strong races." It is probably more nearly true to say that the strong races owe their strength to their milk-drinking (McCollum); also that they got the much-liked meat *because* they were strong.

B. Some of the newer views advocate a lower protein consumption.

1. They are based on experimental studies, the recent experiences of the warring nations, especially of Germany, which appear to show the adequacy of low protein diets, and the general trend of opinion among many scientists.

2. They advocate the consumption of about 75 to 85 grams (about 2 1/2 to 3 ounces) for

VI. How much protein is it wise to eat (*continued*).

a man and four-fifths of this for a woman, including at least some of the more adequate proteins. With this lower standard it is found that almost all of the diets which people naturally choose contain enough protein when the fuel value is satisfactory. Most people are apt to eat more protein than is needed rather than not enough.

3. Some experiments tending to show the possibility or advisability of a low protein diet.

    a. Experiments have been conducted in which adequate fuel in the form of carbohydrate and fat, and no protein was fed for a short time, to learn how much body protein would be broken down. As little as 2.2 grams of nitrogen a day (about 14 grams of protein) has been observed. We are not justified however in concluding that this is the whole of the normal protein decomposition.

    b. Experiments have been made to determine the minimum protein intake possible with nitrogenous equilibrium. This is dependent in part on the kind of protein as would be expected from our knowledge of amino acids.

    c. Chittenden's experiments on professional men, university athletes and soldiers at Yale, have led him to recommend only 60 grams of protein as giving "greater freedom from fatigue, greater aptitude for work, greater freedom from minor ailments."

    d. Hindhede's apparently adequate potato dietary, consisting of from 4 1/2 to 9 pounds of potatoes daily, and margarine, contained only from 38 to 53 grams of protein.[1]

    e. It is thus seen that men can live on a much smaller quantity of protein than is usually consumed.

[1] Lusk, G. *Elements of the Science of Nutrition*, pp. 340–341. Saunders, 1917.

VI. How much protein is it wise to eat (*continued*).

C. The general trend of scientific opinion is away from the older high standards to one recommending about 75 grams per day, provided at least a part of the intake consists of adequate proteins and that the proteins are from varied sources.

VII. Do recent observations show us to be in danger of getting too little protein? (Compare the discussion of fuel needs, chapter IV.)

A. The Washington study.[1]

Analysis of the diet of 31 of the families showed that their average protein consumption per man per day was 3.30 ounces (93.5 grams). The lowest observed was 2.34 ounces (66.3 grams) for a colored family of 4 with an annual income of $520, and a fuel value for the diet of only 1920 calories. Thus the food gave only 64% of the necessary fuel (3000 calories), but 88% of the standard amount of protein (75 grams). Much of the protein was from meat.

B. The New York study.[2]

Of 92 families only 12 were getting less than 75 grams of protein and 45 were getting 100 grams or over. The caloric and mineral deficiencies were far more marked than the protein deficiencies. Here, too, the amount of

[1] "Cost of Living in the District of Columbia." *Monthly Review*, U.S. Bureau of Labor Statistics, 5, no. 61. 1917.

[2] Sherman, H., and Gillett, L. *The Adequacy and Economy of Some City Dietaries.* Association for Improving the Condition of the Poor. New York, 1917.

VII. Danger of getting too little protein (*continued*).

meat was fairly high. In the group spending least for their food 37% of the total money was spent for meat.

C. The Boston study.[1]

This study measures the protein consumption in terms of the percentage of the total calories which is derived from protein, taking 10% as adequate, or 75 grams on the basis of 3000 calories. Of the 200 families 99% show 10% of the calories from protein and 88% show 12% or more. Here, too, there was a much greater deficiency in the fuel value of the food than in its protein content. "They buy their protein in expensive forms, chiefly meat and eggs. Too much meat may merely mean some lack of economy in a well-to-do family. In a family of very small income, it may mean actual malnutrition, because the meat costs so much that other essential elements in the diet cannot be sufficiently provided."[2]

VIII. The psychological factor in the choice of protein foods.

A. The high expenditure for meat by the poor is probably partly due to habit and ignorance of food values, and partly to a real psychological value in meat due to its marked flavor — a pleasant feature of an often otherwise unattractive diet.

[1] Davis, M. M. *Food Supply in Families of Limited Means.* League for Preventive Work. Boston, 1917.

[2] See editorial comment on this and the New York study in the *Journal of the American Medical Association*, 70, p. 234. January 26, 1918.

VIII. The psychological factor in the choice of protein foods (*continued*).

B. Prisoners of war in Germany have had only a third of a pound of meat per week and this cooked in soup. "Men thus fed acquire a positive homesickness for the sight, taste, and touch of meat, they long for the act of mastication of meat."

IX. The cost of protein foods.

A. The cost to the individual.

1. Protein foods, especially meat, are usually the most expensive part of the diet. Often much more money than necessary is spent for them.
2. Relative costs of different protein foods should be compared by computing the cost of the one-half-ounce portions. Usually dried legumes and cereals and dried fish are much cheaper than meat and eggs. The cost of the protein of milk is slightly less or about the same as that of meat.

B. The agricultural cost to the nation. (Discussed under meat in the next chapter.)

REFERENCES

Chittenden, R. H. *The Nutrition of Man.* Stokes, 1907.
Chittenden, R. H. *Physiological Economy in Nutrition.* Stokes, 1904.
Editorial. *Journal of the American Medical Association*, 70, p. 234. January 26, 1918.
Howell, W. *Textbook of Physiology*, chap. 47. Saunders, 1917.

Kellogg, V., and Taylor, A. E. *The Food Problem*, pp. 109–117. Macmillan, 1917.

Lusk, G. *The Fundamental Basis of Nutrition*, chap. 3. Yale University Press, 1915.

Lusk, G. *Elements of the Science of Nutrition*. Saunders, 1917.

McCollum, E. V. "Supplementary Dietary Relationship among our Natural Foodstuffs." *Journal of the American Medical Association*, 68, p. 1379. 1917.

McCollum, E. V. and Davis, M. "Influence of the Plane of Protein Intake on Growth." *Journal of Biological Chemistry*, 20, p. 415. 1915.

McCollum, E. V., Simonds, N., and Pitz, H. "Effect of Feeding the Protein of the Wheat Kernel at Different Planes of Intake." *Journal of Biological Chemistry*, 28, p. 211. 1916.

Mathews, A. P. *Physiological Chemistry*, chap. 4. Wood, 1915.

McKay. *The Protein Element in Nutrition*. Longmans, 1918.

Osborne, T., and Mendel, L. B. A series of papers in the *Journal of Biological Chemistry*, 12, p. 473 (1917); 17, p. 325 (1914); 18, p. 1 (1914); 20, p. 35 (1915); 22, p. 241 (1915).

Sherman, H. *Chemistry of Food and Nutrition*, chap. 8. Macmillan, 1918.

CHAPTER VI

THE MEAT SITUATION

I. The world's meat resources.

A. Cattle and sheep.

1. Great production can take place only in sparsely settled countries where there is an abundance of land for grazing. As the population increases, the great cattle ranges are crowded out, giving place to cultivated fields. For this reason, the number of animals in proportion to the population is constantly decreasing.

2. Countries having a surplus for export:

a. Cattle: Australasia, Argentina, United States, Uruguay, Brazil, and Canada. Before the war, Russia, Denmark, and Hungary exported some cattle, but the amount was not large.

b. Sheep: Australasia, South America, and South Africa.

B. Hogs.

1. Hogs are raised everywhere. The United States is the heaviest producer, the corn belt being the great hog-raising region. Even before the war (1911) the United States raised 42% of the world's swine.

I. The world's meat resources (*continued*).

2. The greatest exporting countries are the United States, Canada, and the Baltic regions of Europe.

II. Meat consumption before the war.

A. The greater part of the meat raised in a country is consumed locally. Even in the crowded territory of Europe, the proportion of imported meat was never large except in Great Britain, which imported almost half of her supply.

B. Differences in the kind of meat eaten. The kind of meat eaten seems to be governed in part at least by racial habits; e.g., Germany ate twice as much pork as beef, in the United Kingdom the proportion was almost reversed, and in the United States about equal quantities of both were eaten. The United Kingdom also had a much higher per capita consumption of mutton.

C. National differences in the quantities eaten.

1. Large amounts of meat are eaten in sparsely populated countries with large grazing lands, such as Australia and New Zealand, and in the wealthy industrial countries, like England, which can afford to import. Shown by their pre-war per capita consumption (compare with the war rations given in IV, below):

a. Australia — five pounds per week.

b. United States — about 3 1/4 pounds per week. With decreasing grazing land, con-

II. Meat consumption before the war (*continued*).

sumption has decreased. According to some estimates, the 3 1/4 pounds is half as much as was eaten in 1840.

c. England — 2 1/4 pounds per week, and Germany — between 2 pounds and 2 1/4 pounds.

2. In Arctic climates, a large part of the diet is meat and fish.
3. There is small consumption in densely populated regions which cannot afford to import meat or prefer to raise dairy cattle; e.g., the consumption in France, Denmark, and Switzerland is about one and a half pounds and in Sweden, Holland, and Norway, it is even less.
4. The consumption is lowest in parts of the Orient; e.g., in Southern India, in the Philippines, and in Japan. Large numbers of people in these regions are prohibited by their religion from eating meat at all.

III. The effect of the war on the supply of meat.

A. Exports to Europe.

Most of the great exporting countries being regions remote from Europe are cut off because of the dangers of transportation and the lack of ships. (See the frontispiece.)

B. European herds.

The herds of both cattle and swine have greatly decreased due to lack of fodder. Ani-

III. Effect of the war on the supply of meat (*cont'd*).

mal feed could not be grown at the expense of bread grains, and ships for importing it are in greater demand for more immediate war supplies. The total European loss for the first three years of the war was estimated to be over 100,000,000 animals. The remaining animals are reported to be greatly reduced in weight, so as still further to reduce the meat resources. The milk supply has decreased alarmingly.

C. The situation of the different belligerents:

1. Great Britain finds most of the sources of her heavy pre-war importations now cut off. Although the imports from the United States and Canada were thirty times as large in 1917 as those of 1914, they have not offset the loss of the supplies from Argentina and Australia. The home-grown meat assets of the country (live animals calculated in terms of cattle according to the proportionate amount of dressed meat they would yield) have decreased 12.5%.

2. France has suffered a decrease of 40% in the number of hogs, 18% of cattle, and 39% of sheep; due to —

   a. Seizure of herds by the enemy. Practically 20% of the cattle fell into the hands of the Germans.

   b. Difficulty in obtaining fodder.

   c. The low price for requisitioned wool. This has made it unprofitable to keep sheep for wool raising.

3. Italy is in much the same position as France.

4. Germany before the war depended largely on imported concentrated cattle feeds. These have been cut off and her herds decreased in proportion. This increased the meat supply at the beginning of the war. Now Germany has lost over half of her stock of hogs, almost half of the sheep, and a third of the cattle. The loss would have been still greater if it were not for the cattle and

III. Effect of the war on the supply of meat (*cont'd*).

hogs taken in occupied portions of France, and in Belgium, Poland, Serbia, and Roumania. Those countries are to-day almost literally without herds. In Belgium in three months alone the herds diminished from 1,800,000 to 700,000 head of cattle, and the decrease has continued until more than three-fourths of the cattle are gone.

5. The northern neutrals, although always small meat consumers, are also suffering from a shortage of cattle due to lack of fodder.

D. The large amounts of meat for the armies:

All of the army rations are much larger than the civilian consumption. This has increased the demand. It varies from the weekly ration of seven pounds of meat and one and three-fourths pounds of bacon which has been allowed soldiers in the field by Great Britain to the four pounds of meat allowed by Germany and Italy.

E. The production of the United States and exports to the Allies. These exports must make up as far as possible the deficiencies in the supply abroad.

1. Since the consumption of meat in the United States is far in excess of the physiological needs, the amount we can ship to the Allies should be limited only by the tonnage available. The exports of beef and pork in April, 1918, were about 220% greater than in the same month last year, and 830% greater than in April, 1914.

2. Hogs have increased both in number and in weight to meet the especially heavy demand for pork products. The ordinary pork export was about 50,000,000 pounds per month.

III. Effect of the war on the supply of meat (*cont'd*).

In the heaviest export month during the fiscal year of 1917–18, 308,000,000 pounds were sent across. This has enabled the English to remove all restrictions on the use of bacon and ham.

3. Increased shipments can be met only in part by increased production and slaughter. It takes three years or more to develop prime steers, and too great slaughtering of cattle is disastrous to the upkeep of the herds. Therefore, although the number of cattle have increased, continued conservation in accordance with the requests of the Food Administration is necessary to maintain our shipments of meat to Europe.

IV. Regulations to alleviate conditions.

A. Great Britain.

The English have thoroughly appreciated the importance of keeping their herds intact, but the slaughtering of cattle must now be governed largely by the amount of fodder available. This causes wide fluctuations in the meat supply, which was not low in the fall of 1917, but became very short in the winter and spring of 1918.

1. In November, 1917, the Ministry of Food asked the country to go on a voluntary ration of two pounds a week.
2. Compulsory rations were put into effect in

IV. Regulations to alleviate conditions (*continued*).

the end of February, 1918, in London, and in April in the rest of the country. Each person was allowed four coupons a week. Children under ten were on half rations. At first, three of these coupons could each buy fivepence worth of fresh meat, and one had to be used for bacon, ham, or game. The total amounted to about one and one-half pounds per week. In the late spring, because of the increased exports of pork products from the United States, heavy workers were permitted two extra coupons for bacon, and boys between thirteen and eighteen years were allowed one. But in order to prevent further slaughter of cattle, only two instead of three coupons could be used for fresh meat. Later all restrictions on the use of pork products were removed. (See III, E, 2, above.)

3. Maximum wholesale and retail prices are fixed.

4. Heavy fines are imposed for wasting food, hoarding, and profiteering — fines as high as £1000. The usual fines seem to range from £20 to £50; prosecutions are made for even such offenses as feeding wheat to poultry or obtaining an extra piece of meat for a dog.

B. France.

1. Meat was not controlled at the beginning of the war. In July, 1917, two meatless days were set and no slaughtering could be done

IV. Regulations to alleviate conditions (*continued*).

on the two preceding days. This ruling was abolished in October, 1917.

2. Three meatless days each week were instituted in May, 1918. Because of high prices, also, consumption of meat has gone down markedly. The London *Daily News and Leader*, February 28, 1918, in a Paris letter, states that rump steak and veal were both selling for 4*s*. 2*d*. a pound.
3. The meat ration of the soldiers at the front was cut. It was formerly one pound per day, in March, 1918, it was about 13 ounces.

C. Italy.

1. In December, 1916, an order forbade the sale of fresh meat on two consecutive days each week. (This applied also to hotels and restaurants.) This was changed to three days in 1918.
2. Part of the meat ration of the army has been replaced by "minestroni," a soup made of vegetables and rice. Salt fish also is provided for those at the front.
3. Animals are on fodder rations.
4. The number of oxen to be slaughtered and their minimum weight are determined in each province by the Prefect in consultation with a veterinary.

D. Germany.

1. Weekly rations of meat and sausages in the

IV. Regulations to alleviate conditions (*continued*).

towns of Germany in January, 1918, were about 8 3/4 ounces per person. All kinds of game and poultry are used as much as possible and in Breslau, for instance, dog meat is used in sausage.

2. Control of cattle and feed is very strict. Sometimes slaughter is prohibited, at other times ordered, according to the amount of feed available; for example, the *Berliner Tageblatt* of November 25, 1917, states that the Food Controller asked all state officers to bring about a quick surrender (voluntary or by compulsion) of all pigs not intended for home slaughtering or breeding, the stocks being too large for the fodder available. To prevent the use of corn and potatoes, all kinds of fodder are used. In general, Germany has slaughtered live-stock when necessary in order to save grain.

E. Regulations and policies of the United States.

The meat situation is the most complex of the food problems with which the Government has had to deal.

1. The system of purchasing meats includes all of the animal foods utilized by the armed forces of the United States, the Allies, and such agencies connected with the war as the Red Cross, the Y.M.C.A., the Commission for Relief in Belgium, etc. This applies also to some of the other staples.

IV. Regulations to alleviate conditions (*continued*).

a. A Food Purchase Board, composed of representatives of the Army, Navy, the Food Administration, and the Federal Trade Commission, determines what foods shall be procured by the Food Administration which then allocates the orders to different concerns throughout the country. About fifty concerns, selected because of their equipment and experience, furnish, on a pro-rated basis, the meat required.

b. The Allied countries operate through the Allied Provisions Exports Commission, through whom all orders are pooled and standardized.

c. Reserves are established at favorable centers and seaboard points to meet emergencies.

2. Fair price determinations are ascertained by various means and agencies, including the Federal Trade Commission, through cost investigations, by profit regulations of the Food Administration and the investigations of subsistence experts of the Army and Navy.

3. The effect of the general control of the Food Administration is to abolish speculative profits and to prevent undue profits. The limitation of profits prescribed by the Food Administration regulation made effective on November 1, 1917, permits the packers to

IV. Regulations to alleviate conditions (*continued*).

earn a profit of 2.5% net on their total annual sales, while in the case of the five principal packers, they are further limited to a profit not exceeding 9% on their investment as applied to the meat business, which includes such by-products as wool, bones, ice, etc.

4. The regulations in respect to the consumption of meat are of necessity altered frequently with the changing conditions of production and consumption here and abroad. Special rules must be made constantly to meet temporary emergencies.

F. It is a much debated question as to how far it is wise to feed grain to hogs and other animals instead of feeding it directly to human beings.

1. There is a keen military demand for pork.
2. A diversified agriculture with a fair emphasis on cattle and hogs is undoubtedly sound national policy.
3. Much of the grain raised is normally in excess of human demands and much of it is not suitable for human consumption.
4. Yet feeding grain to animals, and then eating the animals, is by no means so economical as eating the grain directly. The animal is not an efficient machine for turning grain into human food, because it utilizes a large percentage of its food in its own life processes.

IV. Regulations to alleviate conditions (*continued*).

a. Roughly 15% to 20% of the protein of the feed is recovered as swine protein, only 10% to 15% as beef protein, and about 33% as milk protein.

b. "It may be roughly estimated that about 24% of the energy of grain is recovered for human consumption in pork, about 18% in milk and only about 3.5% in beef and mutton. In other words, the farmer who feeds bread grains to his stock is burning up 75% to 97% of them in order to produce for us a small residue of roast pig, and so is diminishing the total stock of human food." [1]

V. Nutritive value of meat.

A. Composition.

1. Refuse. This varies greatly and must be considered in comparing the relative cost of meats. It may be as high as 62% in shank of beef or as low as 4% in beef sirloin or round.

2. Protein. There is very little difference in the amount in different cuts and kinds, much less than is often thought:

a. A maximum of 21.9% in porterhouse steak and a minimum of 15.8% in beef brisket.

b. The fatter portions of pork, salt pork, and

[1] Armsby, H. P. "The Cost of Roast Pig." *Science*, 46, p. 160. 1917.

V. Nutritive value of meat (*continued*).

bacon are exceptions, having very little protein.

c. A number of the proteins of meat differ as to their solubility in water, the temperature at which they coagulate, etc.

3. Fat. The amount varies considerably.
   a. It is partly stored in quantities so large as to be readily seen and partly distributed in invisible or almost invisible portions throughout the muscle or organ.
   b. Veal is generally lowest and pork highest in fat content. Ham may run as high as 57% fat, and veal cutlet as low as 1%.
   c. The fat content depends in part upon whether or not the animal has been highly fed before killing, an important point when feeds are high.
4. Water. The amount is somewhat variable.
   a. The content is high in lean meat and low in fat meat. A cut of lean beef may have 75% water, while a fat cut from the same animal may not contain more than 50%.
   b. Meat from a young animal, such as veal is apt to run slightly higher in water than from a mature animal.
5. Ash. The percentage is fairly high, especially of potassium and phosphorus. It contains significant amounts of iron, but is low in calcium.

V. Nutritive value of meat (*continued*).

6. Extractives.

a. A miscellaneous group of substances present in meat in small quantity, so called because they can be dissolved out by extracting the meat with water.

b. They give to meat its characteristic palatable flavor to which meat owes its psychological value as a food.

c. Most important physiologically are the substances called purins, which yield uric acid in the body. These are probably present in about the same quantity in most kinds of meat, fish, and chicken. The content is considerably higher in glandular material, like sweetbreads and liver, than in muscle, and in meat soups and meat extracts.

7. Vitamines.

Probably neither of the two, fat-soluble A or water-soluble B, is present in large quantity, except in glands like liver and sweetbreads.

B. Digestibility of meat.

1. It is almost completely digested, both as to protein and fat.

2. There is practically no difference between the different cuts and kinds.

a. Cheap and tough cuts are as completely digested as the more expensive.

b. Veal, even very young veal, is digested as well as beef. The prejudice against it in America is not universal. In Germany, for example, veal is popularly believed to be very easily digested.

V. Nutritive value of meat (*continued*).

c. Extracted meat — i.e., meat from which the extractives and hence the taste have been removed — is almost as completely digested as whole meat.

d. Occasional difficulty in the digestion of pork is probably due to its high fat content which makes digestion in the stomach slow.

3. The final digestion of meat swallowed in large pieces, "bolted," is as complete as well-masticated meat, but large pieces of meat remain longer in the stomach than small pieces. This is not an argument for bolting food, but a caution against too sweeping statements as to the harm done by it.

C. Composition and value of meat extracts and bouillon cubes.

1. Meat extracts are prepared by evaporating either the liquid in which the meat is cooked for canning, or the water extract of the meat. Hence they consist of the parts of the meat soluble in warm or hot water — a little of the protein, the extractives, and the mineral matter, with more or less water.

2. Bouillon cubes are similar in composition to meat extracts, but without the water and with a large quantity of common salt added.

3. Their nutritive value is practically nil. They are so highly flavored that only small amounts can be used. The small amount of protein is negligible as compared with the total protein of the diet.

4. What little value they have as a stimulant is due to the extractives.

REFERENCES

Agricultural Production for 1918. U.S. Department of Agriculture, Office of the Secretary, Circular 103.

Bigelow, W. D., and Cook, A. E. *Meat Extracts and Similar Prepa-*

rations. U.S. Department of Agriculture, Bureau of Chemistry, Bulletin 114.

"Butter, Margarine, and Meat Rations." *The National Food Journal*, 1, p. 249. February 13, 1918.

Ditewig, G. "The Meat Inspection Service of the United States." *Yearbook*, U.S. Department of Agriculture. 1916.

Foster, L. F., and Hawk, P. B. "The Utilization of Ingested Protein as Influenced by Undermastication (Bolting) and Overmastication (Fletcherizing)." *Journal of the American Chemical Society*, 37, p. 134. 1916.

Holmes, G. K. *Meat Situation in the United States*. U.S. Department of Agriculture, Report 109. 1916.

Langworthy, C. F., and Hunt, C. L. *Economical Use of Meat in the Home*. U.S. Department of Agriculture, Farmers' Bulletin 391.

Leach, A. E. Food Inspection and Analysis. Wiley, 1917.

Lusk, G. *Food in War-Time*. Saunders, 1918.

Osborne, F., and Mendel, L. B. "Nutritive Factors in Animal Tissues." *Journal of Biological Chemistry*, 32, p. 309. 1917.

Roorbach, G. B. "The World's Food Supply." *Annals American Academy of Political and Social Science*, 74, p. 1. November, 1917.

Sherman, H. C. *Food Products*. Macmillan, 1917.

Smith, J. R. *Industrial and Commercial Geography*. Henry Holt, 1913.

Woods, C. D. *Meats: Composition and Cooking*. U.S. Department of Agriculture, Farmers' Bulletin 34.

CHAPTER VII

PROTEIN-RICH FOODS USED IN PLACE OF MEAT

I. Fish, eggs, cheese, milk, beans, peas, and nuts are the chief foods used as meat substitutes. Milk is taken up in chapter XII and peas and beans in chapter XIII. As regards the use of these foods it is interesting to note that the Allied Committee on Alimentation, in deciding not to fix a minimum meat ration, states that no absolute physiological need exists for meat, since the meat can be replaced by proteins of animal origin such as those contained in milk, cheese, and eggs as well as by proteins of vegetable origin.

II. The use of meat substitutes is important:

A. To save meat for the Army and the Allies, since it is more easily shipped than most of the substitutes.

B. To introduce an important economy in the individual's expenditure for food. Some, though not all, of the substitutes are cheaper than meat.

C. To cut down on the use of grain for animal food.

III. Fish.

A. Consumption.

The United States eats far less fish than most other nations. Our average per capita consumption is only 18 pounds per year. (Compare this

III. Fish (*continued*).

with our meat consumption of 178 pounds.) The British and Canadians, whose food habits on the whole are similar to ours, consume much more, 56 and 29 pounds per year respectively.

B. Availability.

Our low consumption is not due to lack of fish, because quantities of it are available. The potential supply is practically unlimited. There are 19,000 varieties, some of which, however, are inedible.

1. Many inland waters are plentifully supplied with little known fish that make excellent food. Only a few varieties, such as whitefish and trout, have been widely used, while fully three dozen more varieties from rivers and lakes are wholesome food and available in our markets. The use of many of these has been studied by the Bureau of Fisheries and the State Colleges.
2. Edible varieties of salt-water fish also abound in great numbers and should be utilized. Varieties that have hitherto been more or less despised and wasted have been attractively prepared and now make a valuable addition to the dietary. Whale is on sale on the Pacific Coast and is also being canned, and so is shark and seal meat.
3. The students should become familiar with all the varieties of fish in their locality, especially the little-known kinds. In some of

III. Fish (*continued*).

the smaller inland towns in which fresh fish has not been available, an assured demand will frequently make a steady supply possible, or salt, smoked, and canned fish can be used.

C. Nutritive value and digestibility compared with meat:

1. The protein is about the same in quantity and quality.
2. The fat content is much lower. Few fish have more than 10% fat. Butterfish, shad, catfish, herring, and salmon are among those containing the most fat. Cod and shellfish have little fat.
3. The water content is higher than in meat, varying in most fish from 70 to 80%, and in oysters up to 90%.

D. Fish supply.

1. The potential world supply is practically unlimited. A large proportion of the catch never gets into trade. The average value of the world catch before the war is roughly estimated at $500,000,000, of which the United States took one-eighth.
2. The great fishing regions are in the feeding banks.
   a. American: off the northeast coast.
      (1) Most important are the Grand Banks of Newfoundland, and the smaller banks off Labrador, New England, and New Jersey.
      (2) The Grand Banks of Newfoundland were known to fishermen of Brittany shortly after the voyages of Columbus. The right of fishing on these banks was an important issue in the French and English colonial wars from 1688 to 1763. Amer-

III. Fish (*continued*).

ican negotiators vainly tried to secure from England concessions satisfactory to New England fishermen at the close of the American Revolution. The subject was brought up in most of the Anglo-American commercial negotiations. A satisfactory war agreement has at last been reached in 1918, giving American and British fishermen equal rights in the waters or harbors of either country.

(3) Newfoundland and Labrador are supported almost entirely by fishing. Dried cod constitutes two-thirds of the exports of Labrador to Great Britain.

(4) The total catch of the United States is somewhat smaller than that of Canada. Massachusetts and Maine are the chief fishing regions of the United States. The normal value of the Massachusetts catch is estimated at about $7,000,000 annually.

b. European fisheries: Off the northwest coast.

(1) The North Sea was the greatest fishing ground in the world before the war. The catch in 1914 is estimated at 2,500,000,000 pounds, of which Great Britain took almost half, or 22 pounds per capita. Holland, Denmark, Belgium, France, and Germany also were provided for from the North Sea.

(2) The banks off the Faroe Islands, Iceland, and the other northern islands are rich in fish. Norway is very dependent upon these, as fish and fish products form one-third of the Norwegian exports.

c. Northeastern Asiatic fisheries: the Japanese dominate the richest Asiatic fisheries, for Japan, having few meat animals, depends largely upon fish.

3. Less important fishing regions are numerous, especially

III. Fish (*continued*).

in the Pacific. The great salmon fisheries are not confined to any one region, but extend from the rivers and coast of California and Oregon northward to Alaska.

a. The salmon are caught either in the sea or far inland in the rivers as the fish go far up the rivers to spawn.

b. The drain on the salmon supply had threatened these fish with extermination. National and State Governments have established hatcheries to increase the supply. In the State of Washington alone, there are twenty-two salmon hatcheries where more than 100,000,000 salmon are turned out annually.

c. Salmon is the chief fish export of the United States. Before the war we exported over 40,000,000 pounds.

4. Deep-sea fisheries.

Fishing in the open sea is both hazardous and expensive, but the catch is very valuable. European fleets, especially those of Brittany, penetrate American waters and fleets from Maine and Massachusetts go annually to waters off Iceland for herring and mackerel, which last is the most important open-sea fish. Sardines are found off the west coast of Europe and the eastern coast of the United States. Herring and sprat are used largely as "commercial sardines."

5. Shellfish and crustaceans.

a. The United States furnishes about five-sixths of the world's oyster supply. The numerous bays between Cape Cod and Galveston having shallow water and a suitable temperature are the best in the world for oysters.

b. Clams, crabs, and lobsters bring large cash returns, and are important along the middle Atlantic coast. The American lobster is threatened with extermination. Most of the present supply comes from Canada, Newfoundland, and Japan. These foods

III. Fish (*continued*).

are often too expensive to be frequently substituted for meat, but they should be used where they can be afforded. The mussels of our east and west coasts can be easily and cheaply obtained, and should be more extensively used.

E. Effect of war on the fish supply.

1. The European supply of fish is greatly depleted. The supply in Great Britain is only 46% of the normal amount.

   a. Mines abound in the North Sea and are a constant source of danger. They and the German submarines are a peril not only to the Allied fishing vessels, but also to those of the neutrals.

   b. Both ships and men are lacking. In Great Britain, for example, 80% of the steam fishing ships have been made into auxiliaries of the Navy, and fishermen of military age are in the service.

   c. Fuel and equipment are scarce. Most of the large fishing fleets of Denmark and Holland are laid up in harbors because of lack of fuel (particularly petroleum) and the high cost of fishing equipment.

   d. The Norwegian herring catch, however, is still good, and a survey of Norwegian fish stocks, fresh and preserved, taken in December, 1917, showed a a large supply on hand, sufficient to last even twenty years.

2. In the United States the annual catch was smaller in 1917 than in 1916, because of the utilization of some of the fishing boats by the Navy and because of the high cost of equipment.

   a. All salt-water fishermen as well as wholesale and large retail dealers are controlled by license.

   b. The National Government is urging the States to remove certain less important restrictions which limit fishing. No alteration is being made in regulations necessary to conserve the supply.

III. Fish (*continued*).

F. Preservation of fish.

1. Frozen fish. The development of this process was of great importance for the transportation of fish. Small fish are frozen together in large numbers. Large fish (as halibut) are frozen singly. They can be used with perfect safety if they are not thawed until shortly before using, as they deteriorate after thawing more rapidly than fresh fish.
2. Canning.
   a. The process was first used in the United States in 1819. A few lobsters, salmon, and oysters were canned. The industry has grown tremendously until in 1914 the value of the pack was over $33,000,000.
   b. The industry is scattered all over the country — salmon is packed in Oregon, Washington, and Alaska; tuna, in California; sardines and clams, in Maine; crabs, in Virginia; oysters, along the Atlantic coast from Maryland to Georgia and on the Gulf of Mexico; shrimp, on the Gulf coast and as far north as Georgia on the Atlantic. Roe, herring, and other marine products are also canned.
   c. Other new fish-canning industries are being developed — an excellent method of getting little known fish on the market in an attractive form.
3. Salt fish. This is an important industry

III. Fish (*continued*).

centering in this country at Gloucester, Massachusetts, and dating back to the time of the settlement of New England. Mainly cod, but some cusk and haddock are salted and dried or preserved in brine. Their keeping qualities make them useful for export to Latin-American countries.

4. Smoked fish. Smoking is often thought to improve the flavor and render coarser fish more desirable. Herring, haddock, whitefish, salmon, and various other fish are smoked, especially those with a moderate amount of fat.

IV. Eggs.

A. Nutritive value.

1. Eggs are one of our most important and valuable foods as would be expected from the fact that they serve as the sole food of the embryo chick.
2. They are rich not only in protein, but in ash constituents, especially iron and phosphorus, and in both vitamines. Recall that an average egg gives about seventy calories, half as many as a glass of milk.
3. They are completely and easily digested.
   a. Raw eggs are less completely digested than cooked. The value of raw egg therapy is probably exaggerated.[1]

[1] Bateman, W. C. "The Digestibility of Egg White." *Journal of Biological Chemistry*, 26, p. 263. 1916.

IV. Eggs (*continued*).

b. There is no difference in the completeness of digestion between hard- and soft-cooked eggs, but the soft-cooked are more quickly digested — a difference that may be of importance to the person of weak digestion.

B. The egg and poultry industry.

It is of world-wide extent, undoubtedly the most generally distributed of the animal industries, but only of recent years has it been anything but a local industry.

1. In Europe before the war there was even greater production than in America. Great Britain imported more eggs than the rest of the world combined, getting about half of her supply from Russia.
2. In the United States.
   a. The total production of eggs is very roughly estimated at almost thirty billion per year. Only 1% of this number are exported.
   b. Our consumption, therefore, is slightly under one egg per capita per day. This average, of course, is very unevenly distributed, probably much more unevenly than that of meat. Only one-third of the eggs ever reach the large cities; one-third are consumed on the farms and one-third in small towns.[1]
   c. Many States produce no more eggs than they consume. The region with an excess to ship out to the great cities, to other states, and abroad is a large area in the central part of the country, chiefly in the corn belt and in the Southern States.
   d. Grading of eggs is done by outward appearance (size, cleanliness, and freshness), and by candling.
   e. Because of special difficulties in marketing, many efforts have been made to obtain greater efficiency.

[1] Mandeville, P. *The Cost of Marketing Eggs in 1917.* U.S. Food Administration. Chicago, 1917.

IV. Eggs (*continued*).

It is estimated that nearly 8% of the eggs marketed are lost — a cost of $50,000,000. (For various methods of marketing see the Farmers' Bulletins given at the end of the chapter.)

C. The war and the egg and poultry industry.

Even this widely distributed and comparatively little organized industry has been greatly affected by the war.

1. In the United States the industry was seriously threatened in the spring of 1918.
   a. The supply of poultry had decreased greatly — it was estimated that the farm flocks had been reduced about 50%. This was due to the steady advance in feed prices and a rise in the price of poultry, making it more profitable to the farmer to kill his poultry than to feed it.
   b. The supply of eggs was seriously threatened for poultry slaughtering had been so severe that the supply of old hens and cockerels was practically exhausted and the hens and pullets were being killed.
   c. To avoid this disaster, the Department of Agriculture, having received a special appropriation in the fall of 1917 to aid in increasing the poultry supply, used its agents to actively assist the poultrymen of the country. The Food Administration issued an order preventing the killing of hens and pullets between February 11 and April 30. This stopped the enormous slaughter of hens, increased the production of eggs and allowed them to go into storage so as to have a reasonable supply next winter.
2. Abroad the industry has been almost destroyed. The use of eggs and poultry is confined almost wholly to hospitals and invalids. In some of the German cities one and two eggs a month are allowed — if they are on the market and if one can afford them. In Leipsig in August, 1917, eggs were $1.14 a dozen, as compared with 20 cents a dozen in August, 1914.

IV. Eggs (*continued*).

D. Methods of preservation.

1. Numerous methods have been recommended for the preservation of eggs at home. Covering the eggs with a solution of water glass is probably the best. Only fresh, uncracked eggs should be used.

2. Cold storage.

a. The commercial preservation of eggs helps to maintain a supply through the winter and a more nearly even price throughout the year.

b. The number stored is variously estimated at from 6% to 15% of the total production.

c. The changes in cold storage are very slight if the eggs were fresh when put in. There is a slow loss of water by evaporation through the shell, and a transfer of water from the white to the yellow. This results in a weakening of the membrane about the yoke, so that it may break when the shell is broken. The change in flavor is also slight, except under bad conditions of storage, excessively long storage, or storage of previously contaminated eggs.

3. Frozen and dried eggs.

A growing industry for the preservation of eggs out of the shell. The products are used largely by the baking and confectionery trade.

IV. Eggs (*continued*).

E. Egg substitutes.

1. Numerous ones are on the market, most of them wholly devoid of egg and different from egg in composition. They are practically valueless.
2. Some are composed chiefly of some kind of starch with coloring matter and baking powder, and some of skim-milk powder or other protein material with baking powder.
3. Their production with much advertising, fraudulent and otherwise, has developed considerably abroad since the war.
4. Dried and frozen eggs are plentiful and far better than the so-called egg substitutes.

V. Cheese.

A. General statement of methods of making cheese and its composition.[1]

1. It is made by coagulating the casein of milk by the enzyme rennet, usually obtained from the stomach of the cow. The whey is drained or pressed out. The flavor of different kinds of cheese is due chiefly to the kind of bacteria and molds which act during the ripening process.
2. Cheese contains the casein, fat (if made from whole milk), and most of the calcium and iron of the milk. Most of the lactose, lactalbumin, and the soluble part of the ash is left in the whey. (See chapter XII.)

B. Antiquity of cheese-making.

Cheese is probably the oldest of the milk products. For centuries it has been an important article of diet in the older countries. Job uses cheese-making similes to illustrate his sufferings (Job 10:10) and the young shepherd David brought gifts of cheeses to the army defending Judah from the Philistines (I Sam.17:19).

C. Use in Europe.

[1] See Sherman's *Food Products*, chap. 4, for details.

V. Cheese (*continued*).

The food value is more generally appreciated in Europe and Asia than in the United States. The enormous European supply has had to be supplemented even in times of peace by imports from North America and New Zealand.

1. Great Britain.
   a. Consumption.
      (1) Cheese is classed as more of a necessity than butter, which is now regarded as a luxury. It is a regular article of diet in the workingman's lunch. The average annual consumption before the war was 336,000,000 pounds, less than one-fifth of which was produced at home.
      (2) Consumption has increased during the war. It is included in the military ration. To stabilize the market and encourage production, wholesale prices were fixed by the Food Controller in 1917.
   b. Imports. The average importation before the war was 264 million pounds, over half of which came from Canada. Imports from North America have increased since the war, but the supply from the Continental European "dairy belt" (Northern France and the lowland countries across Europe to Russia) has become insignificant.
2. Continental Europe.
   a. The cheese supply at present is insufficient for the demand, which has been increased because of the shortage of other foods.
   b. Cheese rations have been fixed in urban centers in Germany at from 1/2 to 4 1/3 ounces per week. The supply is running very low.
   c. Cheese prices have been fixed in many countries, the question of price being especially important in Italy, where cheese is so very generally used.

V. Cheese (*continued*).

d. Switzerland and Denmark have both threatened to stop cheese export because of the fodder situation and consequent scarcity of milk. Holland laid an embargo on dairy exports in December, 1917, but made an exception of cheese, which could be exported to Germany in exchange for coal.

D. Production and use of cheese in the United States.

1. The centers of cheese production are New York and Wisconsin. Before the war there were some 2,000,000 dairy cows in Wisconsin and 2000 cheese factories. Both New York and Wisconsin produce American modifications of foreign styles, but the greater part of the product is American (cheddar) cheese. Cottage cheese is now being made in increasing amounts from skim milk.

2. The per capita consumption is only 3 1/2 to 4 pounds per year, much less than in Europe. About 95% of this is of domestic production.

E. Nutritive value.

1. Cheese is a concentrated and valuable food which could well be used in much larger quantity than has been our custom. Many varieties are roughly one-third water, one-third fat, and one-quarter protein. They are therefore higher in protein and fat and lower in water than most meats.

2. It is practically completely digested when eaten as an essential part of a meal.

V. Cheese (*continued*).

3. Cheese is often cheaper than most animal foods. "It is a fair general estimate that a given amount of money spent for American cheese at ordinary prices will buy about twice as much food value as it would if spent for meat." [1]

VI. Nuts.

The possible importance of nuts in our diet is little appreciated. Their use could well be greatly extended.

A. The supply.

1. Nuts are grown commercially over large areas, especially in the South and Southwest, and the crops are increasing in importance. Peanuts (which strictly speaking are legumes, not nuts) are grown in the cotton area especially in Texas and Georgia. In 1909, the peanut crop had four times the value of all the other nuts together, and now the annual value exceeds any single vegetable except the potato. The profit from the enlarged peanut crop partially offset losses from the cotton boll weevil in Texas in 1916–17.
2. The imports, formerly of considerable importance, are now curtailed.

B. The place in the diet.

1. Composition.

a. They are highly concentrated foods, con-

[1] Sherman, H. C. *Food Products*, p. 108. Macmillan, 1917.

VI. Nuts (*continued*).

sisting chiefly of fat and protein. Chestnuts alone are high in carbohydrate and low in fat. Recall that the 100-calorie portion of most nuts is very small; e.g., 12 to 15 almonds make a portion. They are, therefore, to be regarded as staple articles of food and by no means simply as relishes or accessories.

b. Recent experiments show that peanuts and probably other nuts are a satisfactory source of protein.

2. They are considered as a very important part of the diet by groups of "fruitarians" in California.

3. Digestibility.

a. Nuts are almost completely digested under the proper conditions. In experiments with diets of nuts and fruit 90% of the protein, 85% of the fat, and 95% of the carbohydrate was digested.

b. They are much less completely digested if they are not properly masticated, as shown by one of the subjects in the above experiments; hence the great advantage of the finely ground preparations like peanut butter.

c. Occasional discomfort from their use is probably due to insufficient chewing, or eating them after an already sufficient

VI. Nuts (*continued*).

meal. There is no reason to believe that salt adds to the digestibility.

4. Pecuniary economy.

Many nuts and nut products are a cheaper source of protein and energy than some cuts of meat. For example:

Twenty cents spent for sirloin steak (at 40 cents a pound) gives about 475 calories and 37 grams of protein.

Twenty cents spent for peanut butter (at 30 cents a pound) gives about 1825 calories and 88 grams of protein.

Conclusions.

There is an abundance of excellent protein-rich food in the country not needed for export. Its use not only saves meat, but gives variety to the dietary and can lessen the amount spent for food.

REFERENCES

(The United States Department of Agriculture and various States have published many bulletins on eggs and poultry; the Bureau of Fisheries and some States, bulletins on fish; the nut-producing States, bulletins on nuts. Only a few are listed here.)

Atwater, W. O., and Bryant, A. P. *Chemical Composition of American Food Materials.* U.S. Department of Agriculture, Office of Experiment Stations, Bulletin 28.

Bassett, C. E., and Kerr, W. H. *The Community Egg Circle.* U.S. Department of Agriculture, Farmers' Bulletin 656. 1915.

Cobb, J. M. *Pacific Salmon Fisheries.* Appendix III to Report of the United States Commissioner of Fisheries for 1916, Document 839.

Daniels, A. L., and Laughlin, P. "Feeding Experiments with Peanuts." *Journal of Biological Chemistry*, 33, p. 295. 1918.

Editorial. "Peanuts as Food." *Journal of the American Medical Association*, 70, p. 850. 1918.

European Markets for Fish. Bureau of Foreign and Domestic Commerce, Miscellaneous Series, No. 25.

Flohr, L. B. *Marketing Eggs by Parcel Post.* U.S. Department of Agriculture, Farmers' Bulletin 830. 1917.

Jaffa, M. E. *Nuts and their Uses as Food.* U.S. Department of Agriculture, Farmers' Bulletin 332. 1910.

Langworthy, C. F. *Fish as Food.* U.S. Department of Agriculture, Farmers' Bulletin 85 (Revised).

Leach, A. E. *Food Inspection and Analysis*, chap. 9. Wiley. 1917.

Pennington, M. E. *A Study of Commercial Eggs.* U.S. Department of Agriculture, Bulletin 51. 1914.

Pennington, M. E. *A Study of the Preparation of Frozen and Dried Eggs in the Producing Section.* U.S. Department of Agriculture, Bulletin 224. 1916.

Pennington, M. E. "Supplementing our Meat Supply with Fish." Yearbook of the U.S. Department of Agriculture. 1913.

Pennington, M. E. *Practical Suggestions for the Preparation of Frozen and Dried Eggs.* U.S. Department of Agriculture, Bureau of Chemistry, Circular 98. 1912.

Rich, J. P. *Nuts and their Uses as Food.* Bulletin of the University of Texas, October 20, 1914, and *The Uses of the Peanut on the Home Table*, April 5, 1917.

Sherman, H. C. *Food Products.* Macmillan, 1917.

Slocum, R. R. *Marketing Eggs through the Creamery.* U.S. Department of Agriculture, Farmers' Bulletin 445. 1915.

Smith, J. R. *Industrial and Commercial Geography.* Henry Holt, 1913.

CHAPTER VIII

FATS AND OILS — THEIR VALUE AND USE

THE situation as regards the fat supply makes necessary both an actual cutting down of consumption and a substitution of one kind of fat for another — the vegetable oils for the animal fats. This substitution is not difficult, for the possible substitutes are numerous and fairly familiar.

I. The sources of fat in the diet.

A. Fats and oils are all very much alike in composition and properties. The kinds which different nations have eaten have depended chiefly upon climatic and economic conditions; e.g., olive and cocoanut oils in tropical or semi-tropical regions, and lard and butter in meat-producing countries. In recent years with the development of industries and transportation, we have a much greater variety, especially of vegetable products.

1. The vegetable oils. Cottonseed, corn, peanut, and olive oils are the most important in this country.

2. Butter and butter substitutes — oleomargarine and nut or vegetable margarine.

a. The term "oleomargarine" legally covers both substitutes, though strictly it means only margarine made from oleo oil.

I. The sources of fat in the diet (*continued*).

b. The margarines are made by churning different fats with milk. For oleomargarine, oleo oil, neutral lard, and cottonseed or peanut oil are used and sometimes butter is added for flavor. The nut margarines are made of cocoanut, cottonseed, and peanut oils.

c. They are manufactured under restrictions in many countries in order to prevent fraud and protect the butter industry. Canada's law represented an extreme — complete prohibition of the manufacture, sale, and importation — but the demand for butter, due to war conditions, became so great that the prohibition was removed (1917) until "the present abnormal conditions have ceased." In the United States the uncolored product is taxed a quarter of a cent a pound and the colored margarine, 10 cents a pound. In 1917, $2,000,000 was collected from this tax.

3. Lard and lard substitutes.

a. The lard compounds are mixtures of vegetable oils with the harder animal fats.

b. The hydrogenated oils are solid fats made by passing hydrogen through the oils under proper conditions. They are used in the same way as lard and are sold under various trade names.

B. Foods rich in fat.

1. Chiefly animal foods: bacon, meat, cheese, cream, milk.

2. Nuts, olives: almost the only vegetable foods with much fat.

3. Fried foods, and some cakes, pies, and sauces.

C. Amount of fat in foods.

1. The following statements will give students a rough idea of the amount of fat they are

I. The sources of fat in the diet (*continued*).

eating. They show that a diet may be high in fat, even though isolated fats are not used. Most of the figures are merely approximations because the fat content of a food often varies greatly. For that reason no attempt is made to give portions similar to the half-ounce protein portions given in chapter V. For comparison, remember that a tablespoon or a scant inch cube of butter weighs 14 grams.

2. Some approximate quantities.

a. Cream — most States have a legal requirement of not less than 18% fat, so that half a pint of cream contains 40 grams. "Whipping cream" contains still more.

b. Ice cream — legally contains not less than 14% of fat, so that if a quart is cut into 8 slices, each slice will have at least 15 grams.

c. Milk — 15 to 18 grams per pint.

d. Cheese — 7 or 8 grams in an inch cube.

e. Cooked bacon. The fat content varies greatly with the amount of cooking and the kind of bacon, anywhere from 37% to 80%. Probably 50% is a fair average. A person eating 2 or 3 small slices of bacon might get about 5 grams of fat. Much fat is lost from bacon in cooking but this, of course, should be saved and used. Bacon itself, being an easily shipped form of ani-

I. The sources of fat in the diet (*continued*).

mal fat, should be eaten sparingly, unless there is a temporary excess of hogs in the country, as during the summer of 1918.

f. Eggs — 5 or 6 grams per egg. The yolk is one-third fat.

g. Meat and fish — variable, depending not only upon the kind and cut of meat and the way the butcher trims it, but upon whether the individual eats the fat served to him. From 10% to 15% fat in lean meat is a fair average, or 8 to 10 grams of fat in a two-ounce serving.

h. Nuts — high in fat, from 40% for peanuts to 70% for pecans. The 2 ounces of peanuts which gives 14 grams of protein contains over 20 grams of fat, but this amount is considerably more than is usually eaten.

i. Chocolate — 50% fat. An ounce square (one-eighth of a half-pound cake) contains about 14 grams.

j. Most vegetables and fruits are almost completely free from fat.

k. Fried foods. These are often much more extensive sources of fat in our diet than is realized by a person not actually doing the cooking.

(1) Potato chips — about 40% fat.

(2) Doughnuts — 20% to 30% fat or even higher. One good-sized doughnut may contain 20 grams or more.

II. Function of fat in the diet.

A. It is digested almost completely. There is no difference between different kinds; e.g., butter and oleomargarine are digested equally well. The harder fats like beef and mutton suet, when eaten unmixed with softer fats, are digested somewhat less completely, but the difference is not great enough to be significant in the ordinary diet.[1]

B. It is burned as fuel.

1. Fats are used for fuel as are starch and sugar, and can be largely replaced by them. Recall that fat gives 2 1/4 times as much energy as an equal quantity of carbohydrate, and that a scant tablespoon or a scant one-inch cube of fat gives 100 calories.

2. All fats give the same amount of fuel. The slight difference in the fats in taste, odor, color, are due to minute quantities of "impurities" not removed in refining, and have nothing to do with the nutritive value. Olive oil and butter have more of these characteristic substances than cotton-seed oil, which has been refined to a greater extent, but they give no more fuel. Olive oil, contrary to a popular impression, has no special medicinal virtues.[2]

C. The fat eaten in excess of the amount needed for fuel is stored as body fat. Cutting down

[1] For changes of fat in metabolism see Sherman, *Chemistry of Food and Nutrition*, pp. 115–118.

[2] See the editorial comment in the *Journal of the American Medical Association*, 70, 698. March 9, 1918.

II. Function of fat in the diet (*continued*).

on fat is an easy way of diminishing an excessive diet.

D. Fat lengthens the time that foods remain in the stomach. This may result in a feeling of discomfort after a "rich" meal, and it postpones the sensations of hunger. A slice of bread and butter will delay the feeling of hunger longer than a slice of bread and jam, though it may give an equal number of calories. The Europeans who are now so very short of fat are almost always hungry even though their actual needs may be satisfied.

E. Fat in the diet has a marked psychological value. The European nations miss the fat from their diet for this reason also. Food without fat is apt to be without flavor and monotonous. If a food is distinctly unpleasant and different from what a person is accustomed to, actual digestive upsets may result.

F. The only important difference between fats is the presence of the fat-soluble vitamine.

1. This is present in milk fat — that is, in whole milk and butter — and in oleomargarine made from beef fat, but not in lard and vegetable oils. It is also present in cod-liver oil, egg yolks, and in leaf vegetables.
2. It is important to consider this factor in planning the diet, especially of children. If a fair amount of milk is used, the vitamine will be provided. If milk is not available, this vitamine should be obtained from butter.

III. How much fat do we eat?

A. The diet of the wealthy often contains more fat than that of the poor; the meat-eater eats more fat than the vegetarian; the American more than the European or Oriental. There are great racial and individual differences in the quantity consumed.

B. An average of 1300 dietary studies, largely American, but some from other regions, shows that an average of 4 1/2 ounces per person per day is eaten — far higher than most European consumption to-day and much higher than is necessary. This is the total fat of the diet, not including waste.

1. Among the largest quantities was more than 13 ounces per day consumed by Maine lumbermen and almost as much by members of football teams.
2. Smaller quantities, 2 1/3 ounces, were used daily by poor families in New York.
3. Some destitute German laborers averaged only 1 ounce.
4. A Japanese professor consumed 3/4 ounce.

C. The distribution of our fat consumption between isolated fats and fat in our other food also varies greatly. In the recent Washington study of the diet of the poor, the total fat averaged 3.9 ounces and the fat bought as such averaged 2.2 ounces per day.

D. The fat consumed in this country is chiefly butter and lard. On an average about 20 pounds of butter and 10 pounds of lard is eaten annually per person, about 3/5 of a pound a week of both. Remember that this is an average for both rich and poor. The amount of oleomargarine eaten is small as compared with the consumption of butter and with the European consumption, but it is

III. How much fat do we eat (*continued*).

increasing rapidly. In 1916 we averaged only a pound and a half per capita for the whole year, or about a twelfth as much as butter. In 1917 the oleomargarine consumption had gone up 50% — to 2 1/3 pounds.

E. Many other nations derive their fat chiefly from vegetable sources, especially in hot climates. Spain, for example consumes on an average 3/4 of a pound of olive oil per week per person. The well-to-do may eat over a pound a week and the laboring classes about 1/3 of a pound.

F. Students should count up their own fat consumption as nearly as possible, at least that part of it which comes from isolated fats. Find the family consumption of fats per week or month and compute the individual's consumption per week or day. A rough estimate of fat obtained from milk, meat, etc., may be made and the entire fat consumption totaled.

IV. How much fat do we need?

A. It is impossible to say with definiteness. Various older standards give a little under two ounces a day as a possible minimum. (Rubner, 52 grams; Playfair, 51 grams). The Allied Committee on Alimentation, at its second meeting at Rome in April, 1918, fixed 75 grams (2 5/8 ounces) as a desirable minimum ration of fat.[1]

B. Some races live on much less; e.g., the Japanese and Hindus and lately most of the Germans.

C. Three points may be considered:

1. Fuel fat can be largely replaced by carbohydrate without harm to the body.

[1] "The Food Situation Discussed by Scientists." *American Food Journal*, 13, p. 362. July, 1918.

IV. How much fat do we need (*continued*).

2. Enough milk or butter should be eaten to get sufficient fat-soluble A.
3. Enough fat is necessary to make the food satisfactory psychologically. This quantity will be less for a skilled than for an unskilled cook, but it is difficult for most people to get along with less than 1 1/2 or 2 ounces per person daily, of fats bought as such, especially if only a small quantity of fat meat is used.

D. American wastefulness has been shown especially in our actual waste of fats — letting it get into the garbage — and our excessive consumption of it. By cutting down the waste of fat, we may be able to eat as much as usual even though we buy less.

V. The fat situation in the Allied countries.

A. Animal fats are very scarce all over Europe because of the large inroads made in the stock of meat animals. (See chapter VI.)

B. The butter and margarine shortage is especially serious in England but it is not so serious in France and Italy because the English have always used considerable fat while the French and Italians have used smaller quantities.

1. Cause of shortage in Great Britain.
   a. She was the largest butter importer, formerly getting 65% of the world's exports.
   b. These imports came mostly from north-

V. The fat situation in the Allied countries (*cont'd*).

western Europe, the chief dairying region in the world, Denmark, Russia, and Siberia, being the biggest exporters, and Sweden and Holland next. Australia and New Zealand were next in importance to Russia as a source of butter.

c. Since the war.

(1) The neutrals have been supplying Germany under pressure; they need Germany's coal and other necessities. (A glance at the map will show the ease with which surrounding neutrals can export to Germany.)

(2) Russia is now cut off. Supplies from Australia and New Zealand are not available.

(3) Although the United States has increased her percentage of butter export very largely, yet if her total butter exports went to the United Kingdom, it would be only 6% of the amount they imported before the war from sources now mostly cut off.

2. Use of margarine.

a. It is much more widely used in both England and France than in the United States. In England about twice as much margarine as butter is used. The reverse was true before the war.

V. The fat situation in the Allied countries (*cont'd*).

b. The manufacture of margarine in England has increased greatly. The production of vegetable oils from imported oil-bearing seeds has increased until England is the largest producer in Europe. The palm-kernel oil industry which Germany formerly controlled has been developed in England and peanut and cocoanut oils are also refined in great quantity.

C. Regulations in England.

Four ounces of butter or margarine are allowed per person per week — half our average consumption. The lessened meat ration in the winter of 1918 further reduced the total fat consumption. A ration does not imply a guarantee that the amount will be available; it merely gives permission to buy the quantity if it is on the market.

VI. The fat situation in Germany.

A. Probably the most serious individual food shortage which they are facing.

1. Half their fat supply was imported before the war. Now the supply has been largely cut off.

a. The surrounding neutrals have had to curtail their normal exports because of lack of feeds, etc.; e.g., Switzerland has prohibited the exportation of all dairy products.

VI. The fat situation in Germany (*continued*).

b. The embargo which the United States laid on fats to neutrals still further curtailed their export to Germany.

c. Their supply of vegetable oils from the United States and the tropics is not available.

2. Their national supply of animal fats has been greatly curtailed because of their inability to feed stock.

3. The shortage of fats causes special difficulties because of their national habit of using large amounts of fat in cooking and on the table. The food since the war has been considered tasteless and unnatural. It is definitely unsatisfactory because the rapidity of digestion of food with little fat prevents any feeling of satiation.

B. Regulations.

1. In December, 1915, two fatless days were prescribed on which no fats could be used on the table or in the preparation of food.

2. Rations have varied with the time of the year, with imports from neutrals, etc. They varied in 1915 and 1916 from 90 grams to 280 grams of table fat weekly.

3. Clippings from local German papers (December 3–30, 1917) show that the average total fat allowed was about 78 grams per week. Rations vary in different localities

VI. The fat situation in Germany (*continued*).

and are being constantly changed with the supply, from 99 grams per week of butter to none at all, and from 108 grams of oleo to none. There are many indications of the severe shortage. An interesting example (*Braunschweig Volksfreund*, January 16, 1918) is that of an owner of a bootshop found by the police to have 70 pairs of good shoes which he would sell to customers only in exchange for butter, bacon, etc.

VII. The United States and the world fat situation.

A. The United States is the only one of the warring countries which has more fat than it needs and great resources in vegetable oils besides.

B. The exports increased in 1915 and 1916 over the pre-war average.

C. The exports decreased in 1917 due in part to the embargo on fats and oils to neutrals.

1. The United States determines the amount which may be exported to neutrals, the amount depending upon what we and the Allies can spare and what the neutral country needs exclusively for its own use.

2. The result has been a tremendous decrease to some European neutrals, following an increase at the beginning of the war. For example, Sweden, which imported from the United States 45,000,000 pounds of lard

VII. United States and world fat situation (*cont'd*).

in 1915, imported 1,000,000 pounds in 1916, and in 1918 was getting none at all. Similarly our exports of oleo oil to Sweden, Holland, and Denmark have been cut down to a third of the 1915 exports.

3. The chance has thus been diminished of our fats going to relieve Germany's shortage, or of the shipment to the enemy of commodities produced at home by neutrals.

D. Animal fats.

1. The export of butter has increased largely, but it is only 0.1% of the production.
2. The total exports of lard have not increased, but we export about a third of what we produce. Due to the cutting down of exports to the European neutrals we were able to double our exports to Belgium in 1916 and steadily to increase those to France. England gets about a third of the total exports.
3. We export about half as much oleomargarine as we do butter and the amount is increasing, but we export much more oleo oil which is made into oleomargarine abroad.
4. Any large immediate increase in our exports of animal fats must come through the cutting down of our own consumption, because of the time necessary to increase the herds.

VII. United States and world fat situation (*cont'd*).

E. Vegetable oils.

1. The amount of vegetable oils can be increased during one crop year by increasing the acreage planted. This gives us a great potential supply of vegetable oils.
2. Cottonseed oil is second to lard in the amount exported.

VIII. The individual's part in fat conservation.

Unlike wheat, there is no obvious shortage of fat. We can still buy as much butter or lard as we want, though the prices have increased. Thus fat conservation is a matter of voluntary, conscientious effort. There are many ways of saving fat:

A. Use as little fat of all kinds as possible by cutting down the actual consumption, and preventing all wastes.

1. Bake, broil, and boil food more; fry less.
2. Modify recipes so that less fat is used; e.g., in cake.
3. When foods rich in fats — e.g., cheese, bacon, or mayonnaise — are used, butter or other fat is not necessary.
4. Serve butter in small pats and thus avoid plate waste.
5. Use fruit and other simple desserts in place of rich cakes, pastries, or whipped-cream preparations.
6. Students should suggest other methods of saving.

VIII. Individual's part in fat conservation (*continued*).

B. Use vegetable oils in cooking and such fats as the trimmings from beef, chicken, etc. If properly used, cakes, pies, bread, etc., will be just as good. The oils can also be used for frying.

C. Use any chicken, beef, or mutton fat which may be saved, from the meat.

1. Separate the fat from the connective tissue by melting and straining.
2. Chicken fat is especially good to use in cakes, etc. Mutton fat has a distinct flavor which makes it unsatisfactory except in such things as gingerbread. Gingerbreads made with mutton fat can be distinguished from that made with butter by a slightly different texture, but not by the taste.

D. Avoid loss through spoiling.

1. Fats grow rancid more quickly if they are kept in the light and in warm places. Hence avoid glass containers or warm bright spots.
2. Overheating prevents the possible re-use of fats for frying, and may leave unpleasant or even harmful substances in the food.

IX. Utilization of non-edible fats.

A. Fat in garbage.

1. About 3% of fat can be extracted and the residue used for fertilizer. The fat extracted is purified and made into soap by treating with alkali, getting glycerine as a by-product. Enough fat is recovered in this

IX. Utilization of non-edible fats (*continued*).

country to make 200,000,000 12-ounce cakes of soap per year. It is also used in the manufacture of candles, paints, perfumes, etc. Enough glycerine is also obtained to produce 10,000,000 pounds of nitro-glycerine.

2. Out of the 74 cities of the United States of over 100,000 inhabitants, 29, including most of the larger cities, use this method. The rest either incinerate their garbage, dump it, or feed it to pigs.
3. Due to the more careful use of food by the housekeeper, the amount of fat available from garbage has been decreased, in some cases to a considerable extent. In Columbus, Ohio, the fat extracted from the garbage in 1917 was almost 50% less than in 1916. In 14 large cities with a total population of over 5,000,000, nearly 40% less fat was recovered in March, 1917, than in March, 1918.

B. Fats spoiled in the kitchen, and waste fats in hotels, army camps, etc., should be reduced to a minimum. Such fats may be sold to a soap manufacturer who can recover the glycerine as well as make soap; or they may be made into soap at home by mixing with lye, although if this is done the glycerine is lost. An interesting example of the conservation of waste fats is shown in the army camps in Great Britain. Kitchen by-products, such as drippings, bones, butchers' fat and greases, are collected and the amount is sufficient to provide the whole of the requirements of soap for the navy, army, asylums, workhouses, and other institutions, and leave a substantial balance for public use. The glycerine produced is sufficient at the present time to provide the propellant for 17,000,000 shells for ammunition.

C. Fat from bones and other slaughter-house refuse. The bones may contain from 12% to 20% fat, which is extracted by hot water, pressure, or by fat solvents such as petroleum. This fat may be used much as garbage fats are used.

IX. Utilization of non-edible fats (*continued*).

D. Various fats which have long been considered inedible can now be purified so as to be without any unpleasant taste or smell; e.g., cottonseed oil has been used for food only within recent years. In Norway, whale oil is being refined and hydrogenated and used in margarine. Hydrogenated fish oil is being used on the Pacific Coast.

REFERENCES

Atwater, W. O. *Principles of Nutrition and the Nutritive Value of Food.* U.S. Department of Agriculture, Farmers' Bulletin 142.

"Cost of Living in the District of Columbia" (third article) *Monthly Review*, U.S. Bureau of Labor Statistics, 5, no. 6, 1917.

Editorial comment. "Olive Oil not Essential." *Journal of the American Medical Association*, 70, 698. 1918.

Garbage Utilization. U.S. Food Administration Bulletin.

"Governmental Control of Food Supplies in Germany." *Monthly Review*, U.S. Bureau of Labor Statistics, 4, no. 5, p. 720. 1917.

Halliburton, W. D., and Drummond, J. C. "The Nutritive Value of Margarines and Butter Substitutes with Reference to their Content of the Fat-Soluble Accessory Growth." *Journal of Physiology*, 51, p. 255. 1917.

Holmes, A. D., and Lang, H. L. *Fats and their Economical Use in the Home.* U.S. Department of Agriculture, Bulletin 469. 1916.

Kellogg, V., and Taylor, A. E. *The Food Problem.* Macmillan, 1917.

Leach, A. E. *Food Inspection and Analysis.* Wiley, 1909.

McCollum, E. V. "Some Essentials to a Safe Diet." *Journal of Home Economics*, 10, p. 18. 1918.

McKee, M. C. "Fat Absorption in Frying Doughnuts." *Journal of Home Economics*, 10, p. 49. 1918.

Monthly Summary of Foreign Commerce of the United States. Department of Commerce, December, 1917.

Osborne, T. B., and Mendel, L. B. "Nutritive Factors in Animal Tissues." *Journal of Biological Chemistry*, 32, p. 309. 1917. (This article gives many references to other papers on the two vitamines. Note especially those on butter, fat, egg-yolk fat, beef fat.)

Picard, G. H. "Edible Vegetable Oils." *American Food Journal*, 12, pp. 621 and 668. 1917.
Rose, M. S. *Feeding the Family*. Macmillan, 1916.
Sherman, H. C. *Food Products*. Macmillan, 1917.
Sherman, H. C. *Chemistry of Food and Nutrition*. Macmillan, 1918.
Thompson, H. C., and Bailey, H. S. *Peanut Oil*. U.S. Department of Agriculture, Farmers' Bulletin 751. 1916.
Vulté, H., and Vanderbilt, S. *Food Industries*, chap. 14. Chemical Publishing Company, 1916.
Williams, A. W., and Gray, C. E. *Fats and Oils in Cookery*. University of Illinois, Bulletin, July 23, 1917.

CHAPTER IX

THE IMPORTANCE OF WHEAT

THE wheat supply is one of the dominating forces in the world to-day. The way in which the shortage of wheat is met may be the deciding factor in winning the war.

I. A wheat shortage is particularly serious and may be disastrous.

A. Our diet contains more of the cereals, especially wheat, than of any other food.

1. Even with the diminished supply during the spring and summer, our stock of wheat offered the largest supply of calories available from any single raw food material.
2. Of our average diet almost a third by weight has consisted of cereal foods. They give us 43% of the protein, 9.1% of the fat, and 61.8% of the carbohydrate of our diet. Most of this in the past has come from wheat, only a minor part from corn, rye, and other cereals.[1]
3. The diet of the poor contains a larger proportion of cereals than that of the well-to-do, because they can get more for their money from these than from other foods.
4. Other countries consume even more wheat

[1] Langworthy, C. F. *Food Customs and Habits in American Homes.* U.S. Department of Agriculture, Office of Experiment Stations, Circular 110, p. 26.

I. A wheat shortage may be disastrous (*continued*).

than we do, and a larger amount in bread, for which wheat is especially important. Over half the food of the French people is bread. (Discussed further in the next chapter.)

B. Lack of bread affects the morale of a people more quickly than lack of any other food.

1. The industrial classes especially are affected as they are the largest users of wheat because of its relatively low price.
2. The Commission for Relief in Belgium found that the most insistent call of the people was for bread.
3. German experience shows that the success of their rationing regulations depends on the amount of bread allowed.
4. A bread shortage reacts with the utmost seriousness on the military situation. The Army and Navy not only must be given enough food to do their work, but all the supplies of war depend on the morale of the workers at home.

II. Causes and extent of the wheat shortage.

A. European supply before the war.

Of the world's wheat, excluding China, considerably more than half was grown in Europe.

1. Production in the different countries.
   a. Russia, Roumania, and Bulgaria were the only countries of Europe that produced more than they used.

II. Causes and extent of wheat shortage (*continued*).

b. France, Italy, Spain, Great Britain, Germany and Austria-Hungary, although producing large amounts, had to import some.

c. Holland, Belgium, Switzerland, and Scandinavia depended almost wholly on imports.

2. Sources of imports.

a. Russia and Roumania were the leading sources of supply.

b. The United States, Canada, Argentina, India, and Australia were important sources.

c. These seven countries furnished 94% of the world export of wheat, and with Europe constituted the chief world wheat areas.

3. Figures of wheat production, export and import are given by G. B. Roorbach in *The World's Food Supply, Annals of the American Academy of Political and Social Science*, 74, p. 9. 1917.

B. Effect of the war on the wheat supply.

1. Supply of the Central Powers.

a. Many of the usual sources of imports are now cut off. For example, Russia, though now partly open to the Central Powers, has not been able to feed herself.

b. Germany is in control of the large wheat-producing lands of Bulgaria and Roumania.

c. The supplies from these countries and from

II. Causes and extent of wheat shortage (*continued*).

the rest of the Balkan States and Turkey satisfy part of their needs, but their own slackened production has caused a serious shortage for the last three years as their diminishing rations show.

2. The Allies' supply.

a. The production of the Western Allies in 1917 fell far below the normal pre-war production. One-third of the wheat lands of France are barren, so in 1917 she was able to grow but 40% of what she needed instead of the 90% of pre-war years. Italy's crop was short. Great Britain's crop was good, but at best she must always import very large amounts. Her home production of wheat provides only about one-fourth of the amount needed.

b. Russian wheat has not been available.

c. The Balkans are in the control of the Central Powers.

d. Australia and India both have large crops, but lack of ships and the submarine peril make them largely inaccessible. Parts of three crops are stored in Australia. (See the frontispiece.)

e. Argentina had a poor crop in 1916–17 and her remoteness also creates difficulties of shipping. However, some wheat is obtained from this source.

II. Causes and extent of wheat shortage (*continued*).

f. The supplying of the largest part of the wheat demand of the Allies has fallen upon the United States and Canada.

3. The American supply.

a. The 1916 crop was small and the 1917 crop only four-fifths of the average pre-war size — little more than we normally consume ourselves. The exportable supplies from June, 1917, to June, 1918, were estimated at about 20,000,000 bushels The needs of the Allies far exceeded this amount. We had three possible alternatives in January, 1918:

(1) To decrease the exports to the Allies and thus have enough for ourselves.

(2) To keep on as usual for four months and have none for two months.

(3) To cut down our consumption for the entire six months.

b. The last method was adopted. Of our 1917 wheat crop we actually exported about 141,000,000 bushels, seven times as much as we could have exported had our consumption been normal. In addition we have shipped about 10,000,000 bushels to neutrals who were dependent on us. In May, 1918, half the product of our flour mills went abroad.

c. This abnormally low supply and the exces-

II. Causes and extent of wheat shortage (*continued*).

sive demand have resulted in the practical exhaustion of our wheat reserve. Therefore we come to the 1918 harvest without the usual carry-over, so that even if the 1918 wheat crop is unusually large, as it promises to be, a large share will be needed not only for export, but to build up normal reserves here. This has been brought out in the joint resolution passed by the Food Controllers of the United States, France, Italy, and Great Britain, during their conference in London. It applies to all our resources as well as to wheat: "Resolved, that while the increased production of the United States renders it possible to relax some of the restrictions which have borne with peculiar hardship upon all our peoples, yet it is absolutely necessary that rigid economy and elimination of waste in the consumption and handling of all foodstuffs, as well as increased production, should be maintained throughout the European Allied countries and in North America. It is only by such economy and elimination of waste that the transportation of the necessary men and supplies from North America to the European front can be accomplished and that stocks of foodstuffs can be built up in North America as an insurance against the ever-present danger of harvest

II. Causes and extent of wheat shortage (*continued*).

failure and the possible necessity for large and emergency drafts to Europe. We cannot administer the food problem on the basis of one year's war. We must prepare for its long continuance if we are to insure absolute victory."

III. Trade in wheat before the war (to compare with conditions under the Food Administration and to show the need for control.)

- A. Movement of wheat from the farm to the great terminal grain centers, the "primary markets."
  1. The wheat was sold by the farmer to the local grain elevator, usually on the nearest railroad.
  2. From the local elevators most of the wheat went to the terminal elevators at the grain centers or primary markets.
- B. Trade at the primary markets.
  1. The primary markets — Chicago, Minneapolis, Duluth, Superior, St. Louis, etc. — were in the great grain-growing regions, and were both railroad and water-route centers.
  2. The terminal elevators received, stored, and transferred all the grain that flowed from the farm to the primary market, operating on a stupendous scale. From the terminal elevators the wheat was sent to millers or to the seaboard for export, after being stored a varying length of time, depending on the market. This unregulated commerce resulted in a great deal of cross-hauling.
  3. The buying and selling of wheat were done in the grain exchanges. There was comparatively little actual transfer of wheat. A quantity was bought for delivery at some future time and might be sold again and rebought many times before delivery took place. Each

III. Trade in wheat before the war (*continued*).

transfer usually added to or subtracted from the price of wheat without any change in its actual value, the rise and fall in price being due to the "condition of the market" which was dependent on forecasts of the condition and size of domestic and foreign crops, shipping conditions, etc.

C. The price of wheat. It may be understood from the above that —

1. The price the farmer got for his wheat might have little to do with what the consumer paid for it as flour, especially when there was an abnormal demand.
2. There was opportunity for great inflation of prices by manipulation and hoarding.
3. Despite speculation, the law of supply and demand helped to keep the price fair.

IV. War always results in a rise in the price of wheat when it is uncontrolled.

A. The law of supply and demand breaks down because of the greatly diminished wheat supply and the impossibility of much increase of the supply under war conditions, no matter how great the demand or how high the price.

B. Unsettled conditions of the market result in greatly inflated prices. A small shortage may result in a vastly increased price.

C. Heretofore war has in all countries and in all times meant unbridled speculation in foods. This was shown in the Civil War, when wheat increased 130% over the price in 1861, although there was no actual shortage.

IV. War always results in a rise in the price of wheat when it is uncontrolled (*continued*).

D. The situation is further complicated by the breakdown of the transportation system which nearly always occurs during a war.

V. How the United States has met the wheat situation.

A. Stimulation of production by the Department of Agriculture —

1. By educational methods through the state colleges, county agents, press, granges, etc., especially by a vigorous campaign among the farmers so to increase their wheat acreage as to produce a billion bushel crop in 1918.

2. By scientific control of the wheat and the cereal crops; e.g., by constant help to the farmer in selecting and testing seed and in the eradication of destructive insects and plant diseases.

B. Stimulation of production by the action of Congress in establishing the minimum price of $2.00 a bushel for the 1918 wheat crop. It should be understood that the purpose of this legislation was not primarily to keep down the price to the consumer, but to encourage production by the farmer. The price was increased to $2.20 by Presidential proclamation.

C. Development of orderly conditions in the wheat and flour industry in place of the chaotic ones immediately preceding and following our entrance into the war.

V. How the United States has met the wheat situation (*continued*).

1. Elimination of speculation and hoarding by —
   a. Limiting the right to store wheat or flour to thirty days, except with the approval of the Food Administration, and so preventing an artificial scarcity and an advance in price.
   b. Prohibiting the sale of flour more than thirty days in advance, thus making speculation in flour contracts impossible.
   c. Requesting the grain exchanges to suspend all trade in futures during the war.
2. Establishment of the Food Administration Grain Corporation. "A foresighted American action that has helped the Allies stave off a disastrous peace months ago." It was necessary to direct and finance the movement of wheat.
   a. The grain corporation has control of supply and distribution by directing the movement of wheat from the farmer to the miller and then to the dealer, and its sale to the Allies and the Government. Because of the central control in each region, there is the greatest possible economy in time and transportation, through the prevention of cross-hauling.
   b. Method of operation:
      (1) By consultation and coöperation with the producer and dealer in wheat on

V. How the United States has met the wheat situation (*continued*).

the one hand, and the miller and dealer in flour on the other. Millers doing about 85% of the business of the country have voluntarily coöperated with the Food Administration.

(2) By licensing the dealers and millers, thus bringing into line those who do not voluntarily coöperate.

3. Control of price. Low prices are impossible in war-times, but the Food Administration strives for as great a supply as possible at a reasonable price to the consumer and a fair profit to the producer and dealer.

a. The Grain Corporation buys enough wheat for the Allies and the Government to control the market and so makes the legal minimum price of wheat the maximum also.

b. The profits of the millers are limited by agreement.

c. The result has been an actual decrease in the price of flour to the consumer, and an increase of price to the farmer for his wheat.

(1) In May, 1917, when there was no food control, the difference between the price of the farmer's wheat and the flour made from it was $5.86 per barrel of 196 pounds. Fifteen months later the difference was 64 cents.

V. How the United States has met the wheat situation (*continued*).

(2) Wheat, in February, 1917, sold for \$1.80 a bushel and in May for \$3.50 a bushel, almost double. Since the situation has been controlled it sells for \$2.20 a bushel. If the rate of advance which held during the Civil War had obtained, wheat would now be selling at \$4.40.

(3) Flour sold for \$8.75 per barrel in February and went to \$17.00 in May. The average price in the United States in July, 1918, was \$10.50 per barrel.

d. Voluntary and compulsory wheat conservation are discussed in the next chapter.

VI. Control of grain supply abroad and in Canada. For comparison with the methods used in the United States, a few statements in regard to the methods abroad are given here.

A. Italy.

1. Stimulation of production.

a. Minimum prices to the farmer were established, but they have been increased from time to time. If crops are raised under difficulties, or are in excess of normal production, the farmer may get a 10% increase over the fixed rate for his crops.

b. The amount of increased acreage which any farmer shall cultivate may be determined by the Government. A landowner can be made to increase the area rented to his tenants.

c. Expenditures for tractors, mechanical ploughs, etc., are encouraged by granting a subsidy of 30% or

VI. Control of grain supply abroad and in Canada (*continued*).

40% when bought by a group of five or more. This device has given great satisfaction and has had an important influence on the increase of production.

2. Supervision of distribution.
   a. A grain assembly in each province superintends the supply and distribution of cereals and flour.
   b. All native and imported cereals are requisitioned in order to regulate their distribution.
   c. Maximum prices are established.

B. France.

1. Stimulation of production by —
   a. Financial assistance for the purchase of tractors and other machinery.
   b. Furloughs at seeding and harvesting times for some agricultural laborers in the army and even removal from the army of the older farmers.
   c. The use of women in agriculture.
   d. Fixed minimum prices to producers, progressively increased because previous prices were not large enough to induce farmers to grow cereals.
2. Control of commercial operations.

   In October, 1915, the Government was given the right to requisition wheat and flour for the civil population (it always could requisition them for the military); also to buy these commodities abroad and to distribute them. There has been similar control granted for other foods.

C. England.

1. Some of the measures to stimulate production:
   a. Minimum prices to the producer. A bill of April, 1917, provides a minimum price for wheat on a diminishing sliding scale for six years (from $1.87 1/2 to $1.33 7/8 per bushel).

VI. Control of grain supply abroad and in Canada (*continued*).

b. A minimum wage to farm laborers of 25 cents per hour guaranteed for the above period.

c. Government aid to farmers to acquire grazing land for grain production. England before the war had a little less than 25% of her land under cultivation. The acreage planted increased a million acres in 1917 over 1916, and it is expected that in 1918 the increase will be no less than two million and probably three million acres. This was accomplished by the extension of credit to the farmer by the Government and by compelling the farmers to cultivate the land made available.

d. Restriction of acreage for luxury crops.

e. Furloughing of agricultural laborers from the army.

f. Organization of units of women for farm work. Over half a million women of all classes are now working on the land.

g. Governmental provision of seed wheat, farm machinery, and horses to farmers. During 1917, 3500 tractors were placed at the disposal of farmers.

2. The Royal Commission on Wheat Supplies fulfills many of the functions of the United States Grain Corporation. Among other powers it has the control of wheat importation, financing and distribution.

D. Canada.

A board of grain supervisors was established in Canada in June, 1917, with power to fix the price of grain and control its distribution and sale. Infringement of its rulings or orders are punished by fines and imprisonment. The price for 1917 wheat was identical with that established in the United States.

E. Germany.

1. Strenuous efforts to increase production were made, which, however, have never come up to expectations.

VI. Control of grain supply abroad and in Canada (*continued*).

a. The price of wheat was fixed.

b. The Government controlled seed and fertilizer (but there was very little to control).

c. Prisoners of war and reserves have been used for farm labor and men who were inactive on the Eastern Front were sent to farms in Roumania, Poland, and Courland.

2. The feeding of wheat and rye to animals was prohibited. This could not be enforced.

3. Maximum prices to the consumer were established.

REFERENCES

Dondlinger, P. T. *The Book of Wheat.* Judd, 1908.
Kellogg, V., and Taylor, A. E. *The Food Problem.* Macmillan, 1917.
Merz, C. "Wheat for the Allies." *The New Republic*, February 9, 1918.
Report of the Secretary of Agriculture for 1917.
Sherman, H. C. *Food Products*, chap. 7. Macmillan, 1915.
Smith, J. R. *Industrial and Commercial Geography.* Holt, 1913.
Soule, G. "Natural Laws." *The New Republic*, February 16, 1918.
"The World's Food." *Annals*, American Academy of Political and Social Science, November, 1917.
Van Hise, C. R. *Conservation and Regulation in the United States during the World War.* U.S. Food Administration.

CHAPTER X

FLOUR AND BREAD — THE WHEAT SUBSTITUTES

I. Wheat flour.

A. The structure of the wheat grain.

An understanding of this is necessary because of its relation to the kind of flour milled. It is similar for all grains. There are three main parts:

1. The bran. A fibrous outer covering consisting of several layers. It is largely cellulose and is rich in mineral salts.
2. The germ. The small part of the seed from which the plant develops. It contains less starch and more protein and oil than the rest of the berry.
3. The endosperm. The largest part of the berry. It contains the nourishment for the young plant and consists of carbohydrate, chiefly starch, embedded in a network of protein. The endosperm is the chief source of white flour.

B. Flour-making.

1. It is a very ancient process. Excavations show that since prehistoric times wheat has been ground between stones to make flour.
2. The modern machinery also grinds the grain,

I. Wheat flour (*continued*).

but a complicated system takes the place of the hand-turned stones and the product is more refined.

a. Cleaning — removal of foreign seeds, dust, and loose particles of bran, either in "scourers" or by washing in water and drying.

b. Tempering — by heating and applying moisture in order to get the berry tough enough to allow the bran to flake off easily in the milling process.

c. Milling — a complicated process differing in detail with the mills and the kind of flour produced. It consists chiefly of passing the cleaned and tempered grain first through a series of corrugated and smooth steel rollers and then through sieves or bolting cloth of different degrees of fineness. This pulverizes the berry and removes more or less of the bran, the germ, and the coarser parts.

C. Milling products.

1. The kinds of flour. The character of a flour depends on the part of the kernel from which it is made.

a. Graham flour. The entire berry is ground into flour and nothing is removed.

b. Whole wheat or entire wheat flour. It is made by removing from 10% to 15% of the

I. Wheat flour (*continued*).

berry. This removes part of the bran and germ. Note that the product is incorrectly named.

c. "Commercial" Graham and whole wheat flours. These are made to simulate the above by sifting bran into straight grade flours. This is the kind most frequently found on the market.

d. Straight flours, sometimes called baker's patent. These flours consist of about 70% of the berry and contain less of the germ and bran than the whole wheat flour.

e. Patents for family trade. The 70% flour is refined so that it may contain as little as 56% of the wheat berry. By such refinement a large part of the mineral matter and vitamines is discarded.

2. Other mill products:

a. Wheat offals — bran, shorts, and feed middlings. They are used chiefly as animal feeds.

b. Low grade or red dog flours. They are used in darker breads like pumpernickel and rye breads, as feeds, and for technical purposes.

D. Regulations of the Food Administration modifying the milling process.

1. The degree of extraction shall not be less than 74%. This prevents entirely the making of the fancy patent flours.

I. Wheat flour (*continued*).

2. The product is still a fine white flour only slightly different in appearance from those on the market before.

E. Regulation of milling abroad.

Higher extractions of flour are generally required abroad than in the United States. It should be noted that because of differences in moisture (in the United States 13.5%, abroad, 17.5%) our 74% is approximately equivalent to the 78% flour of the European mills.

1. France at one time required 85% extraction, but since July, 1917, wheat flour has been milled at 81%.
2. England has changed the milling requirements as the situation changes, but the flour has recently been of 81% extraction.
3. Italy requires 90% extraction, the so-called whole wheat flour.
4. Germany's flour is milled at 82%, 93% and 97% according to the process used, the purpose for which it is intended, and the class of people to whom it goes. The larger part is milled at 82%.

II. Substitutes for wheat flour. Their advantages and disadvantages as compared with wheat.

A. Composition of cereals and cereal products.

1. The composition of all the cereals is practically the same. They contain approximately 10% protein, 60% to 70% carbohydrate, and

II. Substitutes for wheat flour (*continued*).

small amounts of fat and mineral matter. Oatmeal is a little higher in protein, and rice a little lower. Students should look up tables of composition.

2. The amount of fat and mineral matter vary most, depending partly upon differences in composition of the grains (e.g., oatmeal is higher in fat than the others), but chiefly upon whether or not the germ and the bran have been removed. Examples of the latter point are:

a. White and Graham flour which have respectively about 0.4% and 1.7% ash and 1.0% and 2.4% fat.

b. Old process and new process or "granular" corn meal. The latter has most of the germ and bran removed. There is no significant difference between yellow and white corn or even the red and blue and black varieties. Both yellow and white corn meals can be made by the old or the new process.

c. Ordinary polished rice, which is comparable to white flour, and whole or brown rice.

B. Nutritive value.

1. The great importance of the substitutes as sources of fuel in our diet and also as sources of protein has been discussed in chapters III and V. They all give practically the same number of calories, roughly 1600 calories per pound. The 100-calorie portions vary only

II. Substitutes for wheat flour (*continued*).

from 25 grams for oatmeal to 29 grams for rice. The variations in fat content between the highly milled and the whole cereals are too slight to make much difference.

2. The mineral constituents and vitamines have been much discussed. The whole wheat berry contains from three to five times as much calcium, iron, and phosphorus as the refined flour made from it. The water-soluble vitamine is also contained only in the whole wheat. This is important when the diet is limited, but need not be considered in a varied dietary containing milk, eggs, fruit, and vegetables.
3. The protein of corn is just as satisfactory to keep the body in nitrogenous equilibrium as the protein of wheat, even when the corn meal provides one-half of the calories and three-fourths of the protein.[1]
4. Variations in digestibility of the different cereals under similar conditions are generally too slight to be significant.
   a. A soggy piece of wheat bread may not be so easily digested as a well-made piece of corn bread, but that is a question of skill in cooking, not of differences inherent in the cereals.
   b. The digestibility of the proteins and carbohydrates of corn bread and wheat

[1] Sherman, H. C. "Use of Corn as Human Food." *Journal of the American Medical Association*, 70, p. 1579. June 1, 1918.

II. Substitutes for wheat flour (*continued*).

bread, when fed in a mixed diet, is practically the same.

c. Cereal products containing the bran and germ are not quite so thoroughly digested as the refined products. The "roughage" which they contain is not digested and slightly lessens the availability of the other constituents. This "roughage" is desirable for some individuals, while in others it may produce digestive disturbances. In such cases it can better be obtained from fruits and vegetables.

d. Although whole wheat flour contains slightly more protein than white flour, the lower digestibility offsets this so that practically the same amount of protein is digested and absorbed from each. The same is true of the amount of available energy.[1]

e. For the nation as a whole, 100 pounds of wheat yields more digestible protein to human beings when ground into 100 pounds of Graham or 85 pounds of whole wheat flour than into 70 pounds of white flour. The use of the wheat offals as animal feed should also be considered.

f. The use of a high percentage extraction of wheat flour abroad has aroused much renewed discussion of its digestibility. The subject is still under debate. Two questions are involved — the amount digested and the general effect upon health and comfort. Hutchinson has summarized the effect of war bread on health in England. The much-discussed but really very slight ill-effects he assigns to imperfect grinding of wheat and the wheat substitutes, poor

[1] Sherman, H. C. *Food Products*, pp. 291, 292. Macmillan, 1917.

II. Substitutes for wheat flour (*continued*).

baking, and unpleasant but harmless bacterial changes occasionally resulting from unsatisfactory storage of the bread in accordance with the "twelve-hours order." The occasional diarrhœa in a few patients he assigns to defective teeth or very sensitive colons. Finally he blames the mental attitude of many individuals — "When in doubt blame the war bread." [1]

5. Corn is not a cause of pellagra, as is sometimes stated. Pellagra is probably due to a generally faulty diet. No cereal, although it can be a large part of a well-balanced diet, can be used exclusively without unfavorable nutritional results.
6. "Heating" properties. Some cereals, especially corn and oats, are sometimes said to be "heating." The term means very little. Once in a long time a person is found in whom these foods cause a skin eruption. That corn is eaten to a much greater extent in warm climates than in cold is sufficient proof that there is practically nothing in the heating idea. Well-cooked corn products can be eaten as well in summer as in winter.

C. Availability.

In many sections not all the substitutes are available or there may be temporary shortages due to the difficulties of transportation. They are, however, coming on the market in increasing amounts.

D. Cost.

1. The cost of substitutes varies, but whether they are more or less expensive than wheat flour, they must be used when wheat must

[1] Hutchinson, R. "The Effect of War Bread on Health." *The Practitioner*, 99, p. 501. 1917.

II. Substitutes for wheat flour (*continued*).

be saved; it is one of the duties that the war has brought us.

2. The cost of Victory bread, due to the Food Administration's control of wheat and of the milling and baking industries, will probably remain at a reasonable figure, little or no higher than the recent prices of wheat bread.
3. The price of war bread abroad is less than in this country because the bakers have been subsidized; e.g., in England bread sells for four and a half cents a pound loaf, which is below cost. To make up the difference to the bakers, the Government has appropriated $200,000,000.

E. Keeping qualities.

The ground whole cereals do not keep as well as the refined flour, due in some cases to the large amount of fat which may become rancid and to the tendency to become infested with weevils and other small insects. Such products should be bought in quantities small enough to be used promptly.

F. Bread-making power.

1. Wheat flour is superior to other cereals only because its protein is largely gluten, while the protein of the other cereals, except rye, contains little or no gluten. It is the gluten that makes the sticky and elastic dough which is made porous and light by the gas from the yeast.

II. Substitutes for wheat flour (*continued*).

2. Therefore it is easier to make a raised loaf with some wheat flour. With some substitutes it is wise to use as much as 75% wheat; with rye, which itself has some gluten, as little as 25%, and when a person has skill, no wheat is needed.
3. Quick breads, like corn bread leavened with egg and baking-powder, do not need gluten, but because of their texture and lack of durability are home rather than bakery products.
4. Wheat is especially needed in France because all the bread is made at bakeries. It is impossible to add unfamiliar baking tasks to the labors of the French women already overburdened in the munitions factory or on the farm.

III. Control of commercial baking in the United States.

This was made necessary by the need for the restricted use of wheat.

A. Importance.

1. It is roughly estimated that about 40% of the bread is made in bakeries and 60% in homes. The regulations, therefore, control the use of a large amount of flour.
2. Control covers not only commercial bakers, but hotels, clubs, state, county, and municipal institutions, universities, hospitals, etc., which use three or more barrels a month. Hospitals and sanitariums may be exempted

III. Control of commercial baking (*continued*).

by the State Food Administration from the rule requiring the use of substitutes.

3. It is of great interest because the many processes in the purchase of flour and the making and selling of bread are regulated to an extent which has never before been attempted in any private business in the United States.

B. Based —

1. On an elaborate investigation of the baking industry made by the Federal Trade Commission and the baking division of the Food Administration.
2. On the advice and coöperation of bakers.

C. General business regulations.

1. All bakers using three or more barrels of flour a month are licensed and all the books and premises must be open to Food Administration agents.
2. There must be no unreasonable or exorbitant profits or monopoly. It must be remembered that the Food Administration has no power to fix the price of bread.
3. Without the consent of the Food Administration, there must be on hand no more than the amount of flour required to carry on business for thirty days.
4. Return of unsold bread by stores to the bakers is forbidden on account of the wastage which was found to amount to at least 2% of the annual output or about 600,000 barrels of flour.

D. Limitations on the purchase and use of wheat.

1. Between February 1 and August 31, 1918, pastry bakers and cracker manufacturers could buy only 70% of what they used in the corresponding period of 1917.
2. On February 24, 1918, it was ordered that all bread

III. Control of commercial baking (*continued*).

should contain 20% of wheat substitutes; later this was increased to 25% and on Sept. 1 decreased to 20%.

E. Limitations on the use of other ingredients.

1. The amount of sugar is limited.
2. The amount of fat and the kind used was limited, but later the specific limitations were removed although economy in the use of fat was urged.

F. Limitations on size.

1. The loaf may weigh 3/4 pound, 1 pound, 1/2 pound or multiples of 1 pound. These standard loaves are desirable:
   a. Because the loaf weighing a pound or more is the most economical, requiring less handling for a given amount of dough. The 3/4 pound loaf was authorized because many people could do with less than a pound a day.
   b. Because it fixes competition entirely on price and good baking. Formerly the baker could decrease the weight of his loaf a few ounces without the knowledge of the purchaser, and keep the price the same.
2. Rolls may not weigh more than 2 ounces.

G. "Victory" products.

1. The name may be used for bread, in the making of which all of the Food Administration regulations have been obeyed.
2. It may be used for other products, pies, cakes, etc., which must contain one-third wheat substitute. Waffles, batter cakes, and quick breads must contain two-thirds wheat substitutes to be "Victory" products.

IV. Regulations abroad.

All the warring nations of Europe have their bread supply regulated much more strictly than the United States has. It is of even greater importance abroad than here because of the large amount of commercial baking done — practically all of the baking in France and England is done outside of the home.

IV. Regulations abroad (*continued*).

A. England.

1. English bread must contain from 20% to 50% wheat substitutes and the wheat flour is of 81% extraction.
2. Only a small amount of fat may be used and no sugar or milk.
3. Loaves must weigh 1 pound or a multiple thereof and cannot be sold until at least 12 hours after baking.

B. France.

1. Thirty per cent wheat substitute must be used.
2. No fancy cakes or pastries are permitted.
3. Flour is furnished certain bakers in each district and they sell a regulated amount of bread to the families and individuals on their list.

C. Italy.

1. The loaf must weigh 250 grams (8 1/4 ounces) and be made of the 90% flour.
2. Baking may only be done between 10 A.M. and 9 P.M. and bread may be sold only until 1 o'clock each afternoon.
3. No sweet pastries may be baked.

V. Control of bread-making in American homes: a very important part of the wheat-saving campaign, the success of which has largely made possible the greatly increased shipments.

A. The compulsory part.

For every pound of white wheat flour, a pound of another cereal had to be bought; on September 1, this was changed so that only 20% of other cereals had to be bought with wheat flour.

B. The voluntary part.

1. In 1917 the Food Administration asked

V. Control of bread-making (*continued*).

households to observe two wheatless days each week and a wheatless meal each day. Later the requests were withdrawn, and in April, 1918, the housewife was asked to observe a voluntary ration of 1 1/2 pounds of wheat flour or its equivalent in bread, cake, macaroni, etc.

2. Large numbers of people in private homes, clubs, colleges, hotels, etc., pledged themselves to eat no wheat at all until the 1918 harvest was in. The wheat they had on hand was turned in to the Food Administration of their State for the use of the Army, the Navy, and our Allies in the war.

VI. The cereals used as wheat substitutes.

A. Corn.

1. Other names — maize, Indian corn. The word "corn" in English literature, including the English version of the Bible, commonly refers to wheat or to the grains in general.

2. Where the world's corn is grown.

a. Three-quarters of it is grown in the United States. The great American corn belt, a more important corn region than all of the rest of the world combined, extends from central Ohio to central Kansas and from Kentucky to Wisconsin, with Illinois and Iowa as the leading corn States. Most of the eastern and southern sections of the United States also grow corn.

VI. The cereals used as wheat substitutes (*continued*).

b. The Parana Valley of South America, including Argentina, is very important. Argentina grows much less corn than the United States, but it exports more and is fast developing as a corn-producing country.

c. Various other regions have an extensive corn production, but do not export; e.g., Italy and the Danube Valley.

3. The importance and use of the corn crop in the United States.

a. In 1917 the crop was 3,000,000,000 bushels. This is larger than ever before and more than four times as large as the wheat crop. It affords an enormous reserve supply of material suitable for human food.

b. Most of it is fed on the farms to animals. Only a small percentage is used as human food.

c. The export had been very slight. In the past three and a half years, July, 1914, to January 1, 1918, we exported to the Allies only one-sixteenth as much corn as wheat. The exports are now increasing very rapidly.

4. Importance in the diet.

a. In the United States, much more corn is eaten per person in the South than in the North. Corn meal formed 1.6% of the total

VI. The cereals used as wheat substitutes (*continued*).

food of 72 families in comfortable circumstances, only 0.3% for 161 families, mostly foreigners in congested districts of large cities in the North. It formed 23% of the total food among Tennessee and Georgia mountaineers, and 32.5% among Southern negroes.[1]

b. In Italy it is the main food for a large portion of the rural population. Polenta is practically our corn-meal mush, served in different ways, often with cheese or tomato sauce or meat gravy.

c. It is one of the principal foods in the Balkan regions, southern Russia, Hungary, Turkey, etc.

d. It is extensively used in Mexico and Central America. The bulk of the population derive their nourishment to a surprising degree from corn and beans.

e. In France and Great Britain before the wheat shortage almost no corn was eaten. Now, in Great Britain especially, its use is increasing. The reasons why an extensive increase in France is almost out of the question are discussed under bread.

5. Different forms of corn used as food —

a. Corn meal and corn flour, both white and yellow. The milling is similar to wheat, but not so elaborate.

[1] *Food Value of Corn and Corn Products.* U.S. Department of Agriculture, Farmers' Bulletin 298.

VI. The cereals used as wheat substitutes (*continued*).

(1) In the old method the corn is merely crushed between grooved millstones and the coarse particles of skin or bran are usually bolted out. The modern development of this is the "old process" or "water-ground" corn meal. Practically the whole grain is used and it therefore corresponds to Graham flour.

(2) The new method removes most of the bran and germ. The products are granulated corn meal, corn flour which is more finely ground and bolted, and cattle feed, the bran, germ, etc., which comprise from 30% to 35% of the entire weight of the grain.

b. Hominy. The germ and skin are usually removed and the rest more or less crushed. There is confusion in different parts of the country between the terms "hominy" and "samp."

c. Pop corn — should be better recognized as a valuable part of the diet.

d. Prepared breakfast foods and the various corn products — starch, glucose, oil, etc.

e. Green corn, fresh and canned.

B. Barley.

1. Use as a flour in bread, biscuits, etc.

a. It is found to be probably the best of the

VI. The cereals used as wheat substitutes (*continued*).

substitutes for mixing with wheat for bread-making. Recent improvements in milling will put standard barley flours on the market.

b. It is believed to have been one of the first cereals used by man. It has been widely used among the peasants in northern and central Europe. But without wheat, barley makes a gray, heavy loaf because of its small gluten content. Before the war it had been replaced largely by rye and wheat.

2. Production.

a. It is extremely hardy, and is grown as far north as the Arctic Ocean in Russia and as far south as the Nile and the Equator in eastern Africa.

b. Its drought-resisting qualities make it particularly valuable as a crop in such regions as the part of California near the desert.

c. It is grown much more extensively in Europe than in the United States, though an increasingly large amount is grown here each year.

C. Oats.

1. It is an excellent substitute for part of the wheat in bread. It also makes excellent cookies and crackers with little or no wheat.

2. It is available as oat flour, a small amount of which is on the market; as the well-known rolled oats which may be ground in a food chopper at home to serve as a wheat substitute; and as oatmeal which is produced only in small quantities.

VI. The cereals used as wheat substitutes (*continued*).

3. The supply of these products cannot be greatly increased at once because highly specialized machinery is needed. The mills now in existence have been running 24 hours a day.

4. The oats crop.

   a. Oats are our second largest crop, outranked only by corn. In 1917 it was 22% larger than in 1916. We are the greatest oats-producing country in the world. Most of it is used for animal feed.

   b. The export to the Allies is second to that of wheat.

D. Rye.

1. Use for bread.

   a. Its gluten content, though less than that of wheat, makes it a bread cereal, and when mixed with wheat flour it makes a good loaf. When used alone it makes a dark, heavy loaf, having a characteristic flavor.

   b. With barley it was the standard bread cereal of Europe. In proportion as the purchasing power of the Continental nations increased before the war, rye supplanted barley and to a certain extent wheat supplanted rye.

   c. It is used to a smaller extent in this country. During the wheat shortage the use

VI. The cereals used as wheat substitutes (*continued*).

of rye increased to such an extent that the supply became very low. It was not included among those cereals which the housekeeper could buy on the 50–50 plan.

2. Production.

It can be grown on lands not adapted to wheat and in colder climates.

a. It is an important crop in northern, central, and eastern Europe. Russia and Austro-Hungary produce about 90% of the world's crop.

b. In the United States it was more important before the opening of the corn and wheat lands of the Middle West. It is now grown in the poorer, hilly country, chiefly in the Appalachian region, and is relatively unimportant as a crop. The 1917 crop was 60,000,000 bushels or about one-eleventh the size of the wheat crop. This was a large increase over the crop of 1916.

E. Rice.

1. Food value and use.

a. It is of first importance as a world food, forming the chief food of hundreds of millions of people, supplemented by peas, beans, fish, etc. The rice in the diet of many Oriental people is comparable to the wheat in the diet of Occidental people.

b. It is used either whole or as a flour for part of the wheat in bread, muffins, etc.

VI. The cereals used as wheat substitutes (*continued*).

2. Production.

In those zones in which the rain-fall is abundant, the torrid zones and the warmer parts of the temperate zones, where ordinary grains cannot be grown, the yield is high, about 35 bushels per acre, say twice as much as the average wheat yield. This makes it very important in densely populated regions.

a. The largest production is in China, Japan, southern India, Java, Siam, and the Philippines, where it is the chief cereal crop.

b. It is grown to a lesser extent in the southern part of the United States, particularly in the Carolinas and the Gulf States. In the latter States the production is increasing.

c. Some rice is also grown in southern Europe, the West Indies, and South America.

3. Commerce.

It is valuable for export because it keeps indefinitely. Although China, Japan, Java, and the Philippines produce huge quantities of rice, their enormous home consumption prevents them from having a surplus to export. Most of the rice imports come from India, French Indo-China, and Siam.

4. Milling.

a. An ancient method of milling is still used in parts of the Orient. It consists in pounding the threshed rice or paddy until the close-fitting, chaffy husk is loosened. This leaves a brownish kernel, containing most of the bran and the germ.

b. In the modern methods, the paddy is cleaned and the husk removed. This gives the "cured" or unpolished or brown rice. A huller removes the other skins and brush sieves remove more of the kernel, including the rest of the bran and germ. It is then more highly polished and the product is the ordinary market rice. A layer of talc, paraffin, or glucose is

VI. The cereals used as wheat substitutes (*continued*).

sometimes added to give the rice a better appearance, but this process is not desirable.

F. Buckwheat.

Buckwheat can be used as a wheat substitute, being especially good in batter cakes. The crop, however, is small (about 3% of the wheat crop), so it is relatively unimportant.

G. Sorghums.

These are drought-resisting grains introduced in the southwestern part of the United States about forty years ago. They include kaffir corn, milo, feterita, durra, and kaoliang. They are of increasing importance as a stock feed and can also be milled and the flour used like corn meal.

VII. Some uses of the grains other than for bread.

A. Breakfast foods or cereals.

These are made chiefly from wheat, corn, oats, rice, and less commonly from barley and rye. There is an almost endless variety. Wheat is used the most. Street states that of 112 kinds found on one market, 48 were wheat, 29 wheat laxative preparations, 18 corn, 17 oats, 7 rice, 2 barley, and 1 rye. The non-wheat ones are excellent wheat substitutes.[1]

B. Crackers.

The size of the industry and the fact that wheat flour was almost the only material

[1] Street, J. P., *The Cereal Breakfast Foods*. Connecticut Agricultural Experiment Station, Bulletin 197, 1917.

VII. Some uses of grains other than for bread (*cont'd*).

used makes the regulation of the industry important. The supply of wheat has been limited. Graham, oatmeal, and rye crackers containing at least one-third substitute are being made and are "Victory" products. In the sweet cakes, an average of 25% barley, corn and rice flour, and corn starch is being substituted, some of them containing the necessary one-third to make them "Victory" cakes, and others do not.

C. Macaroni and noodles.

Formerly these were made entirely of wheat. Substitute flours can be used to make noodles, and rice, hominy, and barley can be used in their place entirely.

D. Grains used in the manufacture of alcoholic liquors.

1. The grains used for both alcohol and alcoholic liquors in the year ending June 20, 1916, amounted to about 2% of the total production, but consisted mainly of feed grains.
2. For distilled spirits in 1916–17 about 34,000,000 bushels of corn, almost 4,000,000 bushels of barley and a little over 2,000,000 bushels of rye were used. In 1917–18 none at all was used because of the prohibition on the distillation of liquors.
3. For brewing, about 43,500,000 bushels of barley and 12,000,000 bushels of corn were

VII. Some uses of grains other than for bread (*cont'd*).

used in the fiscal year 1917–18. The dried brewers' grains used as a cattle feed contains 30% of the nutritive value of the original grains.

4. Students wishing to read on the effect of drinking alcohol will find summaries of the subject in most physiologies; e.g., Stiles, *Nutritional Physiology*, chap. 25.

REFERENCES

"Differential between Packaged Foods and Foods in Bulk." *American Food Journal*, 12, p. 625, 1917.

Dondlinger, P. T. *The Book of Wheat.* Orange Judd, 1908.

"Economic Ratio of Bulk and Packaged Goods." *American Food Journal*, 13, p. 98. February, 1918.

Finch, V. C., and Baker, O. E. *Geography of the World's Agriculture.* U.S. Department of Agriculture, Office of the Secretary.

Harcourt, R., and Fulmer, H. L. *Breakfast Foods.* Ontario Department of Agriculture, Bulletin 162. 1907.

Hindhede, M. "Feeding Experiments with Coarsely Pulverized Wheat." *Skandinavisches Archiv. f. Physiologie*, 33, pp. 263–290, through *Chemical Abstracts*, 12, p. 54. 1918.

Hunt, C. L., and Atwater, H. *Cereal Foods.* U.S. Department of Agriculture, Farmers' Bulletin 817.

Kellogg, V., and Taylor, A. E. *The Food Problem.* Macmillan, 1917.

Langworthy, C. F., and Holmes, A. D. *Studies on the Digestibility of Grain Sorghums.* U.S. Department of Agriculture, Bulletin 470.

Leach, A. E. *Food Inspection and Analysis*, chap. 10. Wiley, 1917.

Lusk, G. *The Elements of the Science of Nutrition*, pp. 362–370. Saunders, 1917.

Manufacturers of bakery products. Special License Regulations No. 13. U.S. Food Administration. May, 1918.

Policies and Plans of Operation, Wheat, Flour, and Bread. U.S. Food Administration. February 1, 1918.

Pugliese, R. G. "The Food Values of Different Kinds of Bread." *Revue Générale des Sciences*, 26, pp. 612–617. 1915.

Report of Federal Trade Commission on Bakery Business in the United States and Report of Bakery Section. U.S. Food Administration.

Sherman, H. *Food Products*, chap. 8. Macmillan, 1917.

Smith, J. R. *Industrial and Commercial Geography*, chap. 3. Holt, 1913.

Sprague, E. C., and Laughlin, E. "Breads from Unusual Flours." *American Food Journal*, 12, p. 673. 1918.

Ten Lessons on Food Conservation. Lesson 9. U.S. Food Administration.

Vulte, H., and Vanderbilt, S. B. *Food Industries*, chaps. 3, 4, 5, 6, 7. Chemical Publishing Co. 1916.

Willcox, W. H. "Rations in Relation to Disease in Mesopotamia." *Lancet*, 2, p. 677. 1917.

Winton, A. L., Burnet, W. C., and Bowman, J. H. *Composition of Corn Meal Manufactured by Different Processes.* U.S. Department of Agriculture, Bulletin 215.

Woods and Snyder. *Cereal Breakfast Foods.* U.S. Department of Agriculture, Farmers' Bulletin 249. 1906.

CHAPTER XI

SUGAR

I. The function of sugar as food.

A. Sugar is a valuable fuel food.

B. It is not an essential part of the diet. It can be replaced wholly or in part by starch without lowering the fuel value of the diet.

C. It is valuable psychologically in making food pleasant.

D. If too much sugar is eaten,

1. It may be converted into fat and stored.

2. It may cause digestive disturbances, especially if eaten in concentrated form.

3. It may bring the diet down to a dangerous minimum in mineral and vitamine content. If the appetite is satisfied with a purely fuel-giving food like sugar, not enough of the mineral and vitamine-containing milk and vegetables will be eaten. The danger to the child or school girl who eats large quantities of candy should be considered.

E. For the chemistry of the different kinds of sugar and their digestion and metabolism, see Sherman's *Chemistry of Food and Nutrition*, chapters I and V.

II. Chief pre-war sources of sugar.

The world's supply is about equally divided

II. Chief pre-war sources of sugar (*continued*).

between the sugar made from the sugar cane and that made from beets. The pure sugar from either source is exactly the same in composition, jelly-making properties, etc. Some of the early beet sugar was not as completely purified as the cane, but now this is not the case. Granulated, pulverized, and lump sugar have the same composition.

A. Sugar cane — a tropical and semi-tropical plant resembling a stalk of corn without the ears. The juice contains from 12% to 18% sugar.

1. Production.

   The largest producers are Cuba, British India, Java, the United States and some of its dependencies, South America, Formosa, Japan, and the West Indian islands.

2. Trade in cane sugar.

   Cuba, Java, the Philippines, Hawaii, and Porto Rico are the largest exporters, the supply going mostly to the United States and to England. Although India is a large producer, there is no surplus for export. The United States gets its supply almost entirely from its insular possessions and Cuba.

3. For methods of extracting and refining cane sugar, see Sherman's *Food Products*, chap. 11, or a commercial geography.

B. Sugar beets.

1. Beets, like many other vegetables, contain a considerable portion of sugar. By scientific

II. Chief pre-war sources of sugar (*continued*).

selection, especially in Germany, this has been greatly increased until now the sugar content averages from 12% to 16%.

2. Pre-war production.

a. Europe produced about 93% of the beet sugar of the world, most of it being grown in the great northern plain from Normandy to central Russia. Germany and Austria together in 1913 raised about one-half of the beet sugar and one-fourth of the total sugar of the world. Germany exported about 60% of her crop. Austria, Hungary, France, and Belgium also exported some.

b. The beet-sugar industry in the United States started about 1895 and has steadily increased until in 1915 it supplied nearly 17% of our sugar. Beets could be grown successfully in many parts of the United States, but the industry of sugar-making is not so well adapted to our social and industrial organization as it is to that of Europe. Much of the work has to be done by hand; in Europe women and children are employed, while in this country only the families of immigrants would be available. Farm machinery adapted to beet cultivation has recently been developed, and this will tend to increase the beet acreage.

c. There is a small production in Canada.

III. War conditions.

A. Cane sugar.

The shortage of cane sugar is due chiefly to a lack of ships. There has been an increase in production since 1913, but difficulties in shipping make some of it unavailable. Java is largely cut off from shipping to England, and a considerable part of last year's crop is still in storage. England must, therefore, draw on Cuba for her supply, from which source France and Italy must also supplement their own beet sugar. This means that the Allies must get their sugar from the chief source of supply of the United States.

B. The beet-sugar situation. This shortage is due to an actual lack of beets.

1. The northern part of France, in which practically all the French beet sugar was grown and refined, is in German hands. In 1914 the battle line eliminated 203 of the 213 sugar factories. The line then changed, bringing a considerable number back into French territory (65 in 1916–17). The 1915–16 crop was only one sixth and the 1916–17 crop, one fourth of that of 1912–13. The drive in the spring of 1918 again destroyed most of the beet fields and factories.

2. All sugar grown in Belgium is in the hands of the Germans.

3. Italy's beet-sugar crop was about 25% less in 1916–17 than before the war, and the

III. War conditions (*continued*).

estimated yield of 1917–18 is about 50% less. The Austrian drive in the fall of 1917 destroyed many of the sugar factories and beet fields.

4. In the United States it is estimated that the 1918 beet crop will probably be slightly below normal.
5. The sugar crop of Germany and Austria-Hungary is of course not available to the Allies, but some sugar is being exported to the neighboring neutrals. But as the exports were very heavy before the war, the decrease in sugar consumption was not at first in proportion to the decreased production, an actual increase in consumption having occurred during the first year of the war. The crop for 1916–17 (including that of Belgium) was less than 50% of that of 1912–13 (see C, 4, below).

C. Sugar rations as compared with pre-war consumption.

This serious world shortage of sugar has resulted in a drastic reduction of the amount available for home use.

1. In England before the war the average household consumption of sugar was a little over a pound a week per person. The ration which became effective January 1, 1918, allows one-half pound a week and can only be bought on the presentation of a sugar card. One

III. War conditions (*continued*).

must even have the card to get an allowance of sugar for coffee or tea in a hotel.

2. In France before the war the consumption was lower, the total (including that used by the industries) being about 44 pounds a year per person. In the beginning of 1917 the ration for household use allowed 18 pounds a year, about 5 1/2 ounces a week. In October, 1917, this was reduced to one-fourth pound a week. A small amount was allowed for preserving in June.
3. In Italy the use of sugar has always been limited. The ration like that of France, allows about one-fourth pound a week, although the actual amount obtainable has been less.
4. In Germany and Austria-Hungary the consumption in 1913–14 was 45 pounds and 30 pounds respectively. The following year this increased to 75 pounds in Germany and 39 pounds in Austria-Hungary (see B, 5, above). But production later decreased so much that the ration in 1918 allowed about 6 ounces a week, not quite 20 pounds a year.
5. In the United States in 1917 the total per capita consumption was 1.6 pounds a week. (In 1823 it was 8.8 pounds per year.)
   a. The average household consumption was about 61 pounds a year, a little over a pound a week. The larger part of the

III. War conditions (*continued*).

remainder was used in food industries — candy, soft drinks, ice cream, bake-shop products, condensed milk, etc. A small amount was used in other industries, leather, tobacco, etc.

b. To enable the Allies to maintain even their reduced sugar rations, the sugar resources of the United States must be shared with them. That meant, of course, a reduced consumption, as well as the supervision of distribution and price. Housewives were asked to observe a voluntary ration of 3 pounds a month for each member of their family. Hotels, boarding-houses, and dining-cars were permitted to use 3 pounds for every 90 guests served. On August 1, 1918, the voluntary ration was changed to 2 pounds a month and the allowances for public eating-places to 2 pounds for every 90 guests served. Candy and soft-drink manufacturers received 50% and ice-cream makers 75% of their former consumption.

D. Control of the sugar situation in the United States.

1. All importations of raw sugar are purchased by the International Sugar Committee, which turns the sugar over to the Refiners' Committee. This is composed of representatives of all the cane-sugar refineries and is appointed by the Food Administration.

III. War conditions (*continued*).

The Committee divides the sugar among the various refiners according to the size of their previous sugar meltings.

2. The United States is divided into zones and the refiners are permitted to sell only within certain zones, the limits being fixed with reference to the economical and equitable distribution of the available supply.

3. The distribution of the refined sugar is controlled in great detail. The Federal Food Administrator in each State is permitted a certain amount of sugar for distribution according to the population and the amount used in industries. Each retailer and eating-place serving more than 25 people must file with the State Food Administrator a statement of the amount he used previously. He then receives a certificate of the amount he can buy. This is sent with an order to the jobber, who, when he receives a sufficient number, sends the certificates and orders to the refiner in his territory. The refiner cancels each certificate and sends it to the Food Administrator who issued it. In this way hoarding is prevented. Any one hoarding sugar bought before this ruling went into effect is punished. One hotel company controlling a number of the largest New York hotels and restaurants was found to have on hand 170,000 pounds of brown sugar purchased in November, 1917.

III. War conditions (*continued*).

The company was required to close its confectionery department for three months and to contribute ten thousand dollars to be divided equally between the Red Cross and the Y.M.C.A.

4. The price of sugar is regulated by a series of margins or differentials. The International Sugar Committee buys sugar at a fixed price. The refiners and jobbers sell their sugar at a fixed margin over what they paid for it. Inspectors investigate the prices charged by retailers and wholesalers and report profiteering. This control of price was evident in the Eastern States during the shortage in December, 1917, when the prices were kept level. Refiners said that, without control, sugar would have retailed for 25 cents or more a pound. During the Civil War when there was no real shortage, sugar sold for 35 cents a pound because of speculation.
5. A Sugar Equalization Board was formed in July, 1918, to equalize the cost of foreign and domestic sugars and arrange an even distribution throughout the country. It is capitalized at $5,000,000 in order to be able to deal in foreign sugars.

IV. Possible substitutes for sugar.

The chief of these are the various sugar sirups — concentrated solutions containing usually from 15% to 25% water and from 75% to 85% sugar. They

IV. Possible substitutes for sugar (*continued*).

consequently have a high fuel value. Some of them contain moderate amounts of ash and other substances giving characteristic flavors, and are therefore less limited in their use in the body than pure sugar. This is especially true of molasses.

A. Molasses.

Molasses is a by-product from the making of cane sugar. It is the liquid drained off from the crystals in various stages of the sugar crystallizing and purifying processes. It contains varying amounts of cane sugar, invert sugar, ash, etc.

B. Maple sugar and sirup, sorghum sirup, honey.

The supply of these substitutes is more limited.

C. Corn sirup or glucose.

1. Manufacture and composition.

a. In 1917, 540,000 tons were made, or about one-eighth as much as the sugar consumption.

b. Starch is heated under pressure with very dilute hydrochloric acid. The resulting liquid is neutralized with soda and evaporated to a sirup. By further treatment a solid known as corn sugar is produced, available to bakers, but not to the retail trade. In this country the starch used is all made from corn. Similar products have been made from potatoes

IV. Possible substitutes for sugar (*continued*).

abroad. Corn sirup is not ordinary sugar, but a mixture of dextrin and two sugars, maltose and glucose. The change in the starch is similar to the change during digestion in the body.

2. Uses.
   a. About 40% of the total amount manufactured is used as a table sirup. One variety, known as "corn sirup with cane flavor," is a mixture containing 10% or more of molasses or cane sugar.
   b. About 35% of the total is used by candy factories. The candies containing most corn sirup are pastes like gum drops, and marshmallows. The latter are chiefly corn sirup, corn starch, and gelatin.
   c. The use of corn sirup is somewhat limited because it is not so sweet as sugar and does not crystallize and so cannot be used in large amounts in such candies as fudge.
3. Nutritive value.
   a. It is a valuable food, as valuable as any other kind of sugar, as would be expected from its composition.
   b. The reason some people still have a prejudice against it is probably because —
      (1) Before the passage of the Food and Drug Act, in 1906, it was sometimes fraudulently sold as maple sirup and other more expensive sirups.

IV. Possible substitutes for sugar (*continued*).

(2) At one time it was made with acid which occasionally contained arsenic as an impurity, but for years past it has been free from arsenic as shown by many analyses.

D. Sweet dried fruits like raisins, fruit butters.

E. Saccharin.

Saccharin is a crystalline compound manufactured from coal-tar, with 300 to 500 times the sweetening power of sugar. It has no food value, but it has been used abroad in increasing amounts since the war.

V. Summary of ways to save sugar.

Use less of the sweet foods — candy, frosted cakes, sweet drinks, sugar on cereals and in tea and coffee, sweet deserts. Eat, instead, more fruits, fresh or dried. Learn to use the sugar substitutes in desserts, candy, etc. Can fruits without sugar.

REFERENCES

Abel, M. H. *Sugar and its Value as Food.* U.S. Department of Agriculture, Farmers' Bulletin 535.
Kellogg, V., and Taylor, A. E. *The Food Problem.* Macmillan, 1917.
Mathews, A. P. *Physiological Chemistry,* chap. 2. Wood, 1915.
Palmer, T. G. *Concerning Sugar.* U.S. Sugar Manufacturers' Association. Washington.
Robinson, E. *Commercial Georgraphy.* Rand, 1910.
Sherman, H. *Chemistry of Food and Nutrition.* Macmillan, 1918.
Sherman, H. *Food Products.* Macmillan, 1917.
Smith, J. R. *Industrial and Commercial Geography.* Holt, 1913.
Soule, G. "Natural Laws." *The New Republic.* February 16, 1918.
Vulte, H. T., and Vanderbilt, S. *Food Industries.* Chemical Publishing Co. 1916.

CHAPTER XII

THE VALUE OF MILK

THE importance of milk can hardly be over-emphasized. There is no other food so vital to our national health and efficiency. Students should use every effort first to learn, and then to inform others, of the high food value and economy of milk.

I. The composition and nutritive value of milk.

These subjects have already been discussed or touched upon in the earlier chapters. It is suggested that they be reviewed and developed further here, and that methods of teaching them popularly be considered. Several very valuable government publications on milk which have recently been issued should be read by the students. (See References.)

A. General statement of composition.

1. The average figures are 87% water, 4% fat, 5% milk sugar, 3.3% protein, 0.7% ash. Note particularly that this liquid food is higher in total solids than many of the vegetables and fruits. The composition can be made more vivid by a display of weighed quantities of the substances in a pint of milk. It is doubtful whether this is of as great value for teaching purposes as comparisons made with other foods as suggested below.

I. Composition and nutritive value of milk (*cont'd.*).

2. Find the legal requirements for the composition of milk in your State.[1]

B. Protein.

1. Two proteins are present, the casein which is the principal constituent of cheese, and the lactalbumen left in the whey and coagulated by boiling. These proteins are especially desirable constituents of the diet.
2. Recall that the half-ounce protein portion in milk, whole or skim, is one pint and that a large part of the protein of our diet can therefore readily come from milk. Consider the great value of skim milk as a meat substitute.

C. Fat.

Discuss the common fallacy that the fat of milk is its most important constituent and the "richness" a complete measure of its value.

D. Carbohydrate.

1. The milk sugar or lactose is similar to ordinary sugar (succrose), but is not so sweet.
2. It is used for fuel, like all carbohydrates, and has a special value in correcting putrefaction in the intestines.

E. Fuel value.

1. Comparing the fuel value of milk with that of other foods is one of the important ways of teaching the relative importance of milk. It is more striking than the protein equivalents, but less striking than the calcium.

[1] Summary given in Sherman's *Food Products*, p. 67. Macmillan, 1917.

I. Composition and nutritive value of milk (*cont'd.*).

2. The fuel value varies, of course, with the composition of the milk. A fair average is 145 grams (about two-thirds of a cup) per 100 calories.

3. Recall the 100-calorie portions of other foods as compared with milk or show the quantities of food equal in fuel value to a pint of milk (340 calories), such as four eggs, or a half-pound of lean meat.

F. Ash.

1. We get more total ash from a pint of milk than from comparable quantities of most other foods.

2. Calcium is an especially important part of the ash.

   a. It is essential in the food of both adults and children for the formation and constant renewal of bone, teeth, etc. About 2% of the body is calcium, more than any other inorganic element. About 0.67 grams of calcium per day, according to Sherman, should be supplied in the average diet.

   b. The ordinary diet is probably more apt to be short of calcium than any other element. About 50% of the American dietaries, the calcium content of which has been studied, show less than the desired amount.

   c. Milk and cheese are by far the most important calcium containing foods.[1]

[1] See Sherman's *Chemistry of Food and Nutrition*, p. 269. Macmillan, 1918.

I. Composition and nutritive value of milk (*cont'd.*).

d. To get the 0.67 grams of calcium requires less than 1 1/4 pints of milk and only 2 1/2 ounces of cheese, but over 7 pounds of white flour and 21 pounds of beef. Turnips and carrots and some other vegetables are fairly high in calcium, but it takes 2 1/3 and 2 1/2 pounds respectively of these two to give as much calcium as in the piece of cheese.

e. Thus we can see that a diet high in meat and low in vegetables, and especially a diet low in milk and cheese, is practically sure to be deficient in calcium. "Every family should be using at the rate of at least one-third of a quart of milk per man per day to provide the calcium requirements of that family."[1]

f. An exhibit can be prepared, showing portions of food each containing, say, 0.1 gram of calcium, about one-seventh of the day's requirement.

g. See the United States Food Leaflet No. 11 on Milk for a graphic presentation of the relative calcium content of milk and other foods.

3. The iron content of milk is low. Supplementing milk by green vegetables and eggs in the diet of even quite young children is necessary if an iron deficiency is to be prevented. Iron

[1] Sherman, H. C., and Gillett, *The Adequacy and Economy of Some City Dietaries*, New York Association for Improving the Condition of the Poor, 1917.

I. Composition and nutritive value of milk (*cont'd.*).

in food is discussed in connection with vegetables in chapter XIII.

G. Vitamines.

1. Milk contains both the fat-soluble A and the water-soluble B, as would be expected from the fact that it is the sole food of the young.
2. Methods for measuring quantities of these substances have not been worked out sufficiently to make definite comparisons between quantities in different foods. Fat-soluble A is found in both the cream and in the aqueous part of the milk and is distributed so that roughly the small amount of cream on top of the milk contains as much as all of the skim milk below it. Skim milk is thus comparatively poor in this vitamine.
3. The presence of the vitamines in milk and the body's need for them for the growth and health of the young and the health of adults is one of the chief points to emphasize in teaching the value of milk. The lack of, or a too small quantity of either one may result in a generally poor condition or even in disease.
   a. Lack of water-soluble B may result in beri-beri. There is not much chance of this with an even moderately varied diet.
   b. Lack of fat-soluble A may result in a disease called xerophthalmia. This has been noted in groups of young children in Den-

I. Composition and nutritive value of milk (*cont'd.*).

mark and elsewhere, where separator skim milk has been fed as almost their only food. The children were cured when whole milk replaced the skim milk. This is not an argument against the use of skim milk, especially by adults, but for the use of a sufficient quantity of whole milk by children.

H. General statement.

The importance of milk is not only shown by the occurrence of these diseases, but also by a generally unsatisfactory condition that often results when whole milk is not used. On the other hand, the free use of milk tends to build up a strong nation.

II. Economy of milk.

If we wish to persuade people to use more milk it is vital to the success of our efforts to make clear that milk is really a cheap food.

1. Compare the cost of milk in your neighborhood, not with pounds or quarts of food, but with the calcium or protein content or the fuel value.
   a. Calcium. A study of the cost of this element is the most striking way to show the cheapness of milk, for it takes 21 pounds of meat to give the same amount of calcium as in 1 1/4 pints of milk. (See p. 178.)
   b. Fuel. According to the average prices listed in the *American Food Journal*, July,

II. Economy of milk (*continued*).

1918, milk costs slightly less than 2 cents per 100 calories; round steak (beef), about 5 1/4 cents; fresh eggs, 4 1/2 cents. Milk is much the cheapest fuel from any animal source except fats. Fuel can, of course, be obtained more cheaply from cereals.

c. Protein obtained from whole milk costs about the same as that from moderate-priced cuts of meat. Protein in skim milk or cottage or other skim-milk cheese is the cheapest form of animal protein.

2. Compare the quantities of calcium and protein and the number of calories which can be obtained for a given sum in the different foods.

III. The sensitiveness of milk consumption to variation in price.

A. This sensitiveness is probably due to —

1. Ignorance of the value of milk and the habit of considering it as a beverage only, not as a food.

2. The fact that milk is often the only food for which the consumer has a separate bill. A rise in price of any one food is lost in the large total of the grocery bill, but the milk price shows plainly.

B. When the price of milk went up in the fall of 1917, the use of milk decreased to a degree altogether out of proportion. This was most unfortunate.

III. The sensitiveness of milk consumption to variation in price (*continued*).

1. "The Chicago milk consumer is mad at milk. When it went from 10 to 13 cents a quart, he cut off one-fourth of his consumption. Even now that it has dropped back to 12 cents he still consumes about 16% below normal. . . . Chicago is actually spending less total money for milk to-day than it spent for milk when it retailed at 9 cents a quart." [1]

2. The poor, especially, are affected by the increase in price. In New York City, according to the report of the Mayor's Milk Committee, the total consumption of milk in the fall of 1917 was reduced 25% and the consumption in certain tenement regions 50%. At about the same time a count of the under-nourished school children showed approximately twice as many as the year before.

IV. The amount of milk available and the amount advisable in the diet.

A. A quart a day for every child, a pint for every adult, is urged by many as not too high an ideal. Some pediatrists, however, prefer to recommend at least a pint for each child.

B. We are using much less than this, probably only about 0.7 of a pint per capita.

V. Production and use of milk in the United States.

The total amount produced is variously estimated at from 0.82 to 1.15 quarts per person per day.

[1] Dean Davenport, in the "Review of the Milk Situation." *American Food Journal*, 13, p. 128. March, 1918.

V. Production and use of milk in the United States (*continued*).

B. Only 43% of this is estimated to be used directly as milk (roughly 0.7 of a pint per person), 41% is used for butter, 5% for cheese, and the rest for condensed milk, ice cream, or food for calves.[1]

C. Economy in the use of the milk supply.

1. The most economical way to use milk so that we get the benefit of all the food in it is, of course, as whole milk, or condensed, evaporated, or dried whole milk.
2. The next most economical way is in whole milk cheese, since all but the whey is used in it.
3. Less economical ways are as cream and butter unless all the skim milk is used, as the butter utilizes only about 4% of the milk.

D. The numerous uses to which our huge quantity of skim milk is put.

1. The largest part, an unnecessarily large amount, is fed to animals. Some is actually thrown away.
2. It may be used as a beverage or in cooking. Discuss the advantages of having it, properly labeled, on the retail market.
3. Making it into cottage cheese is probably the most practical method of using it on a large scale. This was emphasized in the spring of 1918 in the campaign of the Department of

[1] *Agricultural Situation for 1918.* Part II, *Dairying.* U.S. Department of Agriculture, Circular 85.

V. Production and use of milk in the United States (*continued*).

Agriculture. Other skim-milk cheeses are also made.

4. Some of it is condensed or made into skim-milk powder.
5. It is artificially soured and sold as buttermilk.
6. It is used for the manufacture of casein for technical purposes such as sizing for paper, ivory substitute, etc.

E. Condensed, evaporated, and dried milk.

These forms of milk are important because of their smaller bulk and better keeping qualities as compared with whole milk. They are therefore easier to ship.

1. Condensed milk is the term usually applied to sweetened milk, which has been concentrated to about two-fifths of its original bulk.
2. Evaporated milk or unsweetened condensed milk has somewhat the consistency, taste, and appearance of thin cream.
3. Dried milk or milk powder contains as little as 5% water.
   a. Skim-milk powder is widely used in the manufacture of ice cream and milk chocolate.
   b. Whole and "half-skim" dried milk have been of late years widely used for infant feeding in Belgium, France, and England.

F. The great importance of maintaining the milk production —

V. Production and use of milk in the United States (*continued*).

1. Because of the importance of milk as a food not only for ourselves, but for Europe. The United States is the great milk reserve for Europe until the European herds are built up again after the war.
2. Because of the length of time taken to replace herds. If a factory is closed down it can be reopened again when the need for its product arises. If a cow is killed it takes practically three years to replace it.

G. Methods of keeping up production —

1. By arranging fair prices. Many large cities have recently had milk commissions to settle the price to be charged the consumer and the price to be paid the farmer.
2. By constant effort to have the product produced and distributed at the lowest price consistent with a good, safe product. The coöperative cow-testing and bull associations are important developments in economical production.
3. Stimulation of consumption by educational means.

VI. American import and export of dairy products.

Before the war we imported dairy products from no fewer than 24 countries. Our exports were unimportant. Now not only has importation largely stopped, but exports have increased immensely, especially of condensed and dried milk. During the

VI. American import and export of dairy products (*continued*).

six months ending with March, 1918, we exported in condensed milk, the equivalent of almost 28,000,000 quarts of whole milk.

VII. The milk situation abroad. (Compare with chapter XIV, section VIII.)

A. There is a serious, universal shortage of milk all over Europe due to the depletion of dairy herds. The farmer found that it paid better to sell his cows than to feed them, because of the lack of fodder and farm labor.

B. In the face of this shortage great effort is being made to have the milk used by those who need it most, rather than by the rich alone. Special regulations are in force to insure a supply for children, nursing mothers, and the sick, and to provide milk for these classes at cost or free, if necessary. Every effort is being made to keep up this supply. The ideal ration is considered to be about a litre for each child, but the quantity actually supplied often falls far below this standard. The use of milk for adults is considered a luxury and it is now, especially on the Continent, practically unobtainable by them.

C. England.

1. Local authorities are empowered to supply milk to children and to nursing mothers and invalids, free or at cost if necessary. Dealers must supply these classes first. The work is in the hands of medical officers and child-welfare associations working with the local authorities.
2. Children under 18 months may have 1 1/2 pints and those from 18 months to 5 years may have 1 pint daily. Others may obtain as much as the medical or other authority prescribes.
3. Maximum prices are set, varying at different times of the year and for the city and county districts from 10 cents to 14 cents per quart (fall and winter of

VII. The milk situation abroad (*continued*).

1917–18); 2 cents extra per quart may be charged for bottled milk.

D. France.

1. Paris at first did not ration milk, but only attempted to insure a supply for her poorer children; now the larger French towns seek to secure a supply for all children. In Paris a special card for children under 3 years and for the sick enables them to secure the full amount of milk necessary at dairies before any one else. They must apply before 9 o'clock in the morning. In April, 1917, it was arranged to supply 1 litre per day free or at a low price to poor children under 3 years.
2. In order to conserve the supply no milk could be sold in cafés and restaurants after 9 A.M.

E. Germany. In peace time there was a large production of milk and an extensive use of dairy products. The war brought about an immediate and heavy reduction in the number of milch cows as well as other animals, but steps were taken very early to secure an adequate supply of milk for the children and the sick.

1. In November, 1915, an imperial decree required all large towns to secure a supply of milk affording one litre to infants up to the end of the second year or to their mothers while nursing was continued. Children over 2 years were allowed one-half of this quantity.
2. In 1916 three-fourths of a litre was decreed as the allowance for children between 2 and 4 years.
3. In the winter of 1917–18 in most towns the privileged milk supply was threatened.
   a. In December the War Food Board instructed the municipalities to do their utmost to secure the milk supply and to keep on hand a small store of milk preparations and a reserve of wheat flour if their plans fail.

VII. The milk situation abroad (*continued*).

b. Children over 6 have difficulty in obtaining their ration. At Essen, Hamburg, and Hanover in December, 1917, for example, the authorities had to curtail the children's rations. Bavaria allows children from 7 to 13 years only skim milk.

F. Austria-Hungary.

1. Vienna and Budapest were both visited by a very severe milk shortage before the rationing system was in complete working order. The result was a great deal of suffering among the poor, even though the infant-welfare stations were well developed.

2. In Vienna, a litre of milk was allowed children for the first year. In April, 1917, the ration for children from 2 to 6 years was reduced to one-fourth litre. This had to be bought before 9 A.M. Every one else theoretically had one-eighth litre, which was obtained before 10 A.M. Then, if any were left over, it was added to the children's allowance. In the fall, children from 6 to 14 years were allowed one-fourth pint.

G. Northern European neutrals.

All these countries were formerly great dairying regions, but are now very short of milk on account of the feed shortage. It is very expensive in most cases. Cheaper milk is provided for the poor, usually by some sort of rebate ticket for the dealer, whom the municipality or other organization reimburses. There is also the preferential treatment for the sick.

VIII. A safe milk supply — milk sanitation.

The importance of milk as food cannot be over-emphasized. But the milk should be "safe"; that is, free from any chance of causing disease. This is especially important, since milk has to be carried such long distances, sometimes 400 miles or more to market, and passed through so many hands. An intelligent handling of the milk problem resulting in an efficient inspection system and pasteurization of all but certified milk or its equivalent, will afford a safe milk supply.

VIII. A safe milk supply — milk sanitation (*continued*).

A. Necessity for sanitary control.

1. Milk is an ideal food for bacteria as well as for human beings, and bacteria therefore multiply with great rapidity in milk if the milk is not kept cold.
2. The many opportunities for the entrance of bacteria.
   a. From the cow itself, if it is diseased.
   b. From outside sources of infection — dirty utensils and milk bottles, the milker's hands, the air and dust of the stable. Each time the milk is handled, if care is not exercised, another opportunity for contamination is offered.

B. The most important milk-borne diseases.

1. Tuberculosis is the commonest disease with which cows are affected. Unless the cow is tested by bacteriological methods, it can rarely be detected. It is especially dangerous for children, who are more susceptible to the bovine tuberculosis than are grown people. Milk may also be inoculated with tubercle bacilli from human sources.
2. Sore throat epidemics may occur from bacteria from the diseased udder of the cow.
3. Typhoid, diarrhœal affections, diphtheria, and scarlet fever may all be carried in milk. The water with which the cans are washed may be contaminated, or the disease may be spread from many sources if there is a case either on the farm or in the dairy.

C. Methods of making milk safe.

1. Prevention of all possible contamination by those handling the milk on the farm and in the dairy and by proper care of the cow.
   a. Ordinary market milk varies enormously in its bacterial content according to the way in which it has been handled. The most important factors in getting a clean milk supply are:
      (1) Having cows and persons who handle the milk free from disease.

VIII. A safe milk supply — milk sanitation (*continued*).

(2) Milking with clean, dry hands into covered small-top pails and sterilizing all utensils.

(3) Prompt and thorough cooling of the milk and continued care in handling until consumed.

b. These measures involve care, but do not involve great expense and could well be made compulsory by city or state legislation, which should also provide an adequate system of inspection.

c. Certified milk or its equivalent is milk produced and cared for under exceptionally sanitary conditions and constantly supervised and inspected by a medical milk commission.[1]

2. Destruction of any pathogenic bacteria that may get in.

a. Pasteurization is a necessary safeguard for the general milk supply. It consists in heating the milk and keeping it hot for a sufficient time to kill pathogenic bacteria, but not all the bacteria which cause it to sour. The shorter time the milk is held, the higher within certain limits the temperature must be. Pasteurization also includes the prompt cooling of milk after this heating to prevent the growth of bacteria.

(1) It is necessary because the great expense attached to the production of certified milk makes it too expensive for ordinary use. But pasteurization should not be used to cover careless methods of production. Standards as high as is practicable should be insisted upon. It is equally necessary for milk and cream whether it is to be used as a beverage or for ice cream, cheese, or butter.

(2) Its use has been greatly increased in the past ten years. The general tendency is toward the pasteurization of all market milk except the

[1] For the standards and methods of production and distribution see Sherman's *Food Products*, Appendix C.

VIII. A safe milk supply — milk sanitation (*continued*).

certified milk, and in some large cities it is compulsory.

(3) Three methods of pasteurizing in commercial use.

(a) "Flash" method. The milk is heated rapidly, for from 30 seconds to 1 minute, to a temperature of about 160° F.

(b) Holding process. The milk is heated rapidly to 140° or 150° F. and held at that temperature between 20 and 30 minutes. The milk may be chilled and then bottled or run hot into bottles heated with steam, and then cooled. This is preferable to the flash method.

(c) Pasteurization in bottles. The raw milk is placed in bottles covered so as to keep out the water and then heated in water to 145° F. and kept at that temperature for 20 or 30 minutes. This prevents recontamination.

b. Milk may be pasteurized at home.

A ready-made pasteurizing apparatus may be bought, or one may be made at home. A cooking-utensil with a close-fitting lid, and large enough to hold a bottle rack, may be used. The bottles are placed in the rack, surrounded by water and the water heated to the boiling point. The whole is then removed from the stove and the bottles left in the water for 20 minutes and then cooled immediately.

c. Boiling the milk instead of pasteurizing it is often more convenient in the home. The question of the use of boiled milk in infant feeding is discussed in chapter XV.

3. Proper care of milk in the home.

The student must be ready if the need arises to teach the importance of keeping milk on ice, or, if

VIII. A safe milk supply — milk sanitation (*continued*).

that is impossible, in an "iceless refrigerator"; of keeping out flies and dirt, of buying milk in bottles and not pouring it out of the bottle until ready to use it, and of using clean utensils for milk. "Keep milk clean, cold, and covered."

D. Grading milk.

Some cities have regulations providing for the division of the milk supply into grades according to the equipment of the dairies and the methods employed, or the bacteriological count of the raw or pasteurized milk, or both. The grades usually include a raw milk similar to certified milk, pasteurized milk, and milk employed only for cooking or industrial uses.

IX. Adulteration of milk.

A. Milk offers an excellent opportunity for adulteration because of its opacity. It may be skimmed, or water added, thus reducing its value as food. If the water added is impure, it also offers an opportunity for contamination.

B. Preservatives were formerly used to keep it from souring, but are now used to a much less extent.

C. The community may be safeguarded against such fraud and against the actual danger of contamination, by an adequate system of inspection. A discussion of the subject together with standards of purity is given in Sherman's *Food Products*, pp. 62–71.

X. Eternal vigilance is the price of a safe milk supply, and it is worth it. Some cities have a properly safeguarded supply and others are approaching it. Every community should have an adequate system of inspection and provide for the pasteurization of all milk not certified, or its equivalent. An intelligent public opinion is of the first importance. Study your local milk ordinance and compare it with those of other towns and with the model ordinance suggested in Hoard's *Dairyman*, 51, p. 376. 1916.

XI. Summary of points to be emphasized in connection with milk.

A. Do everything possible to stimulate the production of safe milk and to get it distributed at the lowest possible price consistent with a reward to the producer and distributor sufficient to keep them in the business.

B. Be ready to coöperate in the efforts of the Children's Bureau for adequate milk supply during their "Children's year" which began April 6, 1918, in the work of the milk stations to supply milk to the poor at cost, and in all similar activities.

C. Use every means to make people appreciate the unique value and economy of milk, and so prevent in this country the tragic results which are already following the cutting-down of milk consumption abroad.

D. "Use More Milk!"

REFERENCES

Agricultural Situation for 1918. Part II, *Dairying.* U.S. Department of Agriculture, Circular 85.

"A Model Milk Ordinance." Hoard's *Dairyman,* 51, p. 376. 1916.

Ayers, S. H. *Present Status of Pasteurization of Milk.* U.S. Department of Agriculture, Bulletin 342.

Brown, L. P. "The Experience of New York City in Grading Market Milk." *American Journal of Public Health,* 6, p. 671. 1916.

Editor, The. "A Review of the Milk Situation." *American Food Journal,* 12, p. 127. March, 1918.

Editorial. "Rising Cost of Milk." *Journal of the American Medical Association,* 70, p. 1001. April 6, 1918.

Lane-Claypon, J. E. *Milk and its Hygienic Relations.* Longmans-Green. 1916.

MacNutt, J. S. *The Modern Milk Problem.* Macmillan, 1917.
Mendenhall, D. R. *Milk.* Children's Bureau, Publication No. 35.
Milk and its Relation to the Public Health. Hygienic Laboratory, Bulletin 56. Public Health and Marine Hospital Service of the United States. 1909.
Milk, the Best Food We Have. U.S. Food Leaflet No. 11.
Milk Prices and the Poor Wage-Earner. Weekly Bulletin of the Department of Health, City of New York. November 3, 1917.
Rose, F. *Milk: A Cheap Food.* Cornell Reading Course, Lesson III, Food Series.
Rosenau, M. J. *Preventive Medicine and Hygiene.* Appleton, 1917.
Sherman, H. C. *Chemistry of Food and Nutrition,* chaps. 10 and 13. Macmillan, 1918.
Sherman, H. C. *Food Products,* chap. 3. Macmillan, 1917.
The Food Value of Milk. U.S. Food Administration, Bulletin 13.

CHAPTER XIII

VEGETABLES AND FRUITS

I. Vegetables and fruits represent a different and happier phase of the food situation than that of most of the staples. They represent a great potential reserve of foods for home consumption. Not only does their presence in the diet add to health, but it releases other foods for shipment abroad.

II. Composition and value in the diet.

Vegetables and fruits are similar in many respects.

A. Water.

Most vegetables and fruits are very high in water, many of the "watery" ones like cabbage, celery, spinach, and berries contain from 90% to 95%. Potatoes, sweet potatoes, corn, peas, beans, and also bananas and grapes, have much less water.

B. Proteins.

1. The protein is very low in most vegetables and fruits. Potatoes have only about 2% in the edible portion, and most others have even less.
2. It is much higher in the legumes—beans, peas, lentils, and peanuts. Lima beans and green peas, for example, even when fresh, have 7% protein, and when dry, from 18%

II. Composition and value in the diet (*continued*).

to 25%. Thus baked beans, bean loaf, and similar dishes are meat substitutes, though they cannot be depended on too largely. Beans and peas are valuable and important meat substitutes if used in a diet containing some animal protein. (See chapter V.)

a. The varieties of beans and peas are numerous. Use the newer varieties as well as the ordinary white navy bean.

b. In response to a patriotic appeal, the 1917 bean crop was approximately 50% larger than normal. Nearly all of this increase was in colored beans, principally Colorado and New Mexico pintos and California pinks. They are much like the white bean in taste, composition, and in the method of cooking.

c. Soy beans, which have been much discussed lately, are high in protein (38%) and in fat (15%) — higher than other beans, but they are somewhat difficult to cook without a pressure cooker, unless made into meal.

d. The Army and Navy are using vast quantities of legumes and have contracted for practically the entire white bean crop.

e. The Food Administration purchased last year's entire crop of pinto beans, in order to distribute them to different markets, to keep the price stable, and to encourage the farmer to continue production next year.

C. Carbohydrate.

This is fairly high in some cases, notably in potatoes, which contain from 18% to 20% starch. Sweet potatoes have even more starch and sugar. Bananas have 22%, mostly sugar when ripe and starch when green. It is instruc-

II. Composition and value in the diet (*continued*).

tive to group the vegetables and fruits, as the diabetic patient must, into groups containing 5%, 10%, and 15% carbohydrate. Note that the leaf vegetables are all in the lower groups.

D. Fuel value.

The fuel value depends chiefly upon the amount of starch and sugar present. For leaf vegetables it is very slight. For some others, especially potatoes, sweet potatoes, bananas, and other sweet fruits, it is an important part of the fuel of the diet.

E. Crude fiber.

Fruits and vegetables contain a relatively high percentage of indigestible fiber. This fiber with other substances present tends to prevent constipation.

F. Ash constituents.

1. Vegetables and fruits are one of the richest sources of the necessary ash constituents of the diet. This is one of the most important points to emphasize in teaching the value of these foods. They are especially important as sources of iron and next in importance to milk as sources of calcium.
2. The ash content is higher in leafy vegetables like spinach, cabbage, and Brussels sprouts than in seeds. In dried leaves there is from three to six times as much ash as in seeds.
3. A large quantity of the ash may be lost if the vegetable is cooked in a large amount of

II. Composition and value in the diet (*continued*).

water and the water thrown out — with spinach as much as 50% of the iron may be lost. The figures used below assume that the vegetable is cooked without additional water or that the water is used.

G. Iron.

1. Need for iron. (See Sherman, *Chemistry of Food and Nutrition*, chap. 11.)
   a. It is one of the necessary constituents of the hemoglobin of the red corpuscles of the blood and of all other active cells.
   b. Very little iron is stored in the body, so the supply must be kept up by getting iron from food. When there is little in the diet there may be a lack of hemoglobin and anæmia may result.
   c. The quantity needed daily is probably about 15 milligrams. It is desirable for women and children to have as much as men in spite of their lower calorie requirement.
2. The iron content of some diets.
   a. Approximate estimates of 150 American dietaries give 14 to 20 milligrams per man per day for the majority. "The typical American dietary does not contain any such surplus of iron as would justify the practice of leaving the supply of this element entirely to chance."
   b. Of the 92 dietaries recently studied by Sherman and Gillett for the New York

II. Composition and value in the diet (*continued*).

Association for Improving the Condition of the Poor, a disturbingly large number, 33, showed less than 15 milligrams of iron.

c. Computations of the iron in the diet of a number of young women students has shown quantities very near the border-line.

3. Foods supplying iron.

a. Egg yolk, meat, whole cereals, and many vegetables are high in iron. Even the vegetables and fruits that are low in iron are often eaten in such large quantities that they furnish a good supply.

b. The compounds of iron in meat are probably not used as advantageously as those in eggs, milk, and vegetables.

c. Milk and some fruits and vegetables, and especially the cereal products made chiefly from the endosperm like white flour and polished rice, are low in iron. Fats and sugar contain no iron.

d. It is suggested that the class make a display of portions of food each containing, say, 2 milligrams of iron, so that 7 1/2 of the portions will contain enough for a day. Some portions containing 2 milligrams of iron:

200 grams of white flour, enough for 3/4 pound of bread.

40 grams of Graham flour, equivalent to 2 medium slices of bread.

II. Composition and value in the diet (*continued*).

22 grams of egg yolk, from 1 1/2 to 2 eggs.
50 grams, almost 2 ounces, of lean meat.
56 grams, 2 ounces of raw spinach, about 1/3 of a cup of cooked spinach.
A little over 1/3 pound of string beans, about 1 1/4 cups.
A third of a pound, one good-sized Irish potato.
Almost a pound of sweet potatoes.
2 1/4 pounds of oranges, 4 large ones.
810 grams of milk, almost a quart.

e. Note from these portions and others like them that the 15 milligrams is easily obtained if eggs, whole cereals, spinach, and many other vegetables are eaten, but that the iron may easily fall below on a diet consisting largely of white bread, sugar, fat, and certain fruits. A child eating large quantities of candy and white bread will not get enough iron or other mineral constituents.

f. A diet containing a large amount of vegetables, whole wheat bread, and the cheaper sorts of fruits, with milk but without meat, was tried in an experimental study in New York and resulted in a gain of 30% in the iron of the diet while the protein, fuel value, and cost remained practically the same as in the ordinary mixed diet.[1]

[1] Sherman, H. C. *Chemistry of Food and Nutrition*, p. 308. Macmillan, 1918.

II. Composition and value in the diet (*continued*).

H. The basic residue.

The ash left when foods burn in the body is either basic or acid in character. It is probably desirable to have the residue from the whole diet basic. Meats and cereals give an acid residue, vegetables and fruits a basic residue. Therefore, the eating of vegetables with meat is a wise habit. Eating bread or rice with meat does not serve the same purpose.

I. Vegetables as a source of vitamines.

1. Water-soluble B is fairly widely distributed in most of them.
2. Fat-soluble A is not so widely distributed.
   a. The leafy vegetables contain it. Their value is in part due to its presence.
   b. Most seeds have very little of it. It is present in the germ of the seed, but is practically absent from the endosperm. Hence beans and peas need to be supplemented by leafy vegetables or milk.
   c. Tubers and roots are more like seeds in this respect than like the leaf vegetables.

J. Summary of the value of vegetables and fruits in the diet.

1. They give a pleasant and varied flavor and texture.
2. They supply the much-needed ash constituents, especially the leafy vegetables.
3. They supply vitamines, the leafy vegetables

II. Composition and value in the diet (*continued*).

especially supplying the less widely distributed fat-soluble A.

4. Some give considerable fuel, and legumes considerable protein, thus serving in part as substitutes for both wheat and meat.
5. They give a desirable bulk to the diet.
6. The leafy vegetables (with milk) should be looked upon as *protective* foods which can correct the deficiencies found in most of the other foodstuff. This "protective" character of milk and the leafy vegetables "should form the main thesis of the teacher of nutrition and dietetics." [1]

III. Use of vegetables and fruits instead of the staples needed abroad.

A. To save wheat: The potato drive to use the surplus of the huge 1917 crop has fixed in every one's mind the interchangeableness of these two foods. One medium-sized potato supplies the same number of calories as a large slice of bread and contains more mineral salts than white bread. Sweet potatoes are equally good instead of wheat.

B. To save meat: Use legumes. Use all the vegetables as "meat extenders" in stews like the French "pot au feu" and in meat pies.

C. To save sugar: Use fruit, fresh and dried; dates, figs, raisins, and prunes are among the sweetest.

[1] McCollum, E. V. "Some Essentials to a Safe Diet." *Journal of Home Economics*, 10, p. 49. February, 1918.

III. Use of vegetables and fruits (*continued*).

D. To save fat: Use jam. It has high fuel value and is a "spreading material" like butter. It is part of the ration of British soldiers.

IV. Do we eat enough vegetables?

A. Workers among the very poor of our cities almost always have to urge a greater use of vegetables.

1. The New York Association for Improving the Condition of the Poor recommends: "Spend not more for meat and eggs together than for vegetables and fruits."

2. In the Boston study the expenditures for meat, fish, and eggs taken together, was generally at least twice as much as for fruit, fresh vegetables, and potatoes.

3. In a negro community in New York City that has the highest infant mortality rate of any community in the city, the diet of 75 mothers was observed in the fall of 1916 and winter of 1917. They ate vegetables on the average only twice a week and fruit about the same number of times.[1]

B. Many young people "do not like vegetables" and must deliberately cultivate a taste for them.

C. Many adults could improve the flavor and nutritive efficiency of their diet by increasing the vegetable content, and at the same time substitute these perishables for a large proportion of the wheat and meat.

[1] Hess, A. F., and Unger, L. J. "The Diet of the Negro Mother in New York City." *Journal of the American Medical Association*, 70, p. 900. 1918.

V. Increasing the production of vegetables.

A. The 1917 war gardens.

1. The response of both professional and amateur gardeners last spring and summer to the imperious need for increasing the food supply was one of the country's significant contributions to the war.

2. A few examples of the response to the appeal in 1917. These are merely illustrative of what occurred throughout the country:

a. The school gardens. They are of particular value, not only because of the food grown, but because of the valuable lessons taught.

(1) The Food Production Committee of New Hampshire found that high schools of that State produced $36,610 worth of vegetables. The grade schools maintained 17,000 gardens, the value of their output not being recorded.

(2) A systematic survey of Indiana discovered 500,000 gardens maintained by children or young people throughout the State.

b. City efforts.

(1) A permanent committee on home gardening was maintained in Los Angeles; 8,000 acres were put into war gardens in and about the city.

(2) New York maintained a Food Committee and utilized at least 12,000 city lots in war gardens.

(3) Interesting community experiments were tried at Denver and Cleveland. In Cleveland, the Mayor's Advisory War Committee advertised for lots and gardeners. They set an official planting day for the entire city. Financial aid was given to gardeners in need of seed and tools, and a soil and production expert and a corps of assistants were maintained by the city to super-

V. Increasing the production of vegetables (*continued*).

intend and correlate all efforts. It is estimated that $300,000 worth of vegetables were grown.

(4) One interesting garden was made under great difficulties by the employees of a copper mine in Arizona. They were from many countries and few spoke English. The region was arid and five artesian wells had to be drilled to supply the water for irrigation. Double crops were obtained and the food that could not be used at once was dried or canned.

(5) About 3,000,000 gardens were planted aside from the increased acreage planted by farmers. Vegetables estimated to be worth $350,000,000 were raised. The value of the produce of home, school, and children's gardens alone was estimated at $100,000,000.

B. The increasing need for gardens.

1. The food situation abroad grows worse as the war progresses, so the burden on us becomes heavier. More and more the railroads must be kept free to rush coal, munitions, and all the supplies of war from one part of the country to another. Local food supplies relieve transportation difficulties. Make your neighborhood self-supporting. The war garden offers an opportunity for service within the reach of every one with a plot of ground and the willingness to work.

2. Intelligent care is of great importance.

a. Seeds and fertilizer are scarce; therefore plant only as much as can be properly cared for and choose the vegetables which can best be raised in your region. Get expert advice.

V. Increasing the production of vegetables (*continued*).

b. Send for *The Small Vegetable Garden*, U.S. Department of Agriculture, Farmers' Bulletin 818.

c. Consider the value of a community garden for your neighborhood rather than a series of private gardens or as a supplement to them. Experience has shown that labor-saving implements and better tools can usually be bought by the larger organization and expert superintendence employed to greater advantage.

C. The war gardens in the United States are not the only ones. The American Army Garden Service is planning truck gardens in France to supply our troops with fresh vegetables in the summer. Great Britain has ordered all her unused lands to be placed under cultivation. The Woman's Auxiliary Army Corps of England is planting similar gardens back of the lines to supply the English troops. At one of the great munitions factories in England employing thousands of people, a hundred acres of the surrounding waste land are intensively cultivated, so that the employees are entirely self-supporting as regards vegetables. In 1917 the French army fed many of their men from similar gardens.

D. War work of women on farms.

1. Continental Europe. Women have always worked in the fields and of course have been doing so in increasing numbers since the war.

2. England. About a quarter of a million women from every profession and class are doing all kinds of farm work. They met with opposition from the farmers for the first two years of the war, but they have dispelled prejudice by their good work and by the fact that the male labor simply could not be secured. In many cases the women are given a short preliminary training. The

V. Increasing the production of vegetables (*continued*).

movement is under the direction of the Board of Agriculture.

3. Canada. Both British Columbia and Ontario successfully organized groups of women for farm work last summer. The care of the girls was undertaken by the Y.W.C.A.

4. United States.

a. The movement was started in 1917 by Vassar College students who for two months successfully did all kinds of work on the college farms. Nine units were organized by the Mayor's Committee of Women on National Defense, New York City. Eight units worked in fruit-growing districts. The Mt. Kisco unit was the largest, consisting of 73 women, most of whom were college girls, though various trades and professions were represented.

b. In 1918, the Woman's Land Army of America carried on a vigorous campaign to enlist women in farm work and to overcome the prejudices of farmers against employing them. For information write to their headquarters at 32 Fifth Avenue, New York City.

VI. Preservation of vegetables and fruits.

A. Kinds of spoilage.

1. The less important kind is a mere deterioration of flavor after picking. This is brought about by normal processes in the plant. The change goes on more slowly if the food is kept cold, and is checked if the food is cooked. Therefore products canned as soon as possible after picking give the best-flavored product.

2. The more important decomposition is caused by micro-organisms, bacteria, yeasts, and

VI. Preservation of vegetables and fruits (*continued*).

molds. These come from the soil, fertilizers, dust, the hands of workers, etc. Their character may depend upon many variable factors such as rainfall, temperature, geographical distribution, the kind of vegetable, and the length of time and method of keeping after picking. The question is more complicated than is often realized.

B. Methods of preventing spoilage by destroying the micro-organisms or preventing their activity.

1. Refrigeration.
2. Removal of water. A certain amount of water is necessary for the growth of bacteria. Therefore, dehydration is a satisfactory method of preventing spoilage. (See section E, p. 215.)
3. Adding substances in which micro-organisms cannot grow.

a. Salting.

This method is applied to meats and some vegetables, especially string and wax beans, spinach, greens, and corn.

(1) Dry pack.

(a) With only a small amount of salt, 2% to 3% of the weight of the vegetable. This allows a certain degree of fermentation to occur. The best known product of this method is sauerkraut.

(b) With enough salt (25% of the weight of the vegetables) to prevent fermentation or growth of yeasts and molds. Dandelions, beet tops, spinach, cabbage, string beans, peas, and especially corn, are satisfactorily

VI. Preservation of vegetables and fruits (*continued*).

preserved by this method. All except corn are salted without cooking. Salted corn may be cooked on the cob to set the milk, then cut and packed with one-fourth of its weight of fine salt.

(2) Wet pack.

It is sometimes found more satisfactory to use a 10% salt solution, about 6 tablespoons of salt to 1 quart of water, for salting some vegetables, especially cucumbers.

(3) These methods require little time, small expense for fuel and containers, and the products are easy to store. But there is a change in flavor and a loss of nutrients in the brine.

b. Pickling. Vinegar, salt, and spices are the preserving materials. The method is applied chiefly to cucumbers, onions, greens, and tomatoes.

c. The addition of "preserving powders" or chemical preservatives. While some of the substances are probably harmless, others are not, and their use should not be considered in the home.

d. "Preserving" and making jelly and jam. The preservative is the strong sugar solution.

e. Canning. This involves destruction of micro-organisms by heat "processing" and their subsequent exclusion.

C. Commercial canning.

1. Importance.

a. "Canning, more than any other invention since the introduction of steam has made possible the building up of towns and communities beyond the bounds of varied production." [1]

b. A century or two ago men on whalers after a voyage of a year or two often came home with scurvy. Nansen and his men drifted in the Arctic ice for

[1] Smith, J. R. *Commercial and Industrial Geography*, p. 227. Henry Holt, 1913.

VI. Preservation of vegetables and fruits (*continued*).

years and remained in good health because of their supply of canned vegetables, fruits, and meats.

c. This comparatively cheap, convenient method of preservation removes any limitations of time or distance upon the consumption of fruits and vegetables in an attractive form. It affords a market for a large crop of such a perishable article as peaches and offers a convenient form to transport large quantities of such fruits as Hawaiian pineapples.

d. Especially important now because of the value of canned vegetables and fruits in feeding the Army and Navy. They give variety to the meals and keep the men in good health. Their use prevents scurvy on board ships and in the Army when fresh vegetables cannot be obtained.

(1) The Army and Navy commandeered about 25% of the canned beans, 12% of the corn, and 18% of the tomatoes of the 1917 pack. Large amounts will be needed this year also.

(2) To supply our troops in France next winter, the Government has entered into an agreement with the French Government by which our armies are to be supplied with vegetables and fruits canned in France. The shipping space thus saved will be considerable.

e. A large amount of our products were also exported in 1917 to the Allied Governments.

2. Extent of the industry.

a. The United States is the largest producer and consumer of canned goods in the world, and the value of the output is increasing. In 1914 the value of the canned vegetables and fruits was $117,000,000. The value of the vegetables was almost four times that of the fruit. The pack of vegetables had increased 84% in value, and of fruit, 112% over 1904. The quantity packed had almost doubled. The 1917 fruit pack, with the exception of apples and berries, showed an increase.

VI. Preservation of vegetables and fruits (*continued*).

b. The most important fruits packed are peaches, pineapples, and cherries, in the order named. Of the vegetables, tomatoes come first, corn second, and peas and beans third. The industry is widely distributed.

c. California produced 64.2% of the total value of the fruit canned in the United States.

3. Method.

a. Grading is done at each step in order to insure uniform, standard products.

b. Preparation of the material for sterilization.

Much of the work is done by machinery. Most of the vegetables and some of the fruits are "blanched"; that is, kept in boiling water from 1 to 15 minutes to soften and also to remove the objectionable gummy substance from the surface of some vegetables. The cans are filled with vegetables by machinery, or, with the higher grade of fruits, by hand to prevent crushing, and the brine or sirup is added. The cans are "exhausted"; i.e., some of the air is removed. They are then sealed and sterilized or "processed."

c. Processing.

Two factors are involved in processing. The temperature must be high enough to destroy all the micro-organisms, but it must not be too prolonged or too high, or the taste and appearance of the product will be injured. Fruits do not need a temperature above the boiling point and they are generally sterilized in water baths. Vegetables need a higher temperature and the cans are usually heated in steam under pressure in autoclaves.

D. Home canning. (For definite directions see the Laboratory Manual, section VII.)

1. All who can get fresh vegetables should can or otherwise preserve enough to supply the

VI. Preservation of vegetables and fruits (*continued*).

needs of their families during the winter in order to make their family and community self-supporting as far as possible and thus decrease the demand on transportation and supplies; to preserve the excess products of the growing season for future use; to add variety to the winter diet and furnish a liberal supply of mineral-containing food.

2. It is of doubtful policy, unless a market is secured beforehand, to can large quantities for sale.
3. Community canning is likely to be superior in results to canning in private kitchens. (See chapter XV.)
4. There are a number of different methods, the relative values of which have been debated at considerable length, so that students may be familiar with all of them.
   a. Open kettle. The old-fashioned method still used somewhat for many fruits and for acid vegetables.
   b. One-period processing in the jar, usually at the temperature of boiling water. It is commonly known as the cold-pack method, though the term might be equally well applied to method c.
   c. Intermittent processing in the jar. A longer method, but preferred by many people for such vegetables as beans, peas, and corn.

VI. Preservation of vegetables and fruits (*continued*).

d. Processing at higher temperature by use of the pressure cooker.

5. A few important points in regard to processing:

a. Most bacteria, yeasts, and molds are easily destroyed by heating to 100° C. or even to a considerably lower degree. There is a variation in resistance among different kinds of bacteria and even among different strains of the same kind.

b. Some kinds of bacteria produce spores which are resistant to heat unless the heating is long continued or higher than 100° C. Otherwise the spores may develop into active bacteria after the food is cool. Spores of some species of bacteria have been known to resist boiling for five hours. In order to destroy spores, heating on a second or third day is often resorted to — intermittent heating.

c. Destruction of bacteria is made easier by the presence of acid, salt, and sugar. For this reason canning fruits and vegetables like tomatoes and rhubarb is easier than canning the non-acid ones.

d. The vegetables with comparatively small surfaces exposed to bacterial contamination, like beets, seem to be easier to can than those with more surface, like asparagus. Removal of the skin before canning also seems to help.

VI. Preservation of vegetables and fruits (*continued*).

e. The way the food is packed in the jar makes a great difference in the length of time required for processing.

(1) Heat penetrates only slowly into a mass of vegetables or fruit. This is one of the most important points to understand for successful canning. There may be entire failure to get the interior of a jar hot enough to destroy the bacteria present.

(2) Heat penetration is quicker when there is free circulation of liquid than when the food is very closely packed. The commercial canner often agitates his cans during processing to bring about this circulation.

(3) In some experiments of Bitting's in a pressure cooker it took an hour for the center of the can of dry, tightly packed corn to reach the temperature of the outside water bath. A can of peas with the large amount of water usually packed with peas was heated in 6 or 7 minutes.

(4) Pumpkin and squash, with their pasty, semi-solid consistency, also require a long time for heat to penetrate, and heavy tomato pulp takes longer than tomatoes surrounded by liquid.

(5) Air is also a very poor conductor of heat. Therefore care must be taken to

VI. Preservation of vegetables and fruits (*continued*).

have the cans filled to the top with liquid.

(6) For successful canning, therefore, pack the jars full, but have plenty of liquid, or else continue their processing longer.

f. For proper penetration of the heat to the contents of a jar, the water in which the jar is placed should come almost to the top of the jar and the water bath should be tightly closed.

g. Quick cooling following the processing is desirable.

6. Changes brought about in canned food when processing is insufficient.

This subject is not completely understood. If sterilization is not completed and the conditions are favorable for spoilage, the canned goods will not keep. Substances with disagreeable flavors and gaseous products may be formed or acids without gas (flat sour). In rare cases, poisonous products may be formed.

E. Drying.

This is probably the oldest method of preservation. It was extensively used in the farm home before transportation facilities made the shipments of fresh fruits and vegetables easy.

1. Two methods are employed: —

a. Outdoor drying, which is used so extensively in California.

VI. Preservation of vegetables and fruits (*continued*).

b. Dehydrating vegetables and fruits by artificial heat both commercially and in the home.

2. Advantages.

a. Keeping qualities. The dehydrated vegetables and fruits if stored in suitable containers seem to keep indefinitely. Some vegetables dehydrated for use in the Boer War were not all used; at the beginning of the present war the barrels were opened and the vegetables were found to be in excellent condition and were used by the English Army in 1914.

b. Transportation. The saving in freight charges, cars, and shipping is obvious when it is remembered that fresh vegetables and fruit often contain over 90% water and, when dried, only from 8% to 10%. This fact is of the greatest importance now.

c. Containers. If the products are not to be exported, metal or glass containers are not necessary. Pasteboard boxes, stout paper bags, or paraffin paper cartons can be used. It is only necessary to keep out dust and insects.

d. Economy. A great possibility for national saving, making use of the vegetables that might otherwise spoil on the farm and in the market.

e. Cost of dried fruits to the individual. The actual cost of a pound can of vegetables

VI. Preservation of vegetables and fruits (*continued*).

or fruits may be less than the cost of a pound of dried fruit; but when the amount of water in the can and in the fruit or vegetable is considered, the dried product is much cheaper, though more labor is required to prepare it for the table. A 100-calorie portion of dried split peas costs on an average about 1 cent and of canned peas, a little over 5 cents. The cost of a 100-calorie portion of evaporate peaches is 1 1/3 cents and of canned peaches 6 1/4 cents.[1]

F. Commercial dehydration.

1. Commercial dehydration received its impetus from an endeavor to supply vegetables to men who were cut off from fresh supplies. The Hudson Bay Company bought dried vegetables for the use of its men in the long winter trapping season. Later, vegetables were dried for the New England fishing fleets, and in Oregon some were dried for the Alaska miners. Vegetables were also dried for the men in the Spanish War. The early products in many cases were not very good — they did not "come back" properly in water.

2. Present situation in the United States.

   a. The process has been brought into prominence by the war. The need for utilizing every ounce of food, the shortage of tin containers, transportation difficulties, and the sugar shortage combined to bring this method of preservation to the front.

   b. Investigations have been conducted by private concerns, universities, and the Bureau of Chemistry of the United States Department of Agriculture, and excellent methods have been worked out, by which distinctive flavor and texture are retained. These methods are now being used by a few concerns.

[1] These prices are averages given in the *American Food Journal*, February, 1918.

VI. Preservation of vegetables and fruits (*continued*).

Others put out an inferior article. There is need for standardization.

c. The Government has placed orders for several thousand tons of dehydrated potatoes for the use of the Army and will probably use other dried products also, as they can be obtained.

3. In the approved method, vegetables such as potatoes and carrots, and fruits such as apples, are pared and sliced. They are then blanched in steam and dried in a current of air at a temperature between 110° and 140° F. Tomatoes are dried and ground and used in hotels for soups, sauces, etc. A combination of certain dried vegetables is known as "soup mixture." Even corn on the cob can be dried if the pith is removed.

4. The value of the product depends on the care with which the above processes are carried out. The vegetable or fruit must be dry enough to arrest the growth of molds and bacteria, but not too dry or dried too rapidly, so that the cellular structure is broken down. The water content should be from 8% to 10%.

5. The process is used to a much greater extent abroad than in the United States.

a. It is widely used in Germany. Before the war there were about 500 commercial plants, and in 1917 there were over 2000; 37,000,000 hundred-weight of potatoes alone were dried in 1916.

b. Canada has sent abroad within the past three years over 50,000,000 pounds of dehydrated vegetables, about two-thirds of which was the vegetable soup mixture, and one-third dried sliced potatoes. When reconstituted this would make about 400,000,000 pounds of vegetables.

G. Home drying.

1. The process has been in use for generations on farms. The methods were crude and some of the products were probably much inferior to those dried by the best modern methods.

VI. Preservation of vegetables and fruits (*continued*).

2. Within the past year it has been reintroduced as a home industry.[1] Excellent results can be obtained, but care and skill are necessary. Too little drying or too much results in the product's molding or not "going back" properly when soaked.

H. Community drying plants.

A more efficient and convenient outfit can be bought if a number of people combine and the cost of using it will be nominal. The drying must be accompanied by instruction on the necessity of long soaking of the product before cooking.

REFERENCES

A Successful Community Drying Plant. U.S. Department of Agriculture, Farmers' Bulletin 916.

Bailey, E. H. S. *The Source, Chemistry and Use of Food Products*, chap. 6. Blackiston, 1916.

Benson, O. H. *Home Canning by the One-Period Cold-Pack Method as Taught to Canning Club Members in the Northern and Western States.* U.S. Department of Agriculture, Farmers' Bulletin 839.

Bitting, A. W., and Bitting, K. G. *Canning and How to Use Canned Foods.* National Canners' Association. 1916.

Bitting, A. W. *Methods Followed in the Commercial Canning of Foods.* U.S. Department of Agriculture, Bulletin 196. 1915.

Bitting, A. W., and Bitting, K. G. *Bacteriological Examination of Canned Foods.* Research Laboratory, National Canners' Association. Bulletin 14. 1917.

Buchanan, E. D., and Buchanan, R. E. *Household Bacteriology.* Macmillan, 1913.

Canned Foods. Miscellaneous Series, No. 54. U.S. Department of Commerce.

[1] See U.S. Department of Agriculture, Farmers' Bulletin 841, *Drying Fruits and Vegetables in the Home*, for descriptions of desirable outfits and processes.

Canning and Preserving. Census of Manufacturers, 1914. U.S. Department of Commerce.

Corbett, Z. C. *The School Garden.* U.S. Department of Agriculture, Farmers' Bulletin 218.

Creswell, M. E., and Powell, O. *Home Canning of Fruits and Vegetables as Taught to Canning Club Members in the Southern States.* U.S. Department of Agriculture, Farmers' Bulletin 853.

Drying Fruits and Vegetables in the Home. U.S. Department of Agriculture, Farmers' Bulletin 841.

Food Supply in Families of Limited Means. League for Preventive Work. Boston, 1917.

Germany's Vegetable Drying Factories. Commerce reports. February 27, 1918.

Hunt, Caroline. "Increasing the Iron Content of the Diet." *Journal of Home Economics*, 7, p. 584. 1916.

Jordan, E. G. *Food Poisoning.* University of Chicago Press, 1917.

Powell, O. *Successful Canning and Preserving.* Lippincott, 1917.

Round, L. A. and Lang, H. L. *Preservation of Vegetables by Fermentation and Salting.* U.S. Department of Agriculture, Farmers' Bulletin 881,

Sherman, H. C. *Food Products*, chap. 9. Macmillan, 1917.

Sherman, H. C. *Chemistry of Food and Nutrition*, chap. 9, 10, and 11. Macmillan, 1918.

Smith, J. R. *Industrial and Commercial Geography.* Holt, 1913.

The Small Vegetable Garden. U.S. Department of Agriculture, Farmers' Bulletin 818.

Women on the Land. Woman's Land Army of America. New York, 1918.

CHAPTER XIV

SUGGESTIONS FOR AN ADEQUATE DIET — THE DIET OF INFANTS AND CHILDREN

THIS chapter gives a brief review of our knowledge of an adequate diet, and shows how the subject may be taught both in scientific and popular terms.

I. Summary in scientific terms.

A. A diet to be adequate should include sufficient fuel, sufficient protein of the right kind — preferably partly animal, a sufficient amount of the right kind of the mineral constituents, and enough of the two unidentified essential constituents — fat-soluble A, and water-soluble B. It should have a texture such as to assist in the elimination of the feces and it should be satisfactory psychologically.

B. The total quantity of protein is not often below what is considered adequate. On a limited and strictly vegetarian diet, the quality of the protein may be inferior, especially for children. The diet is most apt to be low in the amount of calcium and iron, the fat-soluble A, and occasionally, especially among the very poor, in fuel value.

C. Specific foods most helpful in correcting these deficiencies are milk, vegetables — especially the leaf vegetables — and fruits.

II. Ways of teaching essential food facts in the simplest terms — "the five food groups." (See p. 23.)

A. Teach people to think of their foods as being divided into one of five groups: (1) vegetables and fruits; (2) meats and meat substitutes (milk, eggs, fish, cheese, beans, peas, peanuts); (3) cereals and other starchy foods; (4) sweets; (5) fats. This grouping is given in many leaflets, bulletins, and articles. Some of the earlier statements put the protein group first. The grouping given here puts vegetables and fruits first in order to emphasize their importance.

B. Emphasize the following points about these groups:

1. Choose some food from every one of the groups daily and not too much from any one group.

2. Remember that sweets, while important psychologically to help make the diet palatable, are not, so far as we know, essential physiologically. There is no proof that we need any special amount of sugar weekly or daily. Sugar and sirups are valuable means of getting supplementary fuel cheaply and pleasantly.

3. Emphasize milk, especially for children, far more than the other protein-rich foods. Some teachers consider it a weakness that this grouping does not sufficiently emphasize the unique value of milk.

4. Note the possible substitutes in the same group as wheat, and emphasize the fact that

II. Ways of teaching essential food facts (*continued*).

they are just as good for the body as wheat. People are by no means yet free from the idea that cutting down on wheat may injure their health.

5. Note that some foods can be put in more than one group; e.g., potatoes go in group 1 or group 3, sweet dried fruits in group 1 or group 4. Milk, from its composition and varied function, might well be considered in all five.

C. The groups may be called:

1. By the names of the foods.
2. By the names of the most significant components — foods important for minerals and the vitamines, protein-rich foods, starch-rich foods, etc.
3. According to their functions — fuel foods, which take in the last three groups; body building foods, those in the first, second and third groups; "body-regulating foods," the first group.

III. The quantity of food desirable:

A. In scientific terms (as stated for calories, protein, calcium, and iron in previous chapters).

1. It is not difficult for the intelligent person to compute his own consumption if exhibits of portions of food representing respectively, 100 calories, 1/2 ounce protein, 0.1 gram calcium, and 2 milligrams iron are made.
2. The danger is that in such calculations emphasis will be placed on one feature of the

III. The quantity of food desirable (*continued*).

diet only, and that the person computing his calories, for instance, will know nothing about whether these calories are obtained in the wisest way. Computing the calories, and the protein, calcium, and iron content, and considering the vitamine content and the indigestible residue, would probably show whether the requirements were satisfied, and give more valuable and accurate information than could be obtained in any simpler way.

B. In household terms — based upon pounds and ounces of food from the different groups.

1. Complete definite statements of the number of pounds needed, of course, cannot be made, but statements showing a fair range are possible. The following table[1] shows satisfactory quantities of food per day as purchased for a man at moderate work.

	Rich and more expensive diet	*Plain and cheap diet*
Vegetables and fruits . . .	from 2 1/2 lbs.	down to 1 1/2 lbs.
Milk	8 oz.	8 oz.
Meats, eggs, cheese, etc.	from 14 oz.	down to 6 oz.
(Use 2 oz. less for every additional half pint of milk)		
Cereals	from 8 oz.	up to 16 oz.
Sweets	from 3 oz.	down to 1 1/2 oz.
Fats	from 3 oz.	down to 1 1/2 oz.

These quantities have been formulated from the study of many practical diets of

[1] By C. L. Hunt. From unpublished material of the Office of Home Economics, U.S. Department of Agriculture.

III. The quantity of food desirable (*continued*).

satisfactory calorie, protein, and ash content (approximately 3000 calories or over and 90 grams of protein). There is much allowance for variations depending upon necessary conservation measures and upon prices, taste, and availability of different foods. More vegetables and fruits are often eaten and can be used now to save wheat.

2. To make these quantities vivid, the students might weigh them out and distribute them into three meals. The pound and a half of fruits and vegetables might be made up by a combination of an apple or orange, two large potatoes, and an average serving of some other vegetable. If dried fruits are used, one ounce is considered about equal to six ounces of fresh. The growing custom of buying vegetables and fruits by the pound will make the estimation of this group of the diet easier. Knowledge of whether one is eating in accordance with this table, or feeding one's family in accordance with it, will give those daily procedures an added interest.

3. In using this quantitative standard it is most important to be sure that enough vegetables and milk, and a not excessive amount of protein foods are being used.

4. Calculating the quantities by the week instead of the day will be found more satisfactory for a study of the diet, because it minimizes the daily variations. If a dietary study

III. The quantity of food desirable (*continued*).

was made at the beginning of the laboratory course, calculations may be made from that.

5. The quantities given in the table should be multiplied by 4/5 for a moderately active woman and by 3 1/3 for a family consisting of a moderately active man and woman and three children of from 3 to 12 years.[1]
6. The calories and protein of a diet whose weight is known in this way can be very simply calculated. (See the Laboratory Manual, section VI.)

IV. Wise distribution of the money spent for food.

A. This is a vitally important question. "A reasonably satisfactory diet, with adequate allowance of milk, sufficient vegetables and fat, a little fruit, a very moderate allowance of meat or fish, and no luxuries, could not, at the prices prevailing a few months ago, or even at less cost, be purchased by a family of average size for less than 10 cents per thousand calories, and in most instances for not less than 12 cents. The facts seem to be unmistakable. Never was there greater need of competent advice in food economics." [2]

B. The following recommendations have been made for expenditures for low-cost diets:[3]

[1] See U.S. Department of Agriculture, Farmers' Bulletin 808, *How to Select Foods. 1. What the Body Needs.*

[2] Editorial. "The Cost of Adequate Nutrition." *Journal of the American Medical Association* 70, p. 311. February 2, 1918.

[3] *Food for the Family.* New York Association for Improving the Condition of the Poor. 1917.

IV. Wise distribution of money spent for food (*cont'd*).

"1. Spend from one-fourth to one-third of your food money for bread, cereals, macaroni and rice.

"2. Buy at least from one-third to one-half quart of milk a day for each member of the family.

"3. Spend as much for vegetables and fruits together as you do for milk. If you use one-half quart of milk for each member of the family, this may not always be possible; then spend as much for vegetables and fruit as one-third quart of milk a day would amount to.

"4. Spend not more for meat and eggs than for vegetables and fruits. Meat and eggs may be decreased with less harm than any of the other foods mentioned. The amount spent for meat may decrease as the amount spent for milk increases."

C. A valuable discussion of the percentage of the food expenditure for different groups of food is given in Sherman's *Chemistry of Food and Nutrition*, pp. 386–400. (1918 edition.) The following table represents the expenditure in Sherman's household of three adults and four growing children:

	Per cent of total cost of food
Meats, poultry, and fish	10–15
Eggs	5–7
Milk	25–30
Cheese	2–3
Butter and other fats	10–12
Bread, cereals, and other grain products	12–15
Sugar, molasses, and sirups	about 3
Vegetables and fruits	15–18

IV. Wise distribution of money spent for food (*cont'd*).

D. If data are at hand, students should discuss the expenditure in their own families. Even approximate figures will be illuminating.

THE FEEDING OF INFANTS AND YOUNG CHILDREN

By Dorothy Reed Mendenhall, M.D.

Of the Children's Bureau, United States Department of Labor

I. Breast feeding.

A. Importance.

Mother's milk is the normal food of all young animals, and in each species the milk is adapted to the growth needs of the young of that species as well as to its digestive powers. Unlike most young animals the human infant is born long before the time at which it was intended to dispense with maternal nourishment, for it does not develop teeth or the ability to take solid food for many months after birth. An infant deprived of mother's milk to which its partially developed digestive system is adapted, must be fed with the greatest care and intelligence. There is nothing "just as good" as mother's milk.

B. Depends largely on the health of the mother.

1. Good food and care during pregnancy.
2. Skilled assistance at confinement and sufficient rest immediately afterward.
3. An abundant, varied diet, — 3 or 4 regular meals in 24 hours, — water between meals.
4 Regulation of constipation, especially by proper food.
5. Sufficient sleep and rest.
6. Gradual exercise, outdoor airing, recreation.

C. The quantity of milk can be increased by an adequate diet containing a high percentage of animal protein. Cow's milk furnishes the most suitable animal protein and also

I. Breast feeding (*continued*).

supplies calcium in sufficient amounts. Without enough of these constituents, the mother's own body material is used to keep up the milk supply.

D. The quality of the milk can be modified only slightly if the food of the mother is adequate. Milk is a secretion, not an excretion, and the constitution cannot therefore be easily altered.

E. Breast milk can be adapted to suit the baby, and every attempt should be made to do so before resorting to weaning —

1. By attention to details of maternal hygiene given above.
2. By giving water, 1/2 to 1 ounce, or thin cereal water or dilute alkali (lime water) before nursing.
3. By shortening the length of nursing or lengthening the interval between nursings.

F. Mother's milk, if scanty and inadequate as the total food for the infant, should be conserved and augmented by —

1. Attention to the hygiene and food of the mother.
2. One or more artificial feedings during 24 hours. It is better to begin supplementary bottles after the third or fourth month with most infants, as it gives the mother a long period of rest, prolongs the nursing period, teaches the infant to take artificial food, and makes weaning easy at any time. Part breast milk and part bottle at the same feeding is safer if more than one bottle is given, as the breast milk is apt to fail if the child does not nurse at frequent intervals.
3. Giving some artificial food at one or more or every nursing — the mixture with breast milk helps the digestion of cow's milk — either before or after nursing.

G. Interval of feeding (breast and artificial).

Regularity of feeding is as important as the food. Children are born without habits. The foundation of good or bad habits rests with the mothers. Infants must be taught to "expect certain things at certain times."

1. Three different feeding intervals are in use at the present time:

I. Breast feeding (*continued*).

a. Four-hour interval. Five feedings in 24 hours after the first month.

b. Three-hour interval. Seven feedings in 24 hours, usually reduced to six after the early months.

c. Two-hour interval. This was the customary interval in the past; it is seldom used now by pediatrists, except for the first month or the first two months. (Read Grulee, West, or other references given at the end of the chapter on this point.)

2. Either the three- or four-hour interval does very well for the average child. The stomach is more surely emptied during the longer interval, so that in indigestion, colic, etc., the four-hour interval is preferable, The longer interval gives the mother a longer free period, gives the breast time to fill between nursings, and, if managed properly, gives the surest results.

H. The amount of food.

The actual amount of food taken at different times during a day varies considerably in a breast-fed child, but the total amount taken by the child in 24 hours does not materially change. It varies with the individual child, and with the feeding interval. Children fed on the four-hour interval take considerably more at a feeding, but seem to take, if anything, less in the entire day than those fed at shorter intervals.

AVERAGE INFANT INTAKE AT A BREAST FEEDING

AGE	AMOUNT
1–3 days	1/2 ounce
1 week	1–2 ounces
1 month	2 1/2–3 1/2 ounces
3 months	4–5 ounces
6 months	6 ounces
8 months	8 ounces

In cases where the infant is not doing well, weighing before and after nursing will determine the amount received at a meal. In artificial feeding, this table will be useful in deciding how much to give at a meal.

I. Length of each nursing and nursing technique. (Consult Grulee or West.)

II. Artificial feeding of young infants.

As many children have to be weaned during the early months of life, it is necessary to know what is the best form of artificial food, and to study the methods of adapting it to the needs and digestive capacity of the average young infant. No exact rule can be given to fit even the average case. Infant feeding is both an art and a science.

A. Cow's milk is not the milk most like human milk, but it is the best substitute for mother's milk at our disposal. To be a fit food for human consumption and a safe food for infant use, milk must be clean and free from preservatives or other adulterants, free from disease germs, kept cold after production and relatively fresh (under 36 hours). (See the discussion in chapter XII.)

B. The most significant difference between cow's milk and human milk is the low protein, low ash, and high sugar content of human milk.

	fat	*sugar*	*proteim*	*ash*
Cow's milk......	3.5–4%	4.5%	3.5%	0.7%
Human milk.....	3.5–4%	6.5%	1.5%	0.3%

The complete chemical composition should be looked up.

C. An artificially fed child should have water offered it several times a day in addition to the food to insure a normal intake during 24 hours.

D. The giving of fresh fruit juices (orange, apple, peach, etc.) should be begun early in all artificially fed children to insure normal nutrition. Orange juice may be begun as early as the second month. Breast-fed children may also be given water and fruit juices, but their use is not so urgent.

E. Vegetable water may be used as a diluent, instead of cereal water, and furnishes minerals and also the vitamines.

F. Modification of cow's milk for infant use.

1. In the past, from a mistaken notion that chemical similarity would produce equal digestibility, the emphasis has been put on modification of cow's milk to make it as like human milk as possible. Top milk or cream mixtures were used.

II. Artificial feeding of young infants (*continued*).

2. Now whole milk mixtures (4% fat) are generally used. Whole milk is diluted with boiled water or cereal water, and sugar is added. These mixtures have the advantage of being —
    a. Better suited to the average infant and produce normal growth and development.
    b. Easier to digest. Mixtures relatively low in fat and high in protein digest more readily in early life.
    c. Simpler to prepare and more uniform.
    d. Cheaper than high fat formulas.

G. Method of calculating the proper feeding mixture for an infant.

1. The amount of food is calculated according to the weight of the child, rather than its age. Its food should give an average of 40 to 45 calories per pound of body weight the first year and 40 calories per pound of body weight the second year.
2. Most of the food should, of course, be milk. It has been found that 1 1/2 ounces of whole milk per pound of body weight is needed to maintain growth. An ounce just maintains nitrogen equilibrium, 2 ounces approaches the danger point in fat content. When beginning artificial feeding, use a low proportion of milk for the weight of the child, and if the infant is very young or if its digestive powers are weak, increase the food very gradually.
3. Some additional sugar or other carbohydrate must be given. (Refer above to the larger amount of sugar in mother's milk than in cow's milk.) In the past, milk sugar has been used, but it is more expensive than cane sugar and has no significant advantage over it in normal cases. Malt sugar which has a laxative effect is preferable to either cane or milk sugar, for the average infant, but it is also expensive. Infants thrive best on mixed carbohydrates; so besides the sugar in the milk and the added sugar, cereal is added, at first as cereal water as a diluent of the milk, and later as gruel.
4. Table for computing the calories and measuring the food.

II. Artificial feeding of young infants (*continued*).

	Calories per ounce	*Level teaspoonfuls per ounce*
Whole milk	20	4
7% milk	30	4
Milk sugar	117.0	9
Cane sugar	117.0	6
Malt sugar (dextri maltose: malt sugar 51%, dextrin, 47%)	110.0	10
Oatmeal	117.0	9
Wheat flour	102.0	12
Barley flour	102.5	15

5. Mineral salts need not be added, but as milk is rendered more easily digested by alkali, sodium bicarbonate — which is neither laxative nor constipating — or lime water may be added. Boiling, diluting, and mixing with cereals also increase the ease of digestion of the protein.
6. After calculating the amount of milk and sugar indicated by the weight, age, and digestive capacity of the child, the mixture is diluted so as to furnish the proper volume for the stomach of the infant (see H above). Boiled water is used at first as the diluent, then thin cereal water, and later gruel. (See West or Grulee.)
7. The intake of the average infant at feeding. The amount offered should slightly exceed the stomach capacity for a child of a given age. Example: A baby six months old, weighing 14 pounds — stomach capacity at six months of age, 6 ounces; therefore, try 7 ounces at each feeding; five feedings of 7 ounces each will give 35 ounces; 1 1/2 ounces of milk for each pound that the child weighs gives 21 ounces; 1 ounce of sugar added.

FINAL FORMULA

Milk (whole)	21 ounces	441 calories
Water	14 ounces	
Sugar	1 ounce	117 calories
		558 calories or 40 calories per pound

III. Normal weight curve in infancy.

The food of an artificially fed child should never be pushed in order to obtain a more satisfactory gain in weight. The main object during the early months is to avoid digestive upset, until the digestive powers are established. A breast-fed child should gain 6 to 8 ounces a week in the first six months, and 2 to 3 ounces a week during the rest of the first year. An artificially fed child may make a gain of only 2 to 4 ounces a week and still be doing satisfactorily. (See Grulee, p. 70, for ideal and usual weight curves.)

IV. Signs of health.

Gradual steady gain in weight the first year of life is the best index we have of health, but good color, quiet sleep, and normal stools, digestive condition and physical activity, are always to be considered. A rising weight curve may be accompanied by dangerous symptoms, such as a pale, puffy skin, restless sleep, constipation or diarrhœa, vomiting, and listlessness. An excessive gain in weight in a bottle-fed child (over 8 ounces a week) indicates over-feeding.

V. Outfit for the preparation of food and technique of food preparation. (See Grulee or West.)

VI. The question of fresh, pasteurized, or sterilized milk for infant use and of the use and abuse of patent or proprietary foods should be discussed. (See Mendenhall, pp. 16–18, and Grulee.)

VII. Infant hygiene.

The well-being of a young child depends largely on the daily routine of its life and the detailed physical care given him by his mother. The secret of healthy babies and a lowered infant mortality is to have more infants breast-fed and properly cared for by their own mothers in their own homes.

VIII. Feeding of older children.

The question of the nutrition of the child population has become one of the vital issues in the present world crisis. The falling birth-rate and the loss of man power in war has brought all civilized nations face to face with the necessity of stopping the waste of life at its source and during the early years of life.

VIII. Feeding of older children (*continued*).

A. Weight as an index to nutrition.

1. The relation of the height to the weight in childhood gives a rough index of whether or not health and development are normal.
2. Children of the same age may vary greatly in height, according to whether they come of tall or short parents or whether their growth has been stunted by lack of the proper food, by infectious diseases or by remediable defects. Disregarding their age, children of a given height, if their nutrition is properly maintained, should average nearly the same weight. Certainly any child 10% below the average weight for his height should be considered in the physically subnormal class and in need of medical inspection.
3. A Table of Heights and Weights for Children under 16, just published by the United States Children's Bureau, has been widely distributed.
4. The United States Children's Bureau is asking the Nation this year to weigh and measure every child under six years of age. This test was suggested in order to make families and communities realize their responsibility in regard to the nutrition of the child population. It is also important as a preliminary to the saving of one hundred thousand infants hitherto unnecessarily sacrificed to neglect and to ignorance of the proper care of the mother and her child.

B. The periods of life most easily affected by inadequate food.

1. Early infancy. In the cities especially, a great deal of work has been done to safeguard this period by public health agencies. The child triples its original weight during the first year and adds about 50% to its height — a greater gain in weight than in any other period. This is also the time of greatest brain growth.
2. Adolescence. Here we have to consider a greater increase in weight (roughly ten pounds a year) than at

VIII. Feeding of older children (*continued*).

any other period after the first year of life, the development of important organs and the special strain on the nervous system. Boys especially from 12 to 16 seem to need and to be able to use a diet far in excess of the calorie value often thought necessary for their age. Girls at this period frequently take too little food.

C. Most neglected period of childhood.

The pre-school period from 2 to 6 years — the "runabout period." In the tenements the child during this time mostly takes care of himself and often has no settled meals. Agencies to look after him are being developed abroad (nursery schools) and are being advocated in this country.

D. Effect of the war on the malnutrition of children.

1. Work in Europe.

a. Work along prenatal and infant welfare lines has been intensified since the war. The infant death-rate in Great Britain and Ireland in 1916 was lower than before the war. The 1917 rate in England and Wales has risen 6 points, but is even now lower than the average rate in the United States in times of peace. In France and Belgium, work for the protection of maternity and early infancy has also greatly increased. In France, children under 2 years received special care and extra food and the death-rate decreased. Those over 2 did not receive this attention, and the death-rate increased.

b. In Germany the infant death-rate, since the beginning of the war to the end of 1916, declined. Reports seem to show that children under 8 are still protected from any serious undernutrition. From 8 to 18 years of age the conditions are very serious, for the children, besides being undernourished, are overworked and subject to great strain. In Dresden, for example, they get about 1200 calories per day, except the very wealthy

VIII. Feeding of older children (*continued*).

who can afford to supplement the ration. The children are told not to run or to play vigorous games or take long walks.

c. In the child population over 2, reports from Europe show, in general, a gradual increase in the amount of malnutrition and of diseases such as tuberculosis which are influenced by inadequate food.

2. In this country.

a. Before the war.

(1) The prevalence of malnutrition in both city and country is shown by such an investigation as Dr. Thomas D. Wood's survey of the comparative health of rural and city school children. In this survey, malnutrition and remediable defects were found in considerably greater proportion in rural children than in city children.

(2) Undernutrition is not confined to the children of the poor. In a study of over 5000 children in Boston, some of those found undernourished came from well-to-do families.

(3) This malnutrition is due in part to ignorance and neglect as well as to poverty and can best be met by teaching proper food habits. The meals offered children are often hopelessly inadequate: coffee and a sweet bun for breakfast, a noon luncheon bought with a few pennies in the city at the cake or candy shop, or in rural districts, a few scraps from breakfast and a piece of soggy pie, and a meager supper that cannot make up for the inadequacies of the other meals.

(4) General enlightenment on the essentials of an adequate diet and popular teaching on the planning of meals are needed. School lunches and the hot noonday meal in rural schools should be instituted.

VIII. Feeding of older children (*continued*).

b. Since the war.

The high cost of living and ignorant substitution in the matter of customary foodstuffs must lead to a marked increase of undernutrition, especially at the periods of most active growth, unless active preventive measures are undertaken. Reports from our large cities show that this calamity has already overtaken us. In the New York public schools, the cases of grave malnutrition rose from 6% in 1916, to 12% in 1917.

E. Essentials in the diet of the child.

1. The diet of young animals relative to their size must contain more body-building material than the diet of adult animals. Food for growth must contain an abundance of protein, minerals, vitamines, as well as afford abundant fuel.
2. The protein for the best growth and development of the child must consist, in part at least, of animal protein.
   a. Animal protein is found in milk, eggs, meat, including fish and fowl. Of these milk is the most valuable for the child.
   b. The protein of certain vegetables and nuts is adequate for body-building purposes, but it is doubtful if, aside from laboratory experiments on lower animals, these foods can be used as the sole source of protein to produce the best growth and development in the average child. Undoubtedly, however, life can be sustained on a vegetable diet alone.
3. Character of the diet.
   a. Indispensable articles of food in childhood. Plenty of whole milk, or skim milk with butter, green vegetables, especially leaf vegetables and cereals,
   b. Desirable articles: some eggs or meat — including fish and fowl — fruits and sugar.

F. Diet during the second year of life.

1. Four meals a day, occasionally five, including —

VIII. Feeding of older children (*continued*).

a. A quart of milk a day, rarely more.

b. Cereals and breadstuffs.

c. Fruit juice and pulp — fresh or cooked.

d. Vegetable soup or broth or vegetable pulp.

e. Coddled egg.

2. For details of meals see Mendenhall and Daniels, or Rose. (See References.)

G. Diet from the third year throughout childhood.

1. Number of meals. From the third year, three meals a day are sufficient for the normal child. Eating between meals is a matter of habit, and should be discouraged except in the subnormal individual, as the child eats no more food and the digestion is overtaxed with too many meals.

2. Noon dinner. Children do better with the heavy meal at noon. Night dinners are especially bad for the young child. Light suppers produce quieter sleep and a better appetite for breakfast.

3. Forbidden foods for young children. (See Mendenhall and Daniels, or West.)

4. Food groups to be represented in the diet. The indispensable and desirable foods in childhood have been previously mentioned and are well summarized in Hunt's two bulletins given in the References. New foods must be introduced gradually and carefully into the child's diet. Palatability and appetite have to be considered more as the child grows older.

5. The amount of food taken increases as the child increases in size. The calorie need per pound weight gradually falls.

6. Details concerning meals. (See Hunt and Rose.)

H. Serious errors in diet. Diet in childhood may be —

1. Deficient in the essential vitamines, causing beri-beri (deficient in water-soluble B) or xerophthalmia (deficient in fat-soluble A.).

VIII. Feeding of older children (*continued*).

2. Insufficient in general or deficient in various essentials causing such diseases as pellagra, general malnutrition or obscure nutritional diseases, rickets, and possibly scurvy. The causes of rickets and scurvy are still in debate.
   - a. Rickets is a derangement of metabolism, chiefly of calcium and phosphorus, causing local or general disturbance in the normal process of ossification. Diets deficient in fat and high in carbohydrates are frequently followed by this disease. It is less common and less severe in breast-fed children and appears most often between 6 and 18 months of age.
   - b. Scurvy is characterized by a tendency to hemorrhage. It is rare in the breast-fed, but common in artificially fed, infants during the second half of the first year. It seems to appear more frequently in children fed condensed or stale milk. It is easily cured by lemon or orange juice, or the juice of fresh vegetables. (See Mendenhall for further discussion.)

I. War substitutes in the child's diet.

1. There is no substitute food for milk or green vegetables.
2. Fish and chicken are in many ways better for a child than beef.
3. One cereal is just as good as another if well cooked. Some individuals have difficulty with cellulose in coarse cereals. Quick-baked breads or cereals cooked for a short time are difficult for immature or weak digestive powers.
4 "Victory" bread contains nothing injurious to the small children and can be given to an infant if stale or oven dried. (American Pediatric Society, 1918.)

J. General directions for the child's diet.

1. Do not restrict the child's diet.
   - a. Give an abundance of food at regular meal-time.

VIII. Feeding of older children (*continued*).

Teach the doctrine of the full dinner plate before teaching the clean dinner plate.

b. Cut out eating between meals. It spoils the appetite for regular meals and actually decreases the amount of food taken in 24 hours. The food chosen between meals is apt to be less easily digested and injurious to the child — candy, nuts, sweet cakes, etc. Besides, the habit is wasteful.

c. A varied diet is an advantage. Children should be encouraged to like new foods. There is more danger that a diet restricted to a few articles may be inadequate than there is with a varied diet.

2. Three meals a day after the third year should be given, except the mid-morning lunch (milk or milk and oatmeal cracker) advocated for subnormal school children.
3. Arrange for a hot noonday meal for the school child who takes this meal at school. Every child needs a substantial warm noonday meal.
4. It is the parents' duty to select an adequate diet for the child, to provide appetizing, well-cooked meals, and to enforce discipline. The child, if well, should eat what is put before it and not be allowed to leave uneaten portions.

K. Periods of diet to be studied in childhood:

1. Early infancy. The change from milk diet to solid food.
2. Diet from 2 to 6. Gradual introduction of new foods. The food should be well-cooked, mashed, and finely divided. Hard crusts may be included to develop the power of mastication.
3. Diet from 6 to 12. A varied, abundant diet; noon dinner.
4. Diet during adolescence. Special requirements because of growth and the development of new functions.

REFERENCES ON ADEQUATE DIET

Choose Your Food Wisely. United States Food Leaflet No. 4.
Editorial. "The Cost of Adequate Nutrition." *Journal of the American Medical Association,* 70, p. 312. February 2, 1918.
Editorial. "The Food of the Poorer Classes in War-Time." *Ibid.,* 70, p. 234. January 26, 1918.
Editorial. "Unwise Economics in Diet." *Ibid.,* 69, p. 1435. 1917.
Hunt, C. L. "A Quick Method of Calculating Food Values." *Journal of Home Economics,* 10, p. 212. May, 1918.
Hunt, C. L., and Atwater, H. C. *How to Select Foods.* I. *What the Body Needs.* U.S. Department of Agriculture, Farmers' Bulletin 808.
Lauck, W. J. *Cost of Living and the War.* Cleveland: Doyle & Waltz Printing Co., 1918.
Lusk, G. *The Elements of the Science of Nutrition,* chaps. 12 and 21. Saunders, 1917.
Rose, M. S. *Feeding the Family.* Saunders, 1917.
Sherman, H. C. *Chemistry of Food and Nutrition.* Macmillan, 1918.
Stiles, P. G. *An Adequate Diet.* Harvard University Press, 1916.

REFERENCES ON THE DIET OF CHILDREN

Editorial. "The Food Requirement of Healthy Children." *Journal of the American Medical Association,* 67, p. 1698. 1917.
Grulee, C. C. *Infant Feeding.* Saunders, 1917.
Holt, L. E. *Diseases of Infancy and Childhood.* See "Feeding" chapters. Appleton, 1917.
Hoobler, B. R. "Effect on Human Milk Production of Diets containing Various Forms and Quantities of Protein. *American Journal of Diseases of Children,* 14, p. 105. 1917. See also *Journal of the American Medical Association,* 14, p. 421. 1917.
Hunt, C. L. *Food for Young Children.* U.S. Department ol Agriculture, Farmers' Bulletin 717.
Hunt. C. L. *School Lunches.* U.S. Department of Agriculture, Farmers' Bulletin 712.
Lucas, W. P. "Work of the Children's Bureau, Department of Civil Affairs, American Red Cross, France." *Journal of the Amercan Medical Association,* 71, p. 359. August 3, 1918.

Meigs, G. "Infant Welfare in War-Time." *Journal of Diseases of Children*, 14, 80. 1917.
Meigs, G. L. "The Children's Year Campaign." *Journal of the American Medical Association*, 71, p. 243. July 27, 1918.
Mendenhall, D. R., and Daniels, A. *What to Feed Children.* University of Wisconsin, Circular 69.
Mendenhall, D. R. *Milk.* U.S. Department of Labor, Children's Bureau Publications No. 35. 1918.
Rose, M. S. *Feeding the Family*, chaps. 6, 8, 9, 10. Macmillan, 1917.
Sadler, W. S. and L. K. *The Mother and her Child.* MacClung, 1916.
West, M. *Infant Care.* U.S. Department of Labor, Children's Bureau. Publication No. 8. *Child Care.* Publication No. 30.
West, M. *Prenatal Care.* U.S. Department of Labor, Children's Bureau. Publication No. 4.
United States Food Leaflet No. 7.

CHAPTER XV

FOOD AND THE COMMUNITY

THIS chapter deals with some of the community efforts to solve the feeding problem.

I. Public kitchens.

- A. Community or mass feeding has been carried out to a much greater extent abroad than in this country, especially since the war. In the United States the necessity for public kitchens has not yet been felt strongly enough for any widespread movement for their establishment, although a few have been started.
- B. Impetus given the movement abroad by the war due to —
  1. Prevalence of underfeeding, especially among children.
  2. The large number of women at work away from their households.
  3. Difficulty of getting food, the annoying waiting in "queues." The marked development of public kitchens abroad has followed the introduction of rations, and their success is due in part to the fact that more value for the food card can be obtained at the kitchen than at home.
  4. Difficulty in obtaining servants.
  5. The conservation of food as well as fuel possible in large-scale cooking.

I. Public kitchens (*continued*).

C. Two kinds from an economic standpoint to be discussed —

1. Those which do not pay expenses and supply food below cost or free, the money being furnished by individuals or by the authorities. Before the war this was the prevailing type — charity organizations which fed the poor free or at a low cost. As far back as the last decade of the eighteenth century, Count Rumford established kitchens for large-scale feeding of the poor in Munich, London, and Dublin.

2. Those whose prices are such as to cover all costs, but not to allow a profit. The line between these two kinds cannot often be clearly drawn. For example, at times a building or part or all of the equipment is provided, and the sales, therefore, do not have to cover rent and part of the invested capital.

D. The war has brought many interesting developments, but especially noteworthy is the establishment, without any stigma of charity, of kitchens which pay their own expenses and are of the greatest convenience to their patrons. To patronize them means no loss of self-respect, as they are democratic institutions started by the authorities, owned by the community, and operated without profit.

E. In England.

1. At first the Ministry of Food had to contend with much prejudice among the middle class. This has been largely overcome by the

I. Public kitchens (*continued*).

kitchens themselves and the need for them, as well as by the vigorous support of the Ministry.

2. Organization. The kitchens are scientifically planned and have a capable and economical management.

   a. A Defense of the Realm Act provides that a local authority such as a city or rural council, the mayor or aldermen may establish and maintain a National Kitchen and as many distributing depots as necessary. The power may be delegated to the local food committee.

   b. The Government will provide 25% of the initial outlay and loan 25% more. The local authorities must supply the remaining 50%. They are conducted on a self-supporting basis and have no volunteer help.

   c. A director of National Kitchens has been appointed under the Ministry of Food.

   d. All kinds of buildings are used — park buildings, public baths, kitchens serving school lunches, etc.

   e. The service depends somewhat on the community and the available space. In some places there is a cafeteria service, or the cooked food may be taken home. In others, all the food is eaten at home. Usually only dinner is served. Two methods are in vogue — cooking at separate kitch-

I. Public kitchens (*continued*).

ens in various parts of the city, and cooking at one central kitchen and sending it to distributing depots.

f. Two National Kitchens have been established as experimental models, one of which is in London.

g. In places where shops for the sale of cooked food exist, the authorities may coöperate with them and enlarge the extent and scope of their work.

3. Success.

a. Some have been in successful operation for over a year. On March 26, 1918, Lord Rhondda reported that there were 47 kitchens and distributing depots in London, 75 in Greater London, and a total of 250 in the whole country.

b. One example is that of the People's Kitchen at Hammersmith, London. It supplies 6000 customers a week, which represents probably from 12,000 to 15,000 consumers, as many customers buy for their families. Another in South London, an industrial community, serves about 2000 meals a day. At Bradford, the food is prepared at the central school lunch kitchen and is distributed by motor vans in heat-proof vessels to convenient centers. No food is eaten at the depots, but it is carried home for the family meal.

4. Price of meals.

The prices to an American seem surpris-

I. Public kitchens (*continued*).

ingly low, especially in the face of the food shortage, but it must be remembered that standards of wages as well as living are lower abroad. A dinner can be bought for as little as 16 cents. Some of the prices quoted for one kitchen on March 22, 1918, are: carrot soup, 1*d.* the pint, a serving of fish roll, 2*d.*, of beef-steak pudding, 4*d.*, of rice pudding, 1 1/2 *d.*, two large potatoes, 1*d.* At the Bradford kitchens, meat dishes were 6*d.*, soup 3*d.*, and puddings 3*d.*

F. In Germany. No complete survey is possible.

1. Up to the middle of 1916, the public kitchens were largely philanthropic, but Germany saw the necessity of greater development before the Allied countries did.
2. A strong movement for cost-price kitchens began about August, 1916. They were often started by town councils which provided capital and equipment. Munich offered a course of instruction in the management of these kitchens as early as November, 1916. They were officially approved. The President of the War Food Bureau asked that they get their full coal requirements as important war industries. The War Food Committee urged their initiation wherever needed.
3. Various types of kitchens exist, both middle-class and philanthropic. Some industrial concerns feed their workers' families. In some cases free meals are given. Children and

I. Public kitchens (*continued*).

soldiers' families may get meals more cheaply than civilians. Cooked meals are also delivered; e.g., Düsseldorf uses its tram cars and some cities have motor conveyances.

4. The extent of the use of the kitchens depends on the quality and quantity of the rations. When the rations are generous, the attendance at the kitchens falls off. It is difficult to estimate the number of meals served. Of the 563 communes of 10,000 or more inhabitants, only 56 had no arrangements for mass feeding. In most towns only a midday dinner was served. In Berlin the *Lokal Anzeiger* of September 19, 1917, states that there are almost a hundred kitchens for the middle class and officials, and soup kitchens which serve daily 35,000 portions of foods, 14,000 portions of soup, and 8000 portions of bone soup.[1]

G. In Austria.

The war-kitchen movement has developed to an extraordinary extent. There is a Central Union of Commercial War Kitchens which assures supplies to all such kitchens in Vienna and all of lower Austria. All buying is done by a purchasing department. The size of the kitchens varies — they feed from 30 to 7000 in the different kitchens. The midday meal costs from 30 to 47 cents. (*Die Zeit*, September 19, 1917; the paper states further that it is doubtful whether these prices can be maintained.)[2]

[1] Maylander, A. *Food Situation in Central Europe*. U.S. Bureau of Labor Statistics, Bulletin 242. [2] *Ibid.*, p. 99.

I. Public kitchens (*continued*).

H. In Italy.

The fuel shortage in 1917 caused an extensive development of "family restaurants" in the big cities. The foundation was often the restaurant that had existed in coöperative society stores.

I. In Belgium.

Community cooked-food centers on a large scale all over Belgium were established by the Commission for Relief in Belgium. They include:

1. The "soupes," kitchens at which men and women — a million of them — are supplied once each day with thick soup and bread. Very occasionally a small piece of herring can be supplied.
2. Dining-rooms for infants in almost every one of the 3000 "communes" in Belgium. Some communes have several.
3. Similar dining-rooms giving a meal each day to weak and defective children.
4. School lunches in practically every schoolhouse.
5. Canteens providing cooked food for expectant and nursing mothers.

II. Restaurants or canteens in commercial establishments.

These are increasing rapidly with the realization of their social importance and the knowledge that the employee does better work if he is well fed.

II. Restaurants in commercial establishments (*cont'd*).

A. United States.

1. A survey made by the Bureau of Labor (published in December, 1917) gives a picture of the extent of these restaurants in the United States. Of 431 typical establishments, representing a great variety of industries, stores, and offices, 52% had either restaurants or cafeterias. They were patronized by about a fourth of the employees. The lunch-rooms were frequently run at a deficit.
2. The War Department is developing lunch-rooms as an important part of the welfare work in some of the many factories producing munitions and other war supplies.

B. England.

The Health of Munitions Workers Committee (January, 1916) emphasized the need for factory restaurants and furnished complete directions for their establishment and equipment. In June, 1917, the Minister of Munitions reported canteen accommodations in national and controlled factories for somewhat less than half of the 11,750,000 employees. A later report (October) says that over half are now supplied with restaurants. Canteens are required where-ever women are employed at night.

III. College commons.

A well-developed and important form of community feeding.

IV. School lunches.

A. The school lunch is one of our best-developed

IV. School lunches (*continued*).

types of community feeding, but there are still far too few of them. Though feeding only one group in the community, many of the same problems are involved as with the other forms of community feeding and they offer the same opportunities for improving nutritive conditions. They can easily be developed into community food centers supplying after-school demonstrations to the women of the neighborhood, serving as canning and drying centers, and being available in emergencies.

B. History of the school-lunch movement, including its great development abroad, its beginnings in this country in Philadelphia in 1894, and its slow but steady spread to many other cities and rural neighborhoods, is well given in Bryant's *School Feeding*. (See References.)

C. Methods of initiating and financing school lunches.

1. Groups of public-spirited citizens, women's clubs, groups of parents, etc., have frequently paid for equipment and given volunteer service.
2. The city or school district in the rural community sometimes initiates the lunches, but more often takes them over after private groups have shown their necessity and value.
3. The cost of the food, and sometimes of the service, but not the cost of the original equipment, is met by the children's pennies.

D. Kinds of lunches served.

The constant problem is to give as much food,

IV. School lunches (*continued*).

as many calories, and other food requirements as possible, for the children's pennies. This is made possible by economical management and by intelligent, large-scale buying.

1. In rural schools. In one-room schools usually one hot dish, soup, stew, or cocoa is prepared often from the food that the children themselves contribute instead of from purchased food. This is supplemented from the child's lunch-box. In the consolidated schools one or more hot dishes can be prepared in the cooking laboratory.
2. In city elementary schools.
   a. A number of different foods are for sale, each portion costing a penny — milk, nutritious soups, cocoa, peanut butter, meat and jelly sandwiches, and fruits. With the increasing cost of food the size of portions has had to be reduced. An adequate lunch cannot be bought for several cents.
   b. Ingenuity on the part of the manager, variety in the food, and consideration of the wishes of the children are essential if the children are to be led to patronize the school lunch rather than the push-cart man outside.
3. In rooms for tubercular or subnormal children maintained in some places by philanthropy.

   A fairly elaborate lunch, equivalent to almost half of the child's daily needs is often

IV. School lunches (*continued*).

served. In 1917 the Elizabeth McCormick Fund in Chicago served such meals for as little as 13 cents per child. Extremely careful large-scale purchasing is necessary.

4. In high schools.

In the high schools a somewhat different problem from that of the elementary school is presented. The lunch-rooms are more like the ordinary inexpensive cafeterias. In some places they are run by caterers. Usually cheaper and better-balanced meals are served when they are in charge of a dietitian and run in connection with the domestic science department.

E. Some results often following the introduction of school lunches.

1. Increased mental alertness of the children. Teachers almost invariably comment upon this and upon the greater ease of discipline.

2. Lessened malnutrition. Marked gain in weight is noticeable only with the more elaborate lunches. Many illustrations might be given. (See chapter IV for the importance of fighting against malnutrition in school children.)

a. A striking and frequently quoted example is the experiment in Bradford, England, in 1907, where about 40 of the most needy children were given two meals daily for three months and their gain in weight compared with that of a similar group

IV. School lunches (*continued*).

getting their meals as usual at home. The first group of children gained 2 1/2 pounds, and the others 1 1/4 pounds.

b. The "food scouts" of Public School No. 40, New York City, were a group of 25 boys from a malnutrition clinic, which for ten weeks were given a noonday meal ranging from 900 to 1200 calories. The children themselves were greatly interested, their mothers' coöperation was secured, and revolutionary changes wrought in the home diet of the children, chiefly the dropping of tea and coffee and the use of milk. The constipation from which almost all the children were suffering at the beginning was corrected by liberal use of coarse breads and fruits. All but one of the boys gained in weight, 15 of them from 1 to 4 pounds more than the normal gain. Those who gained less were handicapped by colds, sore throats, etc., or by the lack of coöperation of the mother.

3. Important educational advantages.

a. The lunches can be a great socializing and Americanizing influence.

b. Children can be taught to eat the "foods that build strong boys and girls," and to have high ideals of health.

c. The parents can be taught by the lessons brought home by the children.

IV. School lunches (*continued*).

d. The Food Administration's requests as to substitutes can be followed and made practicable to the children and their parents.

V. Coöperative stores and buying clubs.

"One of the products of war is the coöperative organization of consumers. Throughout the country, buying clubs, canning clubs, community gardens and kitchens are spontaneously being formed on grounds either of economy or of food conservation." The organizers and members "should study coöperative literature and acquire the vicarious coöperative experience which it affords." [1]

A. The need. This has been felt especially in Europe.

1. A movement to lower the cost of living by giving to the consumer the advantage of large-scale buying.
2. The increase of food prices as a result of the war has awakened more people to a desire to take action themselves to lower costs and to acquire for themselves the middleman's profits.
3. Public price control is less successful in reaching the retailers than the wholesalers or the food manufacturers. For example, it is possible to control the maximum price paid for meat at the great packing-houses, but more difficult to prevent the rise of retail prices if there is a local shortage in the retail markets of a town.

B. The efficiency of coöperative associations to serve the consumers in war-time is shown by the increase of the sales of the 12 chief coöperative wholesale societies in Europe from $360,000,000 in 1915 to $500,000,000 in 1916.

C. Coöperative stores in Great Britain.

1. This movement was begun in 1844 in the now famous

[1] James Ford, Annotated Bibliography of Consumers' Coöperation. *The Survey*, 39, p. 517. February 9, 1918.

V. Coöperative stores and buying clubs (*continued*).

Rochdale store by 28 flannel weavers who had just emerged from an unsuccessful strike.

2. Some of their principles of action, which are also principles of successful coöperative enterprises everywhere:
   a. "One member, one vote."
   b. Market prices asked for goods — no credit allowed.
   c. Shares of small size and only a low rate of interest paid on them. Net profits divided among members in proportion to their purchases.
   d. Management in the hands of the officers and a committee elected periodically.
   e. Coöperative associations are thus absolutely democratic and open to everybody. They utilize the higher ability of the working-classes which has been called by the English economist Marshall "the waste product in the world's history."
3. Development before the war.
   a. The coöperative stores grew slowly at first and then astonishingly fast. In 1914 there were over 3,000,000 members, comprising, with the families of the members, between one-fourth and one-fifth of the whole population of Great Britain; 1400 retail stores with many branches, and two great wholesale societies; and a trade in both retail and wholesale societies of $650,000,000.
   b. The retail association expanded so as to form wholesale societies to furnish a "coöperative source of supply." These are federations of retail associations. They carry on a large and varied business — buying, banking, farming, and manufacturing. They own the four largest flour mills and the largest boot and shoe factory in Great Britain.
4. Some effects of the war.
   a. The coöperative stores have proved a highly advantageous means of keeping retail prices at a reasonable level. They kept their goods as long as possible

V. Coöperative stores and buying clubs (*continued*).

at pre-war prices, and thus, by competition, lessened the rise in price by profiteering retailers and so saved money to all the consumers in Great Britain.

b. When, to the satisfaction of the coöperators, government regulation of prices was introduced, the prices adopted were often those of the wholesale societies.

c. Membership in the coöperative societies has vastly increased. In 1917 there were over 4,000,000 members.

D. In France.

1. Great progress has been made since 1914 both in the rapid growth of membership and in the extent of the transactions. The shortage of foodstuffs and the general advance in prices have attracted the so-called middle classes.

2. In Paris, the Government has made great use of the coöperative societies, has given over to them the distribution of milk, coal, and frozen meat, has advanced them funds for equipping motor vans to sell goods to soldiers at the front, and has entrusted them with much of the war relief work.

E. In the neutral countries, the development has been no less pronounced.

F. Coöperative stores in the United States.

America has lagged far behind Europe. Organizations of consumers have developed here less rapidly than organizations of producers. Almost no coöperative stores have succeeded that have catered to the well-to-do. Most of the successes have been among immigrants. Many stores have started and failed. In 1917 there were estimated to be over 800 in the United States.

G. Buying clubs in the United States.

Buying clubs are merely groups united for the purpose of getting food at wholesale rates.

V. Coöperative stores and buying clubs (*continued*).

1. A great many of these, both large and small, are in existence all over the country and the number is increasing rapidly.
2. As a war-time measure, yielding quick results, buying clubs have many advantages over the coöperative stores — much greater simplicity of organization, no need for capital, and almost complete elimination of overhead expenses such as cartage, rents, taxes, insurance, clerks, advertising, and depreciation.
3. They have besides most of the advantages of the coöperative stores — reducing the number of middlemen, buying in quantity at wholesale prices or better, buying and selling for cash, and eliminating unsalable stock because the members agree beforehand on the amount they will buy.
4. They are especially economical in the purchasing of staples and canned goods, where delay in delivery is not serious. In buying sugar, cereals, and canned goods there may be a large saving even by as small a group as ten. According to Sullivan, twenty heads of families clubbing together can buy a side of beef, a dressed pig, or a whole mutton and save as much as 38%.
5. Clubs are especially successful among groups of employees of manufacturing concerns. Their community of interest and taste, their common pay-day, and their chance for a common meeting-place makes group buying logical. Frequently they have access to the storage facilities and unloading platform of their firms and sometimes they have received an advance of funds.

H. Clubs have often failed or approached failure in city neighborhoods because of a lack of common interests.

I. In organizing and running a buying club strict business methods must be followed.

VI. Canning clubs, coöperative and otherwise, are discussed in the next chapter.

VII. Agricultural coöperation in the United States.

A. Farmers' organizations have been developed much more than coöperative associations of consumers.

VII. Agricultural coöperation in United States (*cont'd*).

B. The Department of Agriculture now has the names of about 14,000 organizations. These transact approximately $1,500,000,000 of business annually.

1. The leading coöperative States are Minnesota, with almost 1000 organizations in 1914, Iowa with 500, Wisconsin with 400. No State is without some coöperative society.
2. The chief coöperative organizations are elevators, creameries, wholesale and retail stores, cheese factories, and companies dealing in fruit, produce, cotton, tobacco, and live-stock.

VIII. Public markets.

A good method for the direct sale of perishables to the consumer by the producer.

A. These are by no means new — formerly every town and village had one, but of recent years they have grown into favor in many of the large cities.

B. Sales may be made from stalls in a regular market house owned by the city or by individuals, or from the wagon of the farmer drawn up at the curb — a curb market.

C. It is suggested that interested students study the market conditions in their own town, and the facilities afforded farmers to market their produce directly to the consumer.

REFERENCES

Andrews, I. O., and Hobbs, M. *Economic Effect of the War on Women and Children in Great Britain.* Carnegie Endowment for International Peace. New York.

Bassett, C. E., and Jesness, O. B. *Coöperative Organization By-Laws.* U.S. Department of Agriculture, Bulletin 54.

Bassett, C. E. "The Coöperative Purchase of Farm Supplies." U.S. Department of Agriculture Yearbook. 1915.

Bassett, C. E., and Kerr, W. H. *The Community Egg Circle.* U.S. Department of Agriculture, Farmers' Bulletin 656.

Bassett, Moomaw, and Kerr. "Coöperative Marketing and Finance." U.S. Department of Agriculture Yearbook, 1914.

Bexell, MacPherson, and Kerr. *A Survey of Typical Coöperative Stores in the United States.* U.S. Department of Agriculture, Bulletin 394. 1916.

Brown, E. "Feeding School Children." *Journal of Home Economics*, 7, p. 119. 1915.

Bryant, L. S. *School Feeding.* Lippincott, 1913.

Durand, E. C., and Price, H. B. *Coöperative Buying by Farmers' Clubs in Minnesota.* University of Minnesota, Bulletin 167. 1917.

Durand, E., and Robotka, Frank. *Coöperative Stores in Minnesota.* University of Minnesota, Bulletin 171.

Ford, J. Annotated Bibliography of Consumers' Coöperation. *The Survey*, 39, p. 517. February 9, 1918.

Ford, J. *Coöperation in New England, Urban and Rural.* Russell Sage Foundation. 1913.

Harrison, F., and Percival, O. B. *The Rural School Lunch.* University of Illinois. 1916.

Henderson, E. F. "War Orphans and Child Welfare in Germany." *The Survey*, 40, p. 39. April 13, 1918.

Hunt, C. L. *School Lunches.* U.S. Department of Agriculture, Farmers' Bulletin 712.

Jesness, O. B., and Kerr, W. H. *Coöperative Purchasing and Marketing Organizations among Farmers in the United States.* U.S. Department of Agriculture, Bulletin 547. Contains a bibliography.

King, C. L. *Lower Living Cost in Cities.* Appleton, 1915.

Laidler, H. W. *The British Coöperative Movement.* Published by the Coöperative League of America. 1917.

Perky, C. W. *Coöperation in the United States.* New York Inter-Collegiate Socialist Society. 1917.

Powell, G. H. *Coöperation in Agriculture.* Macmillan, 1913.

"Public Kitchens Abroad." *National Food Journal*, 1, p. 393. April 10, 1918.

Public Markets in the United States. Second report of a committee of the National Municipal League. Philadelphia, 1917.

Report of the Chicago Board of Education. 1916.

Sullivan, J. W. *Markets for the People.* Macmillan, 1913.

Terman, C. L. *The Hygiene of the Child.* Houghton, Mifflin, 1914.

Whitney, A. L. "Lunch-Rooms for Employees." U.S. Bureau of Labor Statistics, *Monthly Review*, 5, p. 207. 1917.

CHAPTER XVI

THE WORK FOR FOOD CONSERVATION

THIS chapter is an effort to give a picture of the work in food conservation being done throughout the country, especially by the women. No complete survey of the work done or in progress would be possible at this time. The chapter merely presents statements of a few of the lines that have been followed with marked success in one or in many places, to serve as suggestions to those in the work, and especially to give students a glimpse of the diversity and extent of the movement of which they are a part.

I. The chief state agencies working in food conservation.

The organizations in the various States differ, so that a State may not have all of these agencies.

A. The United States Food Administration.

1. The Federal Food Administrator in each State appointed by the President. The dealings of the Washington office of the Food Administration with the States are conducted through this officer. General instructions and information on food shortages and on policies are sent to him. His duties include the enforcement of Food Administration rulings, and the solution of special problems of distribution of food in his State. Much of his work is carried out through his appointees in the

I. Chief state agencies in food conservation (*cont'd*).

counties, districts, and cities, and through the various members of his staff such as the State Merchant Representative, the Library Director, and the Educational Director.

2. The Home Economics Director, a woman appointed by the Federal Food Administrator with the sanction of the United States Food Administration. She is a member of the staff of the Federal Food Administrator and is in charge of the conservation of food in the homes. Instructions and information from Washington go to her either through the Federal Food Administrator or directly from the Home Conservation Division of the Food Administration in Washington. She usually has a group of her appointees and their committees in the different sections of the State.
3. The Secretary of Volunteer College Students, to make effective use of the college women.

B. The Women's Committee of the Council of National Defense through its chairman of conservation.

In many States this is the same woman as the State Home Economics Director.

C. The United States Department of Agriculture and the State Agricultural Colleges which jointly employ many extension workers.

1. These workers have been in the field for a number of years. After we entered the war, Congress authorized an emergency appro-

I. Chief state agencies in food conservation (*cont'd*).

priation which has enabled them to extend their number and usefulness. Because of the greater age of their organization, it is possible to give more figures on their accomplishments than for some of the other conservation agencies.

2. The organization.
   a. Each State has a Home Demonstration Leader who in many States is also the State Home Economics Director and the Conservation Chairman for the Women's Committee of the Council of National Defense. In the States where these offices are not held by one woman, there is usually close coöperation.
   b. Agents under the direction of the Home Demonstration Leader are assigned to a rural or urban community at the request of a group of people, made either to the Director of Extension Work at the State College or to the Department of Agriculture. Part of the funds must be raised locally by an appropriation from taxes, or by the board of trade or other organizations.
   c. The work is nationally administered in two sections, north and west, and south. The Southern States, where the work was started, have over a thousand agents and they are considered the greatest single educational force in the South. The first Home Demonstration Agent in the North and West was appointed in the fall of 1914. There are now over 600 agents and leaders and the work is making great strides.
3. Scope of work.
   a. It is now directly connected with food conservation, but includes also all phases of home work.
   b. The agent is often responsible for the organization of her community and the development of its work.

I. Chief state agencies in food conservation (*cont'd*).

c. Canning, garden, and poultry clubs are some of the most important phases of the work. In the Southern States the canning clubs had a membership in 1917 of almost 62,000 girls. Besides canning, each girl cultivates a tenth of an acre garden. There are almost 4000 home demonstration clubs for women and 3000 women are members of poultry clubs. All the clubs use the same mark on their products — the "4H."

d. In order to extend her service the Home Demonstration Agent trains volunteer assistants which help in giving demonstrations for the conservation of specific foods. This volunteer work offers an opportunity for college women to supplement the work of the paid agents of the Government. In Toledo, Ohio, for example, there were thirty-four of these trained volunteer workers.

D. Public and private schools, colleges, universities, and normal schools.

These have done much in food conservation through their own teaching and through the public work of the faculty and students.

1. This college course was given during the winter and spring of 1918 in over 700 colleges and normal schools, the students in the courses numbering about 40,000. In other colleges the material was incorporated in courses which had already been planned. Courses were also given in the summer schools.
2. To those who satisfactorily completed their work a certificate was awarded by the Food Administration.
3. In order to use these students and other college women to best advantage, a State Sec-

I. Chief state agencies in food conservation (*cont'd*).

retary of Volunteer College Workers was appointed in 1918 at the end of the academic year to direct their work. Each student was asked to sign up for volunteer work and her name was then sent to the Secretary of her State. The records of the number of girls and their work are not yet complete, but there are an average of 300 girls working in each State. (One State has over 1100 volunteers.) They have been organizing and assisting in canning and drying clubs, in exhibits and demonstrations. They have also rendered valuable clerical help in the offices of the Food Administration in their localities, have written for the newspapers, and have given talks on food. These are only a few of the varied kinds of service which they have given to the Food Administrators and their staffs as well as the State Demonstration Agents and the Children's Bureau in its baby-saving campaign.

E. Innumerable private agencies — churches, fraternal organizations, newspapers and magazines, women's clubs, farmers' societies, public-spirited business houses.

F. The Community Council.

Many localities, at the suggestion of President Wilson and the Council of National Defense, are unifying all their war efforts, including food conservation, by bringing all the citizens and the war organizations together into a Community Council.

II. The subjects being emphasized throughout the community are:

A. Wheat saving and the use of wheat substitutes.

B. Meat, fat, and sugar saving and the use of their substitutes.

C. Canning and drying.

D. Use of foods of which there is an abundance, and of perishable foods.

E. Adequate diet and increased knowledge of food.

F. Increased production and gardens.

In general the idea has been to make every man, woman, and child in the country understand the need for food conservation, to teach them how to conserve, and how actually to make the necessary effort and sacrifice.

III. Methods used to promote food conservation.

These are many, varying with different parts of the country, and among different kinds of people, urban and rural, rich and poor, more and less educated. The following statement gives some of the more conspicuous and successful undertakings. They represent types of the work in which the student should be ready to help.

A. Education through newspapers and magazines.

It is hardly an exaggeration to say that every reading family in the United States is reached by Food Administration news.

1. Every State has an Educational Director. News is sent from Washington to him, and he adapts it to his locality and relays it to the publications of his State.

III. Methods to promote food conservation (*continued*).

2. The Home Economics Director and others also work up much material of local interest. In this the women of the State have a large part.
3. The women coöperate with the local newspaper editor, giving him up-to-date local news items, making him a member of any community publicity committee, obtaining space from the local advertisers through the advertising man on the newspaper and the board of trade, encouraging the women to send in recipes and getting them published. There is much work to be done.

B. Posters.

These have a penetrating effect that comes from no other form of publicity.

1. The familiar ones from the Food Administration and the new ones constantly being brought out, can be obtained from the Federal Food Administrator in each State. Some of the best artists in the country have contributed posters and the result is a series of unusual power.
2. Many localities have produced special posters of their own. Valuable educational work, both for the children and for the community, are the poster contests which have been held by art departments in numerous schools. Street cars, local sign painters, and retail stores are usually ready to coöperate if their help is asked. Boy Scouts are usually avail-

III. Methods to promote food conservation (*continued*).

able for placing the posters out of doors or for distributing material from house to house.

3. If a special campaign is on, spectacular devices are valuable to show its progress. A thermometer, or a clock showing the daily progress, set in the most crowded four corners, a large outlined star, which can be filled with color section by section, a gigantic sack or sheaf of wheat in outline, which slowly takes color as the campaign progresses will give the necessary stimulation to the movement.

C. Distribution of literature.

Huge quantities have been distributed all over the country through many agencies including all public libraries.

1. To get the greatest possible effectiveness:
   a. Choose all paths of distribution carefully.
   b. Choose your literature to suit the people, the locality, market, and conditions. Don't give out bulletins exploiting unobtainable fish, or recipes for quick breads calling for wheat substitutes which are not on the market, or recipes calling for expensive ingredients.
   c. Distribute leaflets wherever possible in connection with demonstrations. Give the audience the printed recipes of foods prepared in its presence. The spoken explanation makes the printed leaflet more effective.

III. Methods to promote food conservation (*continued*).

2. The sources of distribution of the Food Administration literature in every State are the Federal Administrator and his staff.

3. Some publications of the United States Food Administration.

   a. Bulletins issued from time to time dealing with the broad phases of the subject. These are not meant for general distribution, but may be found at all libraries and are valuable to speakers. Numbers 1 to 15 have been issued.

   b. Rules and regulations governing various industries, such as the baking industry.

   c. A large number of publications giving directions to the housewife. They have been most widely distributed and students should be familiar with them. Some of the material is purely ephemeral, as it fits a temporary condition like the severe wheat shortage of last spring and summer, and the potato surplus, but it is none the less important.

      (1) Some of the wheat-saving material: *Until the Next Harvest, Wheat-Saving Program for the Household, Wheatless Recipes.* Many "tested recipes" for wheatless quick breads, desserts, potato dishes, printed simply on slips of paper.

      (2) United States Food Leaflets: published by the Department of Agriculture and the Food Administration jointly. Twenty of these have been published. They have been printed in large editions, some of them, especially the corn meal, oat meal, and milk leaflets, running up to millions. The Massachusetts Food Administrator had the first of these leaflets translated into ten or more languages for the foreign population — Yiddish, Finnish, Lithuanian, French, Swedish Polish, Italian, Syrian, Armenian, Portuguese. They are printed both in the foreign language and in English. The translations have been

III. Methods to promote food conservation (*continued*).

printed in foreign newspapers, distributed in factories, churches, and at all kinds of meetings.

(3) The *Ten Lessons in Food Conservation*, the first of the home conservation publications, designed especially for teachers, is now out of print. *War Economy in Food*, directions for the housekeeper, with a statement of the food situation at the end of 1917, wheatless and meatless menus and recipes, is also almost exhausted. Much of it has been reprinted in other forms.

d. Miscellaneous publications to appeal to the general public, as well as to the housewife. *Until the Next Harvest* in the wheat-saving campaign is of this important character, and also the statements on dining-car and hotel menus.

e. The College Courses — Food and the War.

f. The Food Guide for Home Service.

4. The Day's Food in War and Peace. A series of lessons on food suitable for women's clubs.

5. Publications of the Department of Agriculture.

These have long been the mainstay of the teacher of foods and the housekeeper. Many have been referred to in this book. Among the most recent ones, beside the United States Food Leaflets, are circulars on *Use Potatoes*, *Use Peanut Flour*, *Use Barley — Save Wheat*, *Cottage Cheese Dishes*. These are Department of Agriculture, Office of the Secretary, Circulars Nos. 106, 110, 111, and 109 respectively.

6. Publications of the different States.

State universities, State agricultural colleges, and conservation committees all over the country have published much valuable material. The use of foods abundant in the locality is taught, for example, in Colorado's pinto bean supplement to the United States Food Leaflet on *Dried Beans and Peas*, the Illinois bulletins on local fish, *New Mexico Products in the Family Dietary*, and many others. All food conservation workers should, of course be thoroughly familiar with their state literature.

III. Methods to promote food conservation (*continued*).

D. Libraries.

It is estimated that there are 18,000 libraries in the United States, one for every 6000 inhabitants.

1. A Library Director is on the staff of the Federal Food Administrator. He sees that libraries are equipped with books, pamphlets, and maps on the food situation; that they have food bulletin boards with up-to-date information; and that they encourage the use of library auditoriums for lectures and food demonstrations.
2. A bulletin, *Food News Notes for Public Libraries*, is sent monthly from the Washington Office to over 8000 libraries.
3. The librarians are coöperating with schools, women's clubs, and other organizations in putting on exhibits and other forms of food propaganda. In Boston, for example, most of the women's organizations are coöperating, including such varied groups as the Massachusetts Normal Art School, the suffrage and the anti-suffrage organizations, the Women's City Club, and the Municipal League.

E. Exhibits.

1. Patriotic food shows. The first food show different from the cut-and-dried commercial type was held in Chicago in January, 1918. It was essentially a patriotic endeavor to reach and to teach Chicago's two million inhabitants "what to eat" in war-time and

III. Methods to promote food conservation (*continued*).

"how to cook it." The several colleges and universities took entire charge of all demonstrations. St. Louis, Boston, and other cities since have held somewhat similar shows.

2. Fairs and expositions. At many of the state and county fairs much space has been devoted to food conservation. Some have had exhibits, others demonstrations, and many have had both. The value of this work lies in the large number of people reached who are not touched by the ordinary methods of publicity.
3. Miscellaneous organizations. A multitude of local organizations throughout the country have held food exhibits almost continuously during the past year.
4. A few essentials to an exhibit. Select the material carefully — do not allow extraneous matter to creep in; label everything fully and neatly; arrange the various units so that a glance will show where each belongs; do not overcrowd the material — it is better to leave out some of the less important; have the exhibits where they can be easily seen by all: if possible have a definite beginning and ending. Make the exhibit clear and simple.

F. Classes, demonstrations, speeches: essential methods of teaching food conservation extensively developed in many parts of the country.

1. The public schools have taught food conservation. They have used the United States

III. Methods to promote food conservation (*continued*).

Food Leaflets or books and pamphlets of their own.[1] Some schools have presented most effective plays and pageants.

2. Classes outside of schools.

   a. Schools of country supervisors to teach the use of wheat substitutes for their region.

   b. Well-organized classes of different groups of women, with some of the courses planned by the state agricultural college or the Home Economics Director. Some of these courses, according to the reports, are based on the college courses, simplified. Arizona, for example, gave courses in 40 counties; Missouri, in every county. St. Louis had 53 Food Substitute Cookery Schools in March and April, with 8000 women per week in attendance. Innumerable other instances might be cited, and also many places where the work needs to be developed. Get the help of the Home Demonstration Agents and the Home Economics Teachers. Ask churches, clubs, fraternal societies, and other organizations to coöperate.

3. Lectures and demonstrations innumerable, many of them of great effectiveness. See the Laboratory Manual, section VIII, for instruction on giving demonstrations.

[1] See *Our Country's Call to Service*, by J. W. Studebaker, of Des Moines, published by Scott, Foresman & Company, and the arithmetic, *Food Problems*, by Farmer and Huntington, published by Ginn & Company.

III. Methods to promote food conservation (*continued*).

G. Personal work of Food Administration or Home Demonstration Agents.

This may be very extensive and may range from house to house visits, to advice given in the office on the use of the substitute cereals, wise purchasing, canning and drying, and general instructions of the Food Administration. It is a most important work and one needing well-trained women.

H. Bureaus of information in various cities to answer the constant stream of queries.

Boston, for example, has a Food Facts Bureau with which twenty-six organizations are allied. It assembles and displays printed material on food and facilitates distribution. It has a force of expert volunteers to validate information given out and issues a bulletin called *Food Facts*.[1]

I. Educational work by retail stores.

1. Many of the retailers have been a great educational force for food conservation. They have "played the game," not only in their trade practices, but by advertising food conservation in their newspaper space, on their wagons and in their window displays, by distributing leaflets and by giving demonstrations in their stores. One organization of 400 chain stores which sell food gave a series of window displays in all their stores for six weeks. Upwards of 12,000 other retail mer-

[1] The Food Facts Bureau, of Boston *Journal of Home Economics*, 9, 451. 1917.

III. Methods to promote food conservation (*continued*).

chants have donated a large amount of space on the front page of their catalogues or fashion sheets.

2. Copy for advertising and many suggestions are sent out by the Food Administration to the State Merchant Representatives, from whom they may be obtained.
3. The women of many communities are encouraging this work and urging it upon their merchants.

J. Community canning kitchens.

"Last year community canning kitchens sprang up all over the country. . . . This year the impetus for canning kitchens has increased a hundred fold. This impetus should be wisely guided, and directed, so that the work of these kitchens will be sound and effective. If they are hurriedly, flimsily organized, and inefficiently operated, they merely contribute to confusion and ultimate waste instead of conserving food and labor." [1]

1. Extent of the movement in 1917. No general statement is possible; these examples are merely indicative of what can be done. It is probably true that most States have had at least one, and some many, of these kitchens.
2. Some examples.

   a. North Carolina had 142, besides the usual canning clubs in the country. One cotton

[1] Report of New York State Federal Food Board, 1918.

III. Methods to promote food conservation (*continued*).

mill established a big dryer as well as a steam-pressure canner for the women.

b. New York reports that more than 100 were established; Westchester County had 18, putting up 30,000 quarts of food. During the spring of 1918 the New York State Federal Food Board prepared a mimeographed statement, *Preliminary Material on Community Kitchens*. Much of the same material is given in *The Country Gentleman* of April 13, 1918. This section quotes largely from these two papers.

c. The New York City Canning and Drying Kitchen was undertaken primarily to salvage the food wasted at the wharves and terminals, where a case containing a small percentage of spoiled or imperfect fruit or vegetable is often discarded because it does not pay to re-sort it.

(1) A well-equipped school kitchen and a truck were loaned by the city. The organization consisted of a manager, two canning experts, a bookkeeper, and five unskilled workers, as well as from 30 to 40 volunteer helpers a day.

(2) Some of their accomplishments. The food was first sorted, and some was sold to the poor. The rest was dried, canned, or salted. On one typical day, 33 barrels of squash, 1000 pounds of apples, 150 pounds of grapefruit, 1200

III. Methods to promote food conservation (*continued*).

pounds of cabbage, and 300 pounds of turnips, were transported from the piers to the kitchens. An average of 3000 pounds of potatoes was sold daily to the poor at one cent a pound. A total of more than 8000 quarts of vegetables and fruit were put up. In all, 10 tons of food, which would have been dumped into the river, were saved.[1]

d. Springfield, Massachusetts, maintained a great canning demonstration tent in Court Square in the busiest part of the city, where lessons in canning were given morning and afternoon.

e. Many other cities and villages had successful enterprises.

f. In rural regions, community canneries close to extensive vegetable gardens and orchards have accomplished a great saving both of food and of transportation. In a fertile region in Idaho, six miles from the railroad, the county commissioners equipped a cannery at a cost of $600 and the County Farm Bureau operates it at cost. Forty-two thousand quarts of perishables were canned. In the winter, beef, mutton, pork, and chicken were canned — 5000 quarts had been canned at the time the report was made.

[1] Descriptions of this enterprise are given in the *Forecast* of September, 1917, and the *New Republic* of August 11, 1917.

III. Methods to promote food conservation (*continued*).

3. Important points for a successful community kitchen.

a. A careful preliminary survey. Know the need and the prospects of success before starting. Determine—

(1) The amount of material there is likely to be available for canning.

(2) The number of families who will wish to can for themselves or to have material canned in the kitchen, and how much each will require.

(3) The amount of canned products still on hand from last year.

(4) The number of glass jars available.

(5) The local tin can situation.

(6) The canning situation in the local canneries.

(7) If volunteer labor is to be depended upon, how many skilled workers can be found to pledge themselves for a definite number of hours a week in the kitchen.

b. The direction and constant supervision of a thoroughly trained person. Last year's experience proves that a paid supervisor is an economy in the end. There is much risk of spoilage through unscientific or careless methods of canning, and much opportunity for inefficient management of the plant.

c. Good organization.

(1) Canneries may be started by many different organizations in the community, singly or combined — the Food Administration Committee, a school, a woman's club, the Girl Scouts.

(2) There must be a chairman with committees under her on such matters as location, finance, equipment, supplies, kitchen management, and the disposal of the finished product.

d. Wise location. It should be centrally located, preferably conspicuous because of its educational value,

III. Methods to promote food conservation (*continued*).

and in a room already equipped with water and heat like a school or church kitchen.

e. Modern equipment.

(1) While the simplest home equipment and oil stoves can be made to serve if the enterprise is on a very small scale, usually a pressure canner of adequate size, and the best labor-saving devices will ultimately save money, time, labor, and material.

(2) The Government estimate of the cost of a complete community canning outfit is $300 to $600. That means modern equipment — an adequate canner, slicers, paring-machines, seeders, canners, sealers — capable of turning out several thousand quarts a day. Two or more neighboring communities might share the expense of this equipment.

f. Sound financing.

(1) Kitchens last year ranged in financial success from one which put up 300 cans at a cost of $500 to those in which an initial loan was repaid with interest and a sinking fund put away for the next year.

(2) It is essential to have some working capital to begin with. This may be borrowed, given by individuals or organizations, or collected as a membership fee from those wishing to use the kitchen.

(3) The current expenses may be met by charging either for the canning done for others by the kitchen, or by a small fee per quart for the use of the kitchen by those doing their own canning. Instead of payments in money, a percentage of the cans may be given to the kitchen and sold by it.

4. Some advantages of community over home canning.

III. Methods to promote food conservation (*continued*).

a. Greater chance of good products and less chance of spoilage because of the expert supervision and the better equipment.

b. Saving of money through purchasing jars, etc., in large quantities, buying large machines instead of several small ones, and saving of labor.

c. Marked educational influence, stimulating people to can at home as well as at the kitchen.

d. Great democratizing and socializing influence.

K. Other community kitchens.

1. Wheat-saving kitchens. They are chiefly demonstration kitchens, to serve the important purpose of teaching people how to use the wheat substitutes. Some of these sell small loaves of bread and other products.

2. Kitchens for the general sale of cooked food. (See chapter XV.)

L. The greatest factor of all in food conservation — the daily work and sacrifice of the individual woman in her home. In discussing all this machinery, we must not forget that its ultimate purpose is to reach every one and that it is the daily service of all of us that has made possible the successful carrying out of the food conservation program.

PART II

A LABORATORY MANUAL

OF

FOOD SELECTION, PREPARATION AND CONSERVATION

ELIZABETH C. SPRAGUE

INTRODUCTORY STATEMENT

This laboratory outline is designed for the use of college students, who do not intend to specialize in Home Economics, but who desire general training in the subject of food preparation. The course is elastic so that it may be adapted to the requirements of various types of institutions and of classes.

By careful planning and judicious selection of material the essential points may be covered in thirty-two two-hour laboratory periods, or two periods per week for one semester. It will be found profitable, however, to extend this to forty-eight periods, which may be divided into either three periods of two hours each or two periods of three hours each per week. The latter is a more economical use of time. In either case ample time should be allowed for a thorough discussion of results, in order to fix the principles firmly in the student's mind.

The work is planned to encourage scientific habits of thinking regarding food problems as well as to equip the student with a usable fund of information. As much technical skill as possible should also be acquired, but the fact that real facility can only be acquired by considerable practice should be emphasized. This necessary repetition may be made a requirement for outside work.

For the sake of clearness, the manual has been arranged in outline form; for brevity, as many details have been omitted as was thought wise. A few typical recipes have been included where they seemed necessary. In general such material has been omitted for two reasons; first, to make the emphasis upon the development of principles more evident; second, because there already exists a bewildering mass of recipes. It is hoped that the student may be taught to see that these are simply variations from a few type recipes. Mastery of the principles involved in these type recipes frees one from dependence upon innumerable formal recipes.

While it is intended that the laboratory work shall be given in connection with Part I, the plan of development is not identical in the two parts. For example, eggs are used in the laboratory to introduce the subject of the cooking of protein foods, leading up to meat, fish, and poultry. In the first part, the discussion begins with meat, and eggs are treated as a meat substitute. It is believed that these two courses may be correlated without much difficulty. Since the point of view is different in the two parts, repetition at intervals may be an advantage. Change in sequence will be possible, however, at the discretion of the instructor.

Since intelligent conservation methods must be based on a knowledge of normal methods, they have been introduced as part of the whole subject rather than in special sections. The limitations of a short course seemed to justify the elimination of certain subjects, such as frying, which should not be encouraged at present.

Throughout the course the conservation features should be strongly emphasized, but these must be modified as the regulations of the Food Administration change with changing conditions.

A LABORATORY MANUAL

SECTION I

FOOD CONSUMPTION AND FOOD VALUES

I. Rations and food allowances.

A. Purpose: To visualize in terms of actual food materials the amounts of food which are being consumed by different groups at the present time, in order to furnish a basis for understanding systems of rationing.

B. Weigh out and assemble the amounts of the materials in each ration given below. Become familiar with these quantities in some practical unit of measure, either weight or volume or dimension. Show how the average American ration may be apportioned in three daily meals.

1. Belgian daily ration.[1]

	oz.		oz.
War bread	12	Bacon (about)	1
Potatoes	10 1/2	Lard (about)	2/3
Rice	2 1/8	Brown sugar (about)	2/3
Cerealine	1 2/3	Peas and beans, (dried)	1 2/3

(Many Belgians have lived on this ration almost exclusively for three years.)

[1] Distributed by the Commission for Relief in Belgium. Kellogg, *Fighting Starvation in Belgium*, pp. 160–166. Doubleday Page, 1918.

I. Rations and food allowances (*continued*).

2. Average American dietary (per day).

a. With limited resources:

	oz.		oz.
Bread	12	Meat, eggs, and cheese	6
Cereals	8	Sugar	1 1/2
Potatoes	12	Fats	1 1/2
Fruits and vegetables	12	Milk	8

b. With moderate resources.

	oz.		oz.
Bread	6	Meat, eggs, and cheese	14
Cereals	4	Sugar	3
Potatoes	12	Fat	3
Fruit and vegetables	28	Milk	8

(See section VI, Adequate Diet.)

c. As outside work, make an approximate estimate of the average amounts of food used per person per week, in the student's family or group. Tabulate the results. (See page 289.)

Great care should be taken to secure accurate data so that this material may be used later to calculate the food value of the dietary.

II. The proximate composition of food.

A. Illustrate the proximate composition of food by a separation of the constituents of milk. The characteristics of these constituents should also be noted. (This may be performed as a lecture demonstration if laboratory facilities or time is limited.)

1. Apparatus needed — 100 c.c. graduate, funnel

ESTIMATION OF FOOD USED PER WEEK

Kind of food (as purchased)	*Total amounts used in group*		*Number persons in group*	*Average amounts per person*	
	Measure	*Weight*		*Measure*	*Weight*
a. Foods subject to regulation according to military necessity					
Meat — Beef, veal, lamb, mutton or pork..	....	....	....	....	....
Wheat — as baked products, cake, pie.	....	....	....	....	....
— as flour in cooking sauces, soups, etc......	....	....	....	....	....
— as macaroni, spaghetti, breakfast foods	....	....	....	....	....
Fat — especially animal fat	....	....	....	....	....
Sugar..................	....	....	....	....	....
b. Foods, the use of which is unrestricted					
Milk....................	....	....	....	....	....
Cereals other than wheat	....	....	....	....	....
Meat substitutes (animal)					
Fish	....	....	....	....	....
Poultry................	....	....	....	....	....
Eggs..................	....	....	....	....	....
Cheese................	....	....	....	....	....
Fruits..................	....	....	....	....	....
Sweets, honey, corn sirup.	....	....	....	....	....
Vegetables..............	....	....	....	....	....

II. The proximate composition of food (*continued*).

and filter paper, 2/500 c.c. beakers, a stirring rod, crucible or old aluminum pan in which to

II. The proximate composition of food (*continued*).

burn the residue in *a*, and a watch glass or saucer on which to evaporate *d*.

a. To 50 c.c. of milk add 200 c.c. of water, and to this mixture add 10% acetic acid, drop by drop until no further precipitate forms. (NOTE: An excess of acid will prevent complete precipitation.) Filter. Save both precipitate and filtrate. Wash the precipitate on the filter paper, first with a little alcohol, and then with ether. (Carbon tetrachloride may be used instead of ether, which is highly inflammable and should be used with great care.) Dry. This is the casein of milk.

b. Evaporate on a water bath the ether solution. The residue is fat.

c. Boil the filtrate saved in *a* until reduced to one-third its original volume. Filter and preserve both filtrate and residue. The latter is the albumen of milk.

d. Evaporate the filtrate from *c* to dryness, being careful not to char it. This is the sugar of milk (lactose) and the mineral salts.

e. Char the residue from *d* until no further change occurs. The residue is the mineral matter or ash of milk.

2. At the discretion of the instructor qualitative tests as given in any *Food Chemistry* may be applied to the above substances isolated from the milk.

II. The proximate composition of food (*continued*).

3. A graphic method of representing the composition of milk is often useful. A series of carefully labelled bottles of graduated size may be arranged to contain the food constituents separated from a pint or a quart of milk.

B. The percentage composition of foods.

1. Using the food portions weighed out in I, B, on page 287, arrange in groups as follows, those having a high water content, i.e., dilute foods; a low water content, i.e., concentrated foods; those rich in fat; in carbohydrate; in protein; in ash.
2. Note those which may be classed in more than one group.
3. Refer to tables in any standard text giving the percentage composition of foods; or to U.S. Department of Agriculture, Bulletin 28, *The Chemical Composition of American Food Materials.*

III. The fuel value of foods.

A. Show the amounts of various foods which are equal in fuel.

1. The 100-calorie portion.

a. Apparatus — Scales; Harvard trip-scale type is desirable, using either gram or ounce weights. Scales of the spring-balance type should be avoided unless they have been carefully tested for accuracy. There should be one pair of scales for each two students,

III. The fuel value of foods (*continued*).

if possible, but the number may be reduced to one for four students if conditions demand. This laboratory exercise may be performed as a class demonstration if only a limited number of scales are available.

b. Weigh out 100-calorie portions of foods chosen from the groups below. The number of these portions which can be studied must be determined by the size of the class and the laboratory conditions, but representative foods from each group should be included. (For data refer to tables in Rose, *Feeding the Family*, or other texts.) Students should compute the weight in several instances in order to understand the method of calculation. The student should become familiar with these amounts in order to be able to estimate roughly the fuel value of the food consumed in a day.

Beverages — cocoa; tea and coffee with varying amounts of cream and sugar.

Breadstuffs — especially various types of war breads, — with and without butter.

Cereals — uncooked, cooked, ready-to-serve.

Dairy products — milk, whole, skimmed, condensed; cream, thin (18% fat), thick (40% fat); butter; cheese; eggs.

Desserts — puddings; pie; custard; cake; cookies.

III. The fuel value of foods (*continued*).

Fruits — fresh, dried, cooked; canned; preserves; jelly.

Meats — including fish and poultry. Bacon before and after cooking is especially interesting.

Nuts — in the shell, shelled.

Salads — fruit; vegetable and meat; salad oils and dressings.

Soups — meat, cream of vegetable.

Sweets — sugar, granulated and lump; sirups; chocolate; candy.

Vegetables — watery, starchy; legumes, fresh, canned and dried.

c. Arrange the above portions in the form of an exhibit, attaching clear and uniform labels giving the weights and some descriptive measure for each food. Group the portions in such ways as to bring out suggestive comparisons.

d. Keep a record in terms of 100-calorie portions of all food eaten for a period of 1, 2, or 3 days.

2. Comparison of the fuel value of typical foods using 1 quart of milk (or 1 pint) as a basis.

In non-technical classes and for public exhibitions this method of comparison often seems more graphic and may be used in place of the exercise on the 100-calorie portion, or as a supplement to it.

Calculate the amounts of the typical foods listed in 1, which will be required to furnish

III. The fuel value of foods (*continued*).

the same amount of heat as 1 quart (or 1 pint, if preferred) of whole milk.[1]

Assemble as an exhibit as in 1 above.

IV. The protein value of foods.

A. Purpose.

1. To determine the amounts of various foods which may furnish the protein of the day's ration.
2. To compare these as to cost and availability.

B. Assemble the following quantities of food which yield approximately one-half ounce of protein:

2 eggs
1 pint of milk
2 oz. cottage cheese
2 oz. ordinary American cheese
2 oz. dried fish
2 1/2 oz. lean meat or fish
2 1/2 oz. beans (dried), about 1 1/2 cups cooked
3 oz. oatmeal (raw), about 3 cups cooked
4 oz. macaroni (uncooked)
5 1/2 oz. bread
2 oz. peanuts

1. Record some descriptive measure of the quantities; e.g., the number of one-half-inch slices of bread, the size of the piece of cheese, etc.
2. Make a number of combinations of the protein units so that each group will furnish the

[1] See Rose, M.S, *Laboratory Handbook for Dietetics*, pp. 52–53. Macmillan, 191?.

IV. The protein value of foods (*continued*).

supply of protein adequate for an adult for 1 day.

3. Compare these combinations as to —
   a. Availability under war-time conditions.
   b. Conformity to dietetic principles.
   c. Cost.

C. Using the units given above, keep a record of your own protein consumption for 1, 2, or 3 days and judge as above.

SECTION II

PRINCIPLES OF COOKING

TYPICAL illustrations of the general laws underlying the application of heat to food materials, alone and in combination.

I. Effect of heat on food materials.

A. Change in weight.

1. To show the difference in bulk and weight between food materials as purchased and as consumed.
2. To learn the weights of certain measures of food.

In the following exercise, emphasize the relation between the uncooked and the cooked food in measure and in weight so that the student will learn to translate rations, which are given in amounts of food "as purchased," into terms of the food as consumed.

I. Effect of heat on food materials (*continued*).

1. Expansion of foods.

a. Cereals.

Cook the cereals as indicated below, weighing and measuring before and after cooking.

(1) Cook 1/4 cup rice in 1 1/2 cups boiling salted water (1/4 teaspoon salt) for 25 minutes, or until the grains are softened. Stir occasionally with a fork while cooking. Drain well and dry as for serving before weighing.

(2) Stir 1/4 cup corn meal into 1 1/2 cups *warm*, salted water (1/4 teaspoon salt) and boil gently for 30 minutes. Stir frequently.

(3) Cook 1/4 cup rolled oats in 1/2 cup boiling salted water (1/8 teaspoon salt) for 5 minutes; continue cooking at a lower temperature, in a double boiler or over an asbestos mat, for 30 minutes.

To avoid danger of burning and to reduce the labor, an asbestos mat or a double boiler may be used in each case. In the latter case the amount of water should be decreased and the length of time increased.

Flavor in cereals such as corn meal and oat meal may be developed by cooking from 1 to 3 hours in a double boiler or in a fireless cooker overnight.

I. Effect of heat on food materials (*continued*).

b. Dried fruits and vegetables.

(1) Weigh a measured quantity of dried fruit or vegetables, soak in water for several hours or overnight. Cook until softened in the water in which they are soaked to avoid loss of food material. (Exception: The water in which some legumes are soaked should be replaced with fresh water before cooking.)

(2) For fruits use twice their volume of water and for vegetables three times their volume of water. If an excess of liquid remains when cooking is completed, concentrate by boiling.

(3) Most fruits will cook in about 20 minutes; vegetables, with the exception of legumes, require 30 to 40 minutes. The legumes need from 2 to 3 hours.

(4) The sugar contained in the dried fruits will form a sirup which in many cases will be sufficiently sweet. If not, sweeten to taste using equal parts of corn sirup and sugar.

Record change in weight and in volume as in *a* above.

2. Contraction of foods.

a. Spinach.

(1) Wash thoroughly 1/4 pound of spinach, remove roots and any other portions not suitable for use; weigh the

I. Effect of heat on food materials (*continued*).

cleaned vegetable and the refuse and calculate the percentage of the latter.

(2) Cook the spinach (if full grown) in its own volume of boiling salted water for 20 to 30 minutes. Half the volume of water may be sufficient. Drain and press out the water. The water should be used in making soup.

(3) Measure and weigh the cooked spinach. Calculate the average number of individual servings that may be obtained from 1 pound of spinach as purchased.

b. Meat.

Determine the change in weight and bulk of a piece of meat cooked for the student's family or group. (Outside work.)

Example: Note the approximate dimensions of a 3-pound roast before and after cooking. Determine the change in weight and estimate the number of individual servings. What is the weight of the individual serving before and after cooking?

The above experiments may be performed individually, in groups of two or four or as class groups or demonstrations, as conditions permit.

B. Change in composition.

1. To what is the change in weight of foods during cooking principally due?

2. How is the composition of the cooked foods affected by cooking?

I. Effect of heat on food materials (*continued*).

3. Compare the composition and nutritive value of rice, before and after cooking, with that of the edible portions of potatoes before and after boiling.

II. Effect of heat on food constituents.

A. Protein.

1. Types.

a. Soluble in cold water, coagulated by heat; example, egg albumen.

(1) Solubility — Cut a raw egg white with scissors; dilute a portion with 10 times its volume of water, shake thoroughly, and filter. Boil a portion of the filtrate. What is shown with regard to the solubility of albumen in water?

(2) Coagulability.

(a) Fill a test tube 1/3 full of egg white; suspend the test tube in cold water so that the surface of the egg is below the surface of the water. Place a thermometer in the tube and heat the water slowly. Note the temperature at which the coagulum is first apparent; the temperature at which the whole mass is coagulated; the consistency when the water reaches the boiling point; the consistency after boiling several minutes.

(b) Drop 1 teaspoon of egg white into

II. Effect of heat on food constituents (*continued*).

a bath of smoking hot fat. Observe great care to avoid the spattering of the fat. Note character of coagulum and explain the phenomenon.

b. Insoluble in cold water, hardened and contracted by heat; example, casein of cheese.

(1) Heat a teaspoon of grated cheese with a tablespoon of milk in a test tube, stirring with a thermometer until they blend, noting the temperature at which this occurs. Continue heating and notice the succeeding temperatures and changes.

(2) Heat a small piece of cheese in a frying-pan.

(3) What conclusions can be drawn as to the effect of heat upon the various constituents of cheese?

c. Insoluble in cold water, rendered soluble by boiling; example, collagen of connective tissue.

Boil a piece of connective tissue or tendon in water until the liquid gives a test for protein.

d. Soluble in water, not coagulated by heat; example, gelatin.

Soften 1 teaspoon of gelatin in 1 tablespoon of cold water. Heat to boiling in a test tube observing the temperatures at which changes occur.

II. Effect of heat on food constituents (*continued*).

B. Fat.

1. Place equal portions of a solid fat in each of 3 tubes. Insert a thermometer and heat the first to 175° C., the second to 200° C. and the third to 225° C. Note the kind and amount of fumes given off at different temperatures. Cool and compare the color of the samples after they have solidified.
2. Repeat the foregoing, using samples of butter at temperatures of 150° C., 175° C. and 200° C.

C. Carbohydrates.

1. Sugar.

a. Show the weight and volume of sugar that may be completely dissolved in a cup of cold water. To a small portion of the solution apply the Fehling sugar test. (See any *Food Chemistry*.)

b. To the above sugar solution add enough sugar to make the total volume of sugar used equal to 2 cups. Heat slowly and stir until dissolved. Boil without stirring and note changes in temperature. When the sirup begins to boil and at each of the following temperatures (103° C., 105° C., 110° C. and 115° C.) take out 5 c.c. as a sample, place in a test tube and set aside to cool. Test a portion of the last sample with Fehling's solution. At 115° C. test also by dropping a small portion in cold water. Heat to 123° C. and again test in

II. Effect of heat on food constituents (*continued*).

cold water. Reserve this sugar for future use.

Note the thickness of each sirup when hot and when cold, its tendency to crystallize and the kind of crystals formed. Compare their sweetness and thickness with commercial table sirups.

c. Repeat with a similar solution of corn sirup.

d. Caramelize a small portion.

2. Starch.

a. Mix 1 teaspoon of cornstarch and 1/2 cup of cold water and let stand 1/2 hour. Filter and test the filtrate for starch.

b. Mix a teaspoon of cornstarch and 1/2 cup of cold water — heat to 70° C. Let stand several hours.

c. Mix 1 teaspoon of cornstarch and 1/2 cup of water; boil 2 minutes; let stand for several hours. Examine a specimen from each sample under the microscope. What is shown regarding the solubility of starch and the effect of heat upon the starch grain?

d. In a small dish heat carefully with constant stirring, 1 teaspoon of powdered starch. When it is a *uniform* light brown, add water, boil for a minute, and filter. To a portion of the filtrate add twice its volume of alcohol. Test this with iodine.

II. Effect of heat on food constituents (*continued*).

To the rest of the filtrate add a few drops of HCL and boil for a few minutes. Neutralize and test for sugar.

Name several instances of the formation of dextrin in the processes of cooking. When may sugar be formed?

e. Methods of combining starch and a boiling liquid.

(1) Pour 1/4 cup of boiling water over 1 teaspoon of cornstarch.

(2) Add 1 teaspoon of cornstarch to 1/4 cup of boiling water.

(3) Blend 1 teaspoon of cornstarch with 1 teaspoon of sugar, fat or cold liquid. Add to 1/4 cup hot liquid and boil.

Explain the results by reference to the first three parts of this experiment.

III. Principles of cooking combinations of food materials.

From the results in II, formulate directions for cooking the following combinations of food materials giving reasons for each step of the process:

A. Milk, eggs, and sugar in making a custard.

B. Milk, cornstarch, eggs, and sugar in making a custard.

C. Milk, eggs, and cheese in a Welsh rarebit.

D. Milk, fat, flour, and cheese in a Welsh rarebit.

IV. The principles of proportions of food materials in combination.

A. For thickening liquids.

IV. The principles of proportions of food materials in combination (*continued*).

1. With egg. See section III, custards, p. 308.
2. With starches. See sections III and V, sauces, pp. 309, 331.

B. For enriching.

1. With fat. See section III, sauces, p. 309.
2. With egg. See section V, puddings, p. 332, sponge cake, p. 341.
3. With both egg and fat. See section V, butter cakes, p. 341.

C. For consistency (doughs and batters). See section V, muffins and griddle cakes, p. 335.

SECTION III

PREPARATION AND USE OF PROTEIN FOODS

I. Eggs.

A. Grades of eggs.

1. Purpose.
   a. To become familiar with the different market grades of eggs and their desirability for cooking purposes.
   b. To compare their economic value.
2. Collect samples of all the different market grades of eggs locally available. Examine these as follows:
   a. Make the ordinary practical tests for freshness by noting the character of the shell, by shaking and by floating in water and in a 10% salt solution.

I. Eggs (*continued*).

b. In a darkened room candle the eggs used in *a*.[1]

c. Open samples of each variety, observe and describe the physical characteristics of the different parts of each egg.[2] Observe particularly the "two layers" in the white.

d. Test the suitability of the different grades of eggs for cooking purposes by cooking in several ways. Poached eggs, omelets, and sponge cake offer especially severe tests of an egg's quality.

B. Household preservation of eggs.

Preserve as many eggs as may seem practical under local conditions.

1. Select absolutely *fresh*, *clean* eggs. Do not use dirty ones or those that have been washed.

2. *Water glass solution* (potassium or sodium silicate).

   1 pint commercial water glass.
   6 quarts freshly boiled water.

   Stir until the ingredients are thoroughly mixed. Cool before using. This makes a quantity sufficient to preserve from 6 to 8 dozen eggs.

3. Wash and scald thoroughly glass jars, crocks, a keg, or barrel, according to the number to be preserved. The container must have a tight cover.

[1] See Sherman, *Food Products*, p. 144, and U.S. Department of Agriculture, Farmers' Bulletin 471, *Eggs and their Value as Food*, pp. 17 to 24. How do the practical tests compare with candling?

[2] Sherman, *Food Products*, p. 152.

I. Eggs (*continued*).

4. Pack the eggs in layers, pouring the solution of water glass over each layer so that every part of the shells is covered. The top layer of eggs should be about 2 inches below the surface of the liquid. Cover closely and keep in a cool place. Rinse before using.

C. Cooking of eggs.

1. Purpose.
   a. To apply the principles of cooking protein foods using eggs as an example.
   b. To acquire some skill in making egg dishes.
2. Select 3 eggs of equal weight. Place 2 of the 3 in 2 pints of boiling water; cover and remove immediately from the fire. Take out 1 egg at the end of 5 minutes and the other after 7 minutes. Place the other egg in boiling water and boil 3 minutes. Open each egg immediately at the end of the time of cooking and compare.

   What are the standards for properly cooked eggs? Give a correct method for preparing a hard-cooked egg.
3. From the results above and in section II, p. 299, formulate general directions for preparing dishes in which eggs are used for purposes other than for leavening, such as thickening, binding, clarifying and coating (croquettes).

   Note: The results of the experiments on solubility and coagulability will determine the

I. Eggs (*continued*).

temperature at which egg will combine with other materials, e.g., with milk in custards. It will also suggest the temperature of the water into which an egg should be dropped for poaching. The coagulation temperature and the consistency noted in the experiments in section II, II, A, will also explain the use of a double boiler in making soft custards.

4. Apply the principles of cooking illustrated in the foregoing experiments in the preparation of an egg by poaching and in the following types of omelets: [1]

a. Those using only egg, a little liquid, and seasoning.

(1) French omelet.

(2) Foamy omelet (sometimes called plain omelet).

b. Those in which the egg is extended with a thickened sauce using either flour or bread crumbs.

(1) Rich omelet.

(2) Bread omelet.

c. Soufflés. (Note the similarity to rich omelet.) Types suitable for use as meat substitutes.

(1) Cheese soufflé.

(2) Vegetable soufflé.

(3) Fish, chicken, or meat soufflés.

[1] See *Boston Cooking School Cook Book*, pp. 105–108. Mrs. Allen's *Cook Book*, pp. 177–183.

I. Eggs (*continued*).

d. Many variations of the above types are given in standard cook books.

5. Prepare custards, baked and soft, using the following proportions:

Milk	*Egg*	*Sugar or substitutes*	*Salt*	*Flavoring*
1 c.	1/2	1 to 2 tbsp.	Few grains	To taste
1 c.	1	1 " 2 "	" "	" "
1 c.	1 1/2	1 " 2 "	" "	" "

The principles of proportions (2), of methods of combination, and of cooking are the points to be emphasized. The amounts of salt, sugar, and flavoring are matters of taste. If recipes are needed, refer to a standard cook book; e.g., *Boston Cooking School Cook Book*, pp. 377, 307, and 262; Mrs. Allen's *Cook Book*, pp. 173–186; U.S. Food Leaflet No. 8, *Instead of Meat.*

6. Make a table showing the cost of the amount of each of the egg preparations made, which would be necessary to serve 4 adults; to furnish 1/2 ounce of protein; to furnish 100 calories.

II. Milk.

A. Purpose.

1. To emphasize the fact that milk is a food rather than a beverage.

2. To show the many ways in which milk can be used in the diet.

B. Food value and cost of milk beverages.

Compare the quality of the products, and the cost of —

II. Milk (*continued*).

a. Cocoa or chocolate, made with (1) whole milk, (2) half milk and half water.

b. (1) Coffee served with cream.

(2) Café au lait; i.e., strong coffee added to an equal volume of scalded milk or twice the volume, depending upon the strength of the coffee.

For recipes for these beverages see any good cook book. Weigh out the amounts of each which will furnish 100 calories.

C. Milk sauces.

1. Proportions — with 1 cup of liquid.

a. 1, 2, 3, or 4 tablespoons according to the thickness desired.

b. Fat — varies from 1 to 4 tablespoons. 2 tablespoons is the amount most frequently used. It may be reduced to 1 or even 1/2 tablespoon.

c. Salt — 1/4 teaspoon.

d. Pepper — to taste.

2. Methods of making.

a. Blend the starch or flour with enough cold liquid to make a paste, add the remaining liquid and boil. If fat is to be used, add it last.

b. Combine fat and flour in a ball and stir into the hot liquid until it thickens.

c. Melt the fat, add the flour, and, when it is blended, add the liquid gradually and boil.

II. Milk (*continued*).

d. The first method makes it possible to reduce the amount of fat to a minimum and is therefore to be recommended as a wartime economy. For example, 1 teaspoon instead of 1 tablespoon of fat may be used with a tablespoon of flour. For large quantities, where care must be taken to avoid burning, use a double boiler or an asbestos mat. It is an advantage in that case to heat the milk before combining, but this is unnecessary in preparing small amounts. Use the sauces in scalloped and other creamed dishes, in soufflés, and omelets, and with rice and other cereals cooked with milk. Note the improvement in quality, and food value due to the use of milk. (See also classification of sauces, page 33.)

D. Milk soups.

Cream soups are usually thin white sauces flavored with vegetable stock (the water in which vegetables were cooked) or vegetable pulp.

1. As types of cream soups prepare —
   a. Potato soup or cream of pea soup.
   b. Cream of celery or cream of spinach soup.
   c. Cream of tomato soup.
2. Note the difference in the amount of thickening required in *a* and *b*.
3. What new principle of cooking must be considered in *c*?

II. Milk (*continued*).

4. Use a wheat flour substitute for thickening.
5. Weigh out 1/2 ounce protein portions and 100-calorie portions as before.

E. Milk in desserts.

1. Varieties.
   a. Irish moss blanc-mange.
   b. Cornstarch puddings.
   c. Custards, plain and with rice or tapioca.
   d. Baked rice puddings, "creamy rice" or poor man's pudding.
   e. Indian puddings, plain or with tapioca.
   f. Milk sherbets.

   (For recipes see any standard cook book.)
2. Suggestions.
   a. For class preparation, select those varieties which are either less well known, e.g., Irish moss blanc-mange; or those in which a good standard for the finished product is especially important, e.g., creamy rice pudding and Indian puddings.
   b. Note that in making milk sherbets the curdling by acid (lemon or pineapple) is not important as the curd is beaten smooth in freezing. An especially good flavor is produced by using shredded pineapple for part of the lemon juice.
   c. Show that skim milk may be used in almost all of these preparations with little or no alteration of quality.

II. Milk (*continued*).

d. If desired, comparisons may be made also as to the results when evaporated milk is substituted, especially in the beverages and cooked desserts.

III. Cheese.

A. Purpose.

1. To show the many ways of using cheese.
2. To apply further the principles of protein cookery in cheese preparations.

B. Uses of cheese.

1. As a flavoring material, e.g., with soups, vegetables, soufflés, salads, sauces.
2. As one of the chief ingredients in, e.g., Welsh rarebit, rice fondue, hominy and cheese, cheese sandwiches.
3. Because of its concentration and marked flavor, cheese is combined or eaten with a starchy food.

C. Economic value of different varieties of cheese. Collect samples of different types of cheese locally obtainable:

1. Hard cheese, e.g., Cheddar, Swiss, or Edam.
2. Soft cheese, e. g., Brie, Neufchatel or cream, Camembert.
3. Very soft, e. g., cottage cheese.

D. Which of these are suitable for use as flavor ingredients only and which may be used as meat substitutes? Why? [1]

[1] For chemical composition see Sherman, *Food Products*.

III. Cheese (*continued*).

E. Select recipes and prepare dishes to illustrate the different uses of cheese.[1]

1. With soup.
2. As a meat substitute.
3. As a salad.
4. As a dessert.
5. As a garnish or relish.

F. To apply the principles illustrated previously, each student should prepare one or more of the following dishes. (These will give an opportunity for the development of technique. The products should be judged for appearance and palatability as well as for the condition of the protein material.)

1. Toasted cheese sandwiches.
2. Cheese fondue.[2]
3. Welsh rarebit (custard foundation).

G. Modification of cheese recipes to meet war conditions.

To avoid the use of wheat products:

a. Instead of macaroni and cheese, use whole hominy or rice.

b. In Welsh rarebit, use a cheese recipe thickened with egg rather than with flour. Add tapioca or rice to the rarebit to avoid using toast or crackers.

[1] See U.S. Department of Agriculture, Bulletin 487, *Cheese and its Economical Uses in the Diet.*

[3] *Boston Cooking School Cook Book*, p. 377.

III. Cheese (*continued*).

Baked Rarebit

2 tablespoons small tapioca	1/2 teaspoon salt
1 pint milk	1 teaspoon mustard
1 egg well beaten	1 cup grated cheese

Pepper or paprika to taste

Put all the ingredients into a baking dish and cook in the oven until quite thick, stirring occasionally.

H. Weigh out the amounts of cheese and of some of the prepared cheese dishes which will furnish (1) 1/2 ounce of protein and (2) 100 calories.

I. Cottage cheese making.

An application of the principles of protein cooking. To be done in groups of two or more.

1. Note the appearance of 1 cup of thick sour milk and test for acid.
2. Pour 1 cup of boiling water on 1 cup of thick sour milk.
3. Heat 1 cup of thick sour milk over warm water to 60° C. Strain through cheesecloth.
4. Arrange to have one group reserve 1/4 cup of sour milk. Heat this to boiling and strain through cheesecloth. Compare the curd of 3 with those of 1 and 2. Season for cottage cheese. List the possible ways of serving cottage cheese.
5. Note the volume and weight, in terms of household measures, of cheese obtained from 1 cup of milk and calculate the yield from 1

III. Cheese (*continued*).

quart of milk. Estimate the cost and fuel value. What is the volume of 1 pound of the cheese? Compare the cost of the commercial product with that of the cottage cheese made at home.

J. Use of cottage cheese.

Prepare some of the dishes for which recipes are given in U.S. Department of Agriculture, Bulletin 109, *Cottage Cheese Dishes*.

IV. Meat.

A. Purpose.

1. To illustrate some of the principles involved and the methods used in cooking meat.
2. To compare the economical and nutritive value of different cuts of meat.
3. To show the methods of separating fat from animal tissue.

B. In connection with this lesson, study by means of charts and illustrations in standard textbooks the following points:

1. Skeletal structure of beef, as a basis for the division of the carcass into both wholesale and retail cuts. (Note the similarity between mutton and pork. The smaller size of these animals is the only reason for the smaller number of cuts.)[1]
2. Muscular structure of beef —
   a. Gross structure — arrangement of muscles in the carcass.[2]

[1] Maria Parloa, *Home Economics*, p. 169. [2] *Ibid.*, p. 177.

IV. Meat (*continued*).

b. Microscopic structure — muscle fibers, etc.

3. Wholesale and retail cuts of beef, mutton, lamb, veal, pork. Through visits to the markets and by study of charts and illustrations, students should become familiar with the names, the characteristics, and the cost of the chief types of meats in the form of the cuts used in the household.

C. Relative economy of different cuts.

As preparation for this lesson, students should list the local retail prices of typical cuts of the different kinds of meat.

1. Using the form given below, collect and tabulate the data necessary to give a good general idea of the amounts of expensive and economical cuts of meats which will —

a. Serve 4 adults (or 6, or some other suitable number).
b. Furnish 100 calories.
c. Furnish 1/2 ounce protein.

2. Suggested comparisons.

a. Tenderloin steak.
Skirt, i.e., flank steak.
Porterhouse steak.
Round steak.

b. Rib roast.
Rump pot roast.
Chuck rib roast.

c. Lamb cutlets (round).
Lamb chops (rib).
Lamb chops (loin).

IV. Meat (*continued*).

3. Comparison of cost of different cuts of meat.

Kind and cut of meat	*Price per pound*	*Amount required to serve four adults*		*Half-ounce protein portion*		*100-calories portion*	
		Weight	*Cost*	*Weight*	*Cost*	*Weight*	*Cost*

Compare the amount of fat, lean, and bone in each cut.[1] Note especially the possible "kitchen" waste and "table" waste of fat. Much of this information may be secured in the homes. Include in the tabulation also such data as may be secured in the laboratory in the meat lessons.

D. Principles of cooking meat.

1. Constituents chiefly affected by heat.

a. The water evaporates.

b. Protein.

(1) Albumen coagulates.

(2) Myosin and protein of connecting tissue shrink and contract.

(3) Hemoglobin coagulates and changes color.

c. The fat melts and is pressed out by contraction of the tissue. At a high temperature, the fat decomposes.

[1] See Sherman, *Food Products*, pp. 209–211.

IV. Meat (*continued*).

2. Effects may be shown by the following demonstration experiments.

a. Protein.

(1) Effect of dry heat.

From a 3-inch square of lean beef, scrape out the soft portion with a dull knife, separating the connective tissue as completely as possible. Make the separated pulp into a small cake and heat both it and the connective tissue in a frying-pan. Watch the changes carefully.

(2) Effect of moist heat.

Soak 1 tablespoon of ground beef in 2 tablespoons of water for 10 minutes. Strain the liquid into a test tube and heat *gradually* to boiling, noting all changes. (Compare with the experiment on p. 299, in 1, a.)

b. Fat.

(1) Extraction from the tissues.

Choose several varieties of fat tissue, e.g., beef suet, mutton fat, chicken fat. Put through the meat chopper or cut into small pieces. Heat over boiling water until the connective tissue shrivels up. Cool and while still liquid strain the fat into glass jars. Calculate the cost per pound of the extracted fats. Save these fats and the extracted fat

IV. Meat (*continued*).

tissue ("cracklings") for use in future lessons.

(2) Cooking of fat tissue illustrated with bacon or salt pork. Cook 3 slices of bacon as follows:

(a) Cook 1 slice (in a small frying-pan) until it is crisp, but very light brown. Apply the heat cautiously so that there are no obvious fumes. Pour the drippings into a beaker or jelly glass. Drain the bacon on absorbent paper.

(b) Cook another as in (a), but more quickly and without observing care in regard to excessive heat and smoke. Treat drippings and bacon as in (a).

(c) Cook the third until it is very dark brown with the same treatment as in (b). Compare the cooked bacon and the drippings (when cold). Color in both indicates the degree of decomposition of the fat. To what extent is a color change desirable for the production of flavor?

E. Methods of cooking meat.

1. May be classified in several ways:

a. Method of applying heat —
Dry; moist; combination of dry and moist.

b. Duration of process —
Quick; slow.

IV. Meat (*continued*).

c. Object to be attained.

To retain the juices; to extract the juices; to partly retain and partly extract them.

2. List the ordinary methods, i.e., broiling, stewing, etc., under their proper headings in each of the above classifications.

3. Illustrate the cooking of —

a. Tender meats.

(1) Pan broil or broil beefsteak, lamb, or mutton chop.

(2) Beef roast.

b. Tough meats.

(1) Hamburg steak or Swiss steak.

(2) Boiled or stewed meat.

(3) Pot roast.

(Refer to standard cook book for processes.)

NOTE: The quick processes may be carried through in this lesson. Longer ones may be begun during this lesson and completed either before or during the following one. Discuss results in the following lesson. The meat cooked in this lesson may be used in the preparation of some of the dishes in the next lesson.

F. Conservation of meat.

Show the possibility of the extension of meat flavor by combination with other materials.

1. Materials suitable for carrying meat flavor.

a. Vegetables — Potatoes, carrots, turnips, celery.

IV. Meat (*continued*).

b. Cereals — Rice, barley, hominy, corn meal.

c. Liquids — Milk, water, vegetable stock.

(1) Water in soup.

(2) Thickened with starches for sauce.

(3) Stiffened with gelatin for jellies.

2. Methods of extending flavor.

a. Stews which include large proportions of vegetables.

b. Pies, molds, and croquettes, using cereals.

c. Soups with vegetables or cereals.

d. Scalloped meats, croquettes, soufflés, and minced meats, using sauces as extenders.

e. Jellied veal, chicken, etc.

3. Meats suitable for such use.

a. The tougher cuts such as neck, flank, and soup meat.

b. Trimmings and other less presentable pieces such as rib ends.

c. Left-over meats.

Have the class prepare as many dishes of the various types as are necessary to illustrate the above methods; if recipes are necessary, refer to current bulletins and standard cook books.

General References:

Maria Parloa, *Home Economics*, chap. IX.

U.S. Department of Agriculture, Farmers' Bulletin 391, *Economical Use of Meat in the Home.*

U.S. Food Leaflets: No. 5, *Make a Little Meat Go a Long Way;* No. 3. *A Whole Dinner on One Dish.*

V. Fish.

A. Owing to the great difference in the fish available in different localities, this lesson, even more than the others, must be adapted to suit local conditions.

Chose from the following types of fish, those which are locally available. Compare their cost and desirability.

1. Fresh fish —

    Fresh water.
    Salt water.
    Shell fish.

2. Preserved fish —

    Canned.
    Salted.
    Smoked.

Is canned, salted, or dried fish more or less expensive than similar fresh fish?

Are there any disadvantages connected with the use of preserved fish? Of fresh fish?

B. Principles and methods of cooking.

1. Fresh fish and shell fish.

    a. Effects of heat are practically the same as for meat. To emphasize these, the experiments in section II may be repeated using oysters instead of egg albumen and heating to different temperatures.

    b. Because of the lack of fat in fish, it is often added in cooking; e.g., as salt pork or bacon.

V. Fish (*continued*).

c. Acid (lemon juice or vinegar) is often used either to add or to modify flavor. Acid added to the water whitens boiled fish.

d. Owing to the difference in the thickness and character of the connective tissue of fish, the time required for cooking is less than for similar pieces of meat.

e. Sauces served with fish are important; to add flavor (lemon juice, vinegar, or tomato sauce); to add fat (e.g., tartar sauce); or to add moisture (white sauce).

2. Salted and smoked.

a. Need of preliminary treatment before cooking.

(1) To remove excess salt; e.g., soaking salt cod.

(2) To restore moisture; e.g., soaking smoked haddock (Finnan Haddie) in milk and water.

3. Prepare the fish chosen from A, 2, above, to illustrate as many as possible of the different methods of cooking.

a. Broiled (avoid frying to save fat). Serve with sliced lemon or tomato sauce.

b. Boiled. Serve with egg sauce or sauce tartar.[1]

c. Baked fish — planked or stuffed. (What kind of stuffing can be used?)

d. Fish cakes or balls. Use either salt fish

[1] See *Boston Cooking School Cook Book*, pp. 267 and 277.

V. Fish (*continued*).

or canned fish flakes and bake instead of frying the balls.[1]

e. Scalloped fish.[2]

In re-heating scalloped dishes in the oven to brown the crumbs, be sure that the boiling temperature is reached throughout the mixture, as it has been shown that disease has been transmitted through contaminated dishes of this type which had not been sufficiently heated.

4. Compare the cost and nutritive value as in previous lessons.

VI. Poultry.

A. In the preparation of poultry the principles involved are the same as those in the cooking of meat and fish. It may not be practical to repeat many of these cooking processes except as they may be essential for the study of the economic value of different kinds and grades of poultry.

B. If the laboratory facilities are limited, such studies may profitably be carried on as outside work. Problem suggested for home study — determine the relative economy in serving chicken:

1. Roasted and stuffed.
2. Fricasseed.
3. Stewed with potatoes and corn meal dumplings.

[1] *Boston Cooking School Cook Book*, p. 178. [2] *Ibid.*, p. 176.

VI. Poultry (*continued*).

4. Creamed chicken.

NOTE: In all preparations, apply conservation principles by using wheat flour substitutes and avoiding excess fat.

SECTION IV

PREPARATION AND USE OF VEGETABLES AND FRUITS

I. Purpose:

To illustrate the principles underlying the cooking of vegetables and fruits.

II. Effect of cooking vegetables.

A. Softening the cell wall. This is especially important in tubers and roots, as potatoes, beets, but is less important with celery, cabbage, onions, which are often eaten raw.

B. Change in flavor. *Improved*, in potatoes, green beans, spinach. *Changed without impairing*, in onions, celery, cabbage, if cooked carefully. *Destroyed or impaired* — long cooking of celery results in loss of flavor due to loss of volatile flavoring substances; long cooking of onions, turnips, cabbage, results in the production of strong flavor.

C. Change in color. Color in white vegetables (onions, turnips, cabbage) and green vegetables (peas, beans, asparagus) is retained by limiting time of cooking. Darkened color results from long continued cooking and is accompanied by an impaired flavor.

D. Moisture content. It is reduced in baked vege-

II. Effect of cooking vegetables (*continued*).

tables, e.g., squash, potatoes, but it may be increased slightly in cooked green vegetables, more markedly in "soggy" boiled potatoes.

E. Losses. Kind and amount depend upon —

1. Method of cooking; e.g., whether baked or boiled.
2. With and without skin.
3. Size of pieces.
4. Amount of water.

III. Demonstration of effects of cooking.

In order to show some of the most important of the above principles, samples of vegetables should be prepared either by the instructor or by such students as may be able to give additional time. These samples should be ready for exhibition and discussion at the beginning of the lesson period. In each case secure three samples by taking out the following portions:

1. Vegetable cooked until just soft enough to be pierced by a fork.
2. A portion cooked twice as long as in 1.
3. A portion very much over-cooked.

   Note in all cases the character of the vegetable broth as well as the vegetables. Use the vegetables and broths in the preparation of creamed vegetables and vegetable soups.

A. Carrots.

1. Cooked whole.
   a. In boiling water.
   b. By steaming.

III. Demonstration of effects of cooking (*continued*).

2. Cut in slices, cubes, or straws.
   a. In a large excess of water.
   b. In as little water as possible.

B. Cabbage, onions, or turnips.
1. Cooked in large pieces or whole.
2. Cut in small pieces.

IV. Class work.

A. Prepare potatoes as follows to insure a minimum of loss:
1. Baked.
2. Boiled in the skins. While still hot remove peeling, and brown (whole) in a small amount of savory fat (bacon fat or fat saved from the experiment in the meat lesson) or vegetable oil.
3. "Stewed" potatoes. Cut pared potatoes in thin slices, barely cover with water, and add salt and butter to season. Boil until the slices are tender but still whole and just enough water left to make them juicy. No water should be poured off.

B. Contrast the methods of cooking old and young spinach if both are available. (Emphasize in both cases the necessity of thorough cleaning.)
1. Young spinach. Cook without the addition of any water for 10 minutes, chop fine, season with fat and salt. Simmer for 10 minutes.
2. Old spinach. Blanch, to remove rank flavor. Cook in a limited amount of water. The time

IV. Class work (*continued*).

will vary with the age of the vegetable. Finish as in 1.

C. If time permits, prepare such vegetables as are available on the local market to illustrate the above principles and attractive methods of serving.

D. Dried vegetables.

If cooked at 100° C., all dried vegetables should soak in cold water from 8 to 12 hours. If cooked under 15 pounds pressure, the soaking is unnecessary.

1. Succulent dried vegetables. Green beans, carrots, onions, etc., should be cooked in the water in which they were soaked to avoid loss of the mineral constituents.
2. Dried legumes.
   a. Some legumes, such as cow peas, are rank in flavor so that the water in which they were soaked cannot be used.
   b. Cook by boiling or under pressure, dried soy beans, pinto beans, lima beans, peas, or other legumes.
   c. With the cooked vegetable prepare baked beans, bean or pea soup, bean loaf, bean croquettes, and other preparations which may serve as meat substitutes.

V. Compare the economic and nutritive value of these dishes with similar portions of meat.[1]

[1] For recipes, see U.S. Food Leaflets, various state publications, Sprague, E. C., "Nutritious Vegetable Soups," *Journal of Home Economics*, 10, p. 80, February, 1918.

VI. Fruits.

A. The principles of cooking are practically the same as those involved in cooking vegetables.

B. Fruits as a source of sugar.

Soak well-washed dried prunes overnight in enough water to cover them. Cook in the same water until tender. Remove the fruit and reduce the juice to a thick sirup to be poured over the fruit. Note that no added sugar is necessary to sweeten them.

C. Fruit sweetened with sugar and sugar substitutes.

1. Cook three equal portions of the same fruit and sweeten them respectively as follows:

a. With sugar, recording the weight of sugar used.

b. With the amount of corn sirup which contains the same weight of *total solids* as the weight of sugar used in *a*. (See note (3) below.)

c. With the amount of corn sirup which contains the same weight of *sugar* as that used in *a*. (See note (4) below.)

Is there a noticeable difference in sweetness or other qualities in the three samples?

A note on the quantitative relation between commercial corn sirup and cane sugar.

(1) Composition of corn sirup:

78% commercial glucose
- 32% dextrose
- 9% sucrose
- 37% dextrin, etc.

22% water

Density of a 78% sugar solution = 1.4.

Weight of 1 cup of sirup — 237 × 1.4 = 332 grams.

VI. Fruits (*continued*).

(2) Calculation for substitution on the basis of total solids (commercial glucose):

332 grams $\times$ 78% = 260 grams commercial glucose in 1 cup of sirup.

$\frac{200}{260} = 0.77$, or approximately 3/4 cup of sirup = 1 cup of cane sugar (200 grams).

(3) Measures containing the same amount of total solids (commercial glucose):

1	cup	sugar	is	equal	to	3/4	cup	sirup
3/4	"	"	"	"	"	9/16	"	"
1/2	"	"	"	"	"	3/8	"	"
1/4	"	"	"	"	"	3/16	"	"
2/3	"	"	"	"	"	1/2	"	"
1/3	"	"	"	"	"	1/4	"	"

1 tablespoon sugar = 3/4 tablespoon sirup.

(4) Measures containing the same amount of sugar:

1	cup	sugar	is	equal	to	1 3/5	cup	sirup
3/4	"	"	"	"	"	1 1/5	"	"
1/2	"	"	"	"	"	4/5	"	"
1/4	"	"	"	"	"	2/5	"	"
2/3	"	"	"	"	"	1 1/15	"	"
1/3	"	"	"	"	"	8/15	"	"

1 tablespoon sugar = 1 3/15 tablespoon sirup.

Substituting sirup for sugar on the basis given in (3) does not give a very sweet product in cakes, therefore the equivalents on the basis of the sugar in the sirup have been used in the cake recipes given later.

With either basis, it has not been found satisfactory to use all sirup. Half sugar and half sirup have given the best results in our experience.

Owing to the amount of water in the sirup, the liquid in the type recipe must be reduced according to the amount of sirup used. With 1 cup of sirup use 1/4 cup less liquid.

VII. Vegetables and fruits as salads.

Emphasize —

A. Importance in the diet.

B. Principles of preparation.

C. Classification of salad dressings.

D. Food value and cost.

SECTION V

PREPARATION AND USE OF CEREAL PRODUCTS

I. Cereal flours.

A. Comparison of thickening power.

Make a sauce with each of the flour substitutes, using 1/2 tablespoon with 1/2 cupful water and boiling for 1 minute. Compare as to consistency, texture, color, and flavor. Tabulate results and determine which is best fitted for conservation purposes under present local conditions.

B. Apply these results in making some of the following types of sauces, which should be served in suitable combinations. List the ways in which each may be used.

Types of sauces:

1. Named according to the liquid used.

a. White sauce — using milk (inaccurately called cream sauce).

b. Cream sauce — using cream.

c. Tomato sauce — using tomato juice.

I. Cereal flours (*continued*).

2. Named according to the treatment of the ingredients.
   Examples — drawn butter, brown sauce.
3. Named according to flavoring materials used.
   Examples — egg sauce, mushroom sauce.

C. Practical application.

1. Make white sauces thickened with the most suitable flour substitutes and use in the preparation of creamed vegetables, meat, or fish; macaroni, rice, or similar dishes.
2. Prepare puddings including some of each of the types below. The principles of proportion, and the methods of combining and cooking are the same as for sauces.

   a. Molded.

   (1) Thickened with cornstarch or other cereal to make a firm mold when cold; e.g., plain cornstarch pudding, chocolate cornstarch pudding.

   (2) With egg as part of the thickening; e.g., lemon cornstarch pudding, strawberry cornstarch pudding.

   b. Soft.

   (1) Plain — fruit pudding, using either fresh or dried fruits; e.g., "Norwegian prune pudding," "thickened prunes."

   (2) With egg; e.g., "soft lemon pudding," "floating island." [1]

[1] Recipes for the above or similar dishes can be found in Mrs. Allen's *Cook Book*, pp. 511–513, the *Boston Cooking School Cook Book*, pp. 411–412, and other standard cook books.

II. Doughs and batters using cereal flours.

The substitution of other cereal flours for wheat flour in dough and batter mixtures has presented one of the most difficult war-time problems in cooking.

A. Principle of substituting weight for weight.

1. Recipes have been worked out on the principle that a given weight of wheat flour may be replaced by an equal weight of a substitute. This does not mean that other methods of substitution may not be satisfactory. Some flours in equal weights may absorb more water than others.

2. The measures of equal weights of different materials will vary according to the character of the flour or meal. The weight of a standard cup of flours and meals is affected by many factors, such as the fineness of the material, whether it is sifted or unsifted and how the cup has been filled.

3. The table of weights and measures on page 335 has been adopted as a result of repeated weighings in the experimental laboratory of the Food Administration in coöperation with the Office of Home Economics of the Department of Agriculture, using flours available on the local market. The measures used in the succeeding recipes represent the weights in this table. For the benefit of those working with them, plus and minus signs are used to show that the measures are not exact; 8/9 of a cup, for instance, must be

II. Doughs and batters using cereal flours (*continued*).

translated either into 1 cup or 7/8 of a cup, and the sign shows which has been done. There is, however, so much variation in the size of the measuring cup, and also so much difference in the ways of measuring, that there is no greater error in this translation from one fraction to another than is bound to occur in any use of measures.

4. It must be remembered that measures are not accurate and that more uniform results may be secured by weighing. Note especially the difference in the weights of bread and pastry flours. The amount of substitute to be used will depend upon the kind of flour used in the original recipe.

5. Weight of 1 cup of uncooked cereals.

Cornmeal, coarse	130 grams	= approximately	5 oz.
Hominy grits	134 "	"	5 oz.
Oats, rolled	75 "	"	3 oz.
Oats, fine, granulated	136 "	"	5 oz.

6. Weight of 1 cup of cooked cereals.

Hominy	258 grams	= approximately	9 oz.
Oats, rolled	257 "	"	9 oz.
Rice	270 "	"	9½ oz.

The weights of cooked material will vary considerably according to the way the material is cooked and packed in the cup. The weight of the rice given is for that cooked in a double boiler with four times its volume of water; no water was unabsorbed at the end of the cooking and the grains were soft but whole. Steamed rice lightly piled in a cup may weigh as little as 148 grams (5 1/3 oz.).

7. Equivalent Weights and Measures

1 cup = ¼ quart = 237 c.c.

Unit	*Wheat flour*		*Substitutes*				
	Bread	*Pastry*	*Barley*	*Ground rolled oats*	*Corn flour*	*Oat flour and fine corn meal*	*Rice flour, buckwheat and coarse cornmeal*
1 cup	4oz.	3½ oz.	2⅝ oz.	3½ oz.	4oz.	4½ oz.	4⅝ oz.
	113 *gr.*	100 *gr.*	76 *gr.*	98 *gr.*	109 *gr.*	125 *gr.*	133 *gr.*
Oz.	*Cups*	*Cups*	*Cups*	*Cups*	*Cups*	*Cups*	*Cups*
1	¼	¼ (+)	⅜	¼ (+)	¼	¼ (−)	¼ (−)
2	½	½ (+)	¾	½ (+)	½	½ (−)	⅜ (+)
3	¾	⅞ (−)	1⅛	⅞ (−)	¾	¾ (−)	⅝
3½	⅞	1	1⅛	1	⅞	⅞ (−)	¾
4	1	1⅛	1½	1⅛	1	1 (−)	⅞ (+)
5	1¼	1⅜ (+)	1⅞	1⅜ (+)	1¼	1⅛	1⅛ (−)
6	1½	1⅝ (+)	2¼	1⅝ (+)	1½	1⅜ (+)	1⅜
8	2	2¼	3	2¼	2	1⅞	1¾ (+)
10	2½	2⅞	3¾	2⅞	2½	2¼ (+)	2¼ (−)

(+) indicates generous measure. (−) indicates a scant measure.

B. Quick breads.

Purpose: To show the use of wheat flour substitutes in quick breads.

1. Muffins.

a. Proportions. A wide variation may be made in the proportion of materials used

II. Doughs and batters using cereal flours (*continued*).

in muffins. The following are suited to the average taste and may be used as a basis for substitution. If sour milk is used instead of sweet, the amount of flour should be reduced to 1 3/4 cups, with 1/2 teaspoon of soda and 2 teaspoons of baking powder instead of 4 teaspoons of baking powder.

Liquid		*Flour*	*Fat*	*Sugar*	*Egg*	*B.P.*	*Salt*
Sweet milk	1 c.	2 c.	1 T.	1 T.	1	4 t.	¼ t.

If a softer texture is desired, 1 3/4 cups, or even 1 1/2 cups of flour is all that is necessary.

Substitution should be based in terms of percentage, *by weight*, of the flour used in the type recipe.

For example, the 2 cups of bread flour in the muffin recipe weighs 226 grams, or about 8 ounces. (1 *standard cup measures 1/4 quart or 237 c.c.*)

25% substitution requires 56 grams or 2 ounces of the substitute.
50% substitution requires 113 grams or 4 ounces of the substitute.
75% substitution requires 169 grams or 6 ounces of the substitute.

b. Substitutions to save wheat.

(1) Flours and meals.

Show that successful muffins may be made using different proportions of wheat flour and meal substitutes.

Instead of the 2 cups of wheat flour given in the type recipe use the following proportions by measure, all of which are equal to 75% substitution by weight:

II. Doughs and batters using cereal flours (*continued*).

(*a*) Barley muffins ...... ½ c. wheat flour, 2¼ c. barley flour
(*b*) Buckwheat muffins... ½ c. " " 1⅜ c. buckwheat flour
(*c*) Corn muffins .... ½ c. " " 1½ c. corn flour
(*d*) Cornmeal muffins.... ½ c. " " 1⅜ c. cornmeal (fine)
Cornmeal muffins ... ½ c. " " 1⅛ c. cornmeal (coarse)
(*e*) Rice muffins......... ½ c. " " 1⅛ c. rice meal (coarse)
(*f*) Or, by weight, 56 grams (2 ounces) of wheat flour and 226 grams (6 ounces) of any of the substitutes.

For the softer muffins use a total of 7 ounces instead of 8 ounces. These will require greater skill in handling.

(2) Uncooked cereals.

Show that only 25% of cereal in this condition can be substituted to make a satisfactory muffin.

Instead of the 2 cups of wheat flour in the type recipe, use the following proportions:

Oatmeal Muffins

1 1/2 cups wheat flour, 3/4 cup rolled oats.

Method — Heat the 1 cup of liquid to boiling, pour over the oats, let stand until cool, then mix muffins as usual.

Other uncooked cereals are not satisfactory.

(3) Cooked cereals. In using cooked cereals as wheat flour substitutes allowance must be made for the water which they have taken up in cooking. This is an uncertain factor, as the amount will differ according to the method of cooking. The following proportions are

II. Doughs and batters using cereal flours (*continued*).

for well-cooked, but not "mushy' cereals.

(a) Instead of the 1 cup of liquid and the 2 cups of flour in the type recipe, use the following proportions:

Hominy grits — 2 tablespoons liquid, 1 1/2 cups wheat flour, and 1 cup of cooked hominy, equal to 1/3 cup uncooked.

Oats, rolled — No liquid, 1 1/2 cups wheat flour and 1 1/3 cups cooked rolled oats, equal to 3/4 cup uncooked.

Rice, 1/3 cup liquid, 1 1/2 cups wheat flour, 3/4 cup of cooked rice, equal to 1/4 cup uncooked.

(b) Notes.

Only 25% by weight of the whole cereals can be used to make a good light muffin. By grinding the rolled oats in a meat chopper, a meal can be made which will allow 75% substitution as in (a).

A combination of two or more of the cereal substitutes is usually more satisfactory than one used alone.

With cooked cereals and potato, the mixture is very stiff, almost like biscuit dough because the moisture is held by the cereal. It must be thoroughly mixed.

II. Doughs and batters using cereal flours (*continued*).

Rice flour muffins are improved by increasing both the egg and baking powder one half.

The basic recipe makes 8 large muffins (2 3/4″ × 2 × 1 1/8″) or 16 small (1 3/4 × 1 1/4 × 3/4). The latter are more desirable, because they are more thoroughly baked. Bake about 30 minutes at 205° C. (400 F.) which is a moderately hot oven.

c. Modifications to save other materials.

(1) Reduce the amounts of fat and sugar.

(2) Substitute vegetable fats for animal fats.

(3) Use corn sirup instead of sugar.

(4) Omit eggs.

These modifications may alter the quality of the muffins somewhat, but should not do so markedly.

The size of the class and the laboratory conditions must determine the number of variations which should be made. The work should be carefully planned so that the results of the class work will indicate clearly to the whole class the differences due to the variations. Each member of the class should begin to acquire skill in the handling of doughs and batters.

2. Griddle cakes.

II. Doughs and batters using cereal flours (*continued*).

Typical proportions for griddle cakes:

Liquid		*Flour*	*Fat*	*Sugar*	*Egg*	*Leavening*	*Salt*
Sweet milk	1 c.	1½ c.	1 tbsp.	1 tbsp.	1	3 tbsp. B.P.	¼ tbsp.
Sour milk	1 c.	1¼ c.	1 tbsp.	1 tbsp.	1	(½ tbsp. soda) (1 tsp B.P.)	¼ tsp.

a. If a thinner mixture is preferred, 1 1/4 cups of flour with sweet milk and 1 1/8 cups with sour milk can be used.

b. Compare with the proportions for muffins. Why do they differ?

c. Make the same substitutions in the proportions for griddle cakes as were made for muffins and determine the desirability of each.

d. For future use the results in this lesson should be recorded either in tabular or in recipe form, so that they will be easily available for practical use.

3. Corn breads.

a. Those made from corn meal, liquid, and salt with a possible addition of fat and sugar.

b. Those which include eggs.

c. Those which use cooked corn meal.

d. Those which use corn meal alone.

Select recipes representing each of the above groups from U.S. Department of Agriculture, Farmers' Bulletin 565, *Corn Meal as a Food.* Note the points in which the program of the Food Administration requires changes in ingredients and make the necessary substitutions.

II. Doughs and batters using cereal flours (*continued*).

C. Cakes.

1. Types of cakes.

a. Sponge cakes.

GENERAL PROPORTIONS

Showing typical variations using pastry flour.

(1)	4 eggs,	1 cup sugar,	1 cup flour,	1 tbsp. lemon juice,	1 tsp. salt
(2)	5 eggs,	1 " "	1 " "	1 " " "	1 " "
(3)	6 eggs,	1 " "	1 " "	1 " " "	1 " "

b. "Butter" cakes. (Many other fats may be used instead of butter.)

GENERAL PROPORTIONS

Showing typical variations, using pastry flour.

	Liquid	*Fat*	*Egg*	*B.P.*	*Flour*	*Sugar*	*Flavor*	*Salt*
Plain	1 c.	¼ c.	1	6	3 c.	1½ c.	1	½ tsp.
Rich	¾ c.	¾ c.	3	4	3 c.	1½ c.	1	" "
Very rich	½ c.	1 c.	6	3	3 c.	1½ c.	1	" "

For methods of mixing see standard cook books.

c. Note the degree in which the above recipes violate the conservation program. If cakes are to be used at all in war-time, only very simple ones should be made, substituting as far as possible —

(1) For wheat flour — other cereal flours, substituting on the basis of the weight of pastry flour.

(2) For animal fat — vegetable fats.

(3) For sugar —

Reduce the amount of sugar. Use one-half sugar and one-half corn sirup.

II. Doughs and batters using cereal flours (*continued*).

(NOTE — If sirup is used in sufficient quantity to make cake sweet, it also makes it heavy. See quantitative relation between corn sirup and sugar, p. 330.)

When sirup is used, the addition of raisins, citron, and other fruits increases the sweetness. Honey, maple sirup, and molasses are also used in special cases.

2. Proportions for war cakes.

a. Sponge cakes.

(1) As substitutes for wheat flour, rice, corn, potatoes, and barley flours may be used, alone or in combination, in amounts equal to the weight of the wheat flour.

(2) For the 1 cup of flour in sponge cake (*a* above) the following substitutions can be made:

Barley flour......	1⅛ cups.
Corn flour........	⅞ cup.
Oat and rice......	½ cup oat flour.
	¼ cup rice "
Oat and corn.....	½ cup oat flour.
	¼ cup corn "

All of these are equal to 100% substitution by weight on the basis of pastry flour.

(3) Calculate measures which would be equal to 33 1/3% and 50% substitutes.

II. Doughs and batters using cereal flours (*continued*).

b. Variation of proportions in plain "butter" cakes.

By reference to weights of flour substitutes given in the muffin lesson, vary the proportions for plain or rich cake, using the cereal flours in amounts ranging from 50% to 100%.

c. Other cakes made with wheat flour substitutes.

(Sirup substituted for half the sugar on the basis of its sugar content (41%). 1 cup sirup (11 1/2 oz.) = 4 3/4 oz. sugar.

Chocolate Cake (1)

50% rice flour 50% barley flour
50% sirup on basis of glucose content. See p. 330.

1/2 cup fat	1 cup rice flour
2/3 cup sugar (about 4 3/4 oz.)	2 cups barley flour
1 cup sirup (about 11 1/2 oz.)	6 teaspoons baking powder
3 eggs	1 teaspoon cinnamon
3/4 cup milk	1 teaspoon vanilla
1 teaspoon salt	2 squares chocolate

Cream the fat, sugar, and egg yolk. Add the sirup and mix well. Add alternately the liquid, and the dry ingredients sifted together. Add flavoring and melted chocolate. Fold in the well-beaten egg white. Bake about 1 hour, starting in a moderate oven (350° F.–177° C.). After 20 minutes raise the temperature to 400° F.–205° C.

Chocolate Cake (2)

75% buckwheat flour 25% ground rolled oats
(50% sirup on basis of glucose content.)

1/2 cup fat	1 3/4 cups buckwheat flour
2/3 cup sugar (4 3/4 oz.)	1/2 cup ground rolled oats

Chocolate Cake (2) (*continued*).

1 cup sirup (11 1/2 oz.)	6 teaspoons baking powder
3 eggs	1 teaspoon cinnamon
3/4 cup milk	2 squares chocolate
1 teaspoon salt	1 teaspoon vanilla

Mix and bake as above.

Spice Cake (1)

100% barley flour
50% sirup on basis of glucose content. See p. 330.

1/2 cup fat	6 teaspoons baking powder
2/3 cup sugar (about 4 3/4 oz.)	1 teaspoon salt
1 cup sirup (11 1/2 oz.)	1 teaspoon cinnamon
3 eggs	1/2 teaspoon cloves
3/4 cup milk	1 teaspoon allspice
1 teaspoon vanilla	3 3/4 cups barley flour
1 cup raisins	

Method — Cream the fat, sugar, and egg yolk. Add the sirup and mix well. Add alternately the liquid, and the dry ingredients sifted together. Add the flavoring and fold in the well-beaten egg whites. Bake for 1 hour in a moderate oven (170° C.–350° F.). After 20 minutes raise the temperature to (205° C.–400° F.).

Spice Cake (2)

50% rice flour 50% buckwheat
50% sirup on basis of glucose content. See p. 330.

1/2 cup fat	6 teaspoons baking powder
2/3 cup sugar (about 4 3/4 oz.)	1 teaspoon salt
1 cup sirup (11 1/2 oz.)	1 teaspoon cinnamon
3 eggs	1/2 teaspoon cloves
3/4 cup milk (6 oz.)	1 teaspoon allspice
1 teaspoon vanilla	1 cup rice flour
1 teaspoon ginger	1 cup buckwheat

Mix and bake as above.

d. Cakes containing no egg and a minimum of fat.

(1) Canadian War Cake

Recipe	Substitutes
2 cups brown sugar	3/4 cup molasses or 1 cup corn sirup
2 cups hot water	
2 tablespoons fat	2 tablespoons corn oil
1 lb. seedless raisins (raisins make the cake richer)	
1 teaspoon salt	
1 " cinnamon	
1 " cloves	
3 cups flour	3 cups of barley flour

Boil all except the flour for 5 minutes after bubbling begins. When cold, add 1 scant teaspoon of soda dissolved in 1 teaspoon of warm water. When cool stir in flour.

Bake in 2 loaves for 45 minutes in a slow oven.

This cake is better if allowed to age for a few days or a week before using.

(2) Gingerbread

Prepare gingerbread from the following recipe:

1 cup cornmeal	1 teaspoon baking powder
1 cup wheat flour	1 teaspoon baking soda
2 teaspoons cinnamon	1 cup molasses
2 teaspoons ginger	1 cup sour milk or buttermilk
1/2 teaspoon salt	2 tablespoons fat

Sift the dry ingredients and add molasses, milk, and fat. Beat well and pour into a greased pan. Bake 25 minutes. Notice that this recipe uses corn meal or half the wheat flour ordinarily used.

(a) Compare this with other recipes in any standard cook book and note conservation features.

(b) Substitute rye flour for the 1 cup of wheat flour.

(c) Substitute barley flour for the 1 cup of wheat flour.

II. Doughs and batters using cereal flours (*continued*).

(3) Frostings add greatly to the consumption of sugar. As conservation measures, either omit altogether, or before baking sprinkle the cake lightly with a mixture of spice and sugar, or place split almonds or other nuts on top.

(4) Calculate the fuel value of a piece of sponge cake, of plain cake, very rich cake, or plain cake frosted.

Assume that sponge cake in the proportions given may be cut into 16 pieces, and that the butter cakes may be cut into 24 pieces.

D. Biscuits.

1. By class demonstration, show methods of mixing and the proportions of liquid in drop biscuits and in molded biscuits.

GENERAL PROPORTIONS FOR BISCUITS

Liquid	*Flour*	*Fat*	*Baking powder*	*Salt*
To be determined	1 c.	1 tsp.	2 tsp.	1/4 tsp.

a. Drop biscuits.

Using wheat flour (white) with proportions given above, sift the dry materials, mix in the fat thoroughly, and add enough liquid (note the amount) to make a dough which is too soft to be handled. Drop by spoonfuls on an oiled pan and bake in a hot oven (225° C.).

b. Molded biscuits.

Repeat *a*, but add enough liquid (note

II. Doughs and batters using cereal flours (*continued*).

the amount) to make a soft dough. Mix barely enough to combine the ingredients. The dough should not look smooth. Cut out one biscuit (1). Knead the rest of the dough *slightly* — until it looks smooth. Cut out two biscuits (2 and 3). Knead the remainder of the dough *very thoroughly*. Cut into biscuits (4).

Bake biscuits (1), (2), and (3) immediately in a hot oven (225° C.). Let (3) stand a half-hour, then bake at same temperature as others. Reserve these biscuits, which should show characteristic differences, to compare with those made with wheat flour substitutes.

2. Use of the substitutes.

a. Use those available in your locality, choosing one of each type.

Flours	*Meals*	*Whole cereal*
Corn	Corn	Rolled oats
Rice	Oatmeal	Rice
Barley	Kafir corn	
Buckwheat	Feterita	

b. Proportions.

For either drop or molded biscuits as much as 75% to 100% of the flour and meal substitutes may be used.

E. Pastry.

This subject may include a comparison of the qualities of the different kinds of fats, the amounts of each required to produce tender crusts and their economic values.

II. Doughs and batters using cereal flours (*continued*).

1. Principles and proportions in pastry are similar to those in biscuits except that a larger proportion of fat is used.

General Proportions

	Liquid	*Fat*	*Flour*	*Salt*
Plain pastry.......	Amount variable	1/4 c.	1 c.	1/4 tsp
Rich pastry.......	"	1/3 c.	1 c.	1/4 tsp.

2. Tenderness of pastry depends —
   a. Upon the amount and kind of fat used.
   b. Upon the amount of water — the smaller the quantity of water used, the more tender will be the crust.
   c. Upon the handling of the dough; too much or too heavy kneading toughens the pastry.
3. Suggested substitutions.
   a. For wheat flour, use from 50% to 100% of rice, corn, oat, or barley flours, or a mixture of two or more.
   b. For lard, butter, or fat compounds, use 1 to 2 tablespoons of vegetable oil in place of 1/4 cup of the solid fats. With the oil, very little water is needed; e.g., from 1 1/2 to 2 tablespoons for 1 cup of flour and 2 tablespoons of oil.
4. Emphasize the use of the one-crust pie.

F. Bread.

1. Purpose.

II. Doughs and batters using cereal flours (*continued*).

a. To compare the properties of different grades of wheat flour, if these are on the market, with those of suggested substitutes.

b. To compare the character of the different kinds of yeast.

c. To demonstrate the different methods used in bread-making.

2. Gluten test.

May be done as a class demonstration.

a. To 2 tablespoons of flour add water to make a stiff dough which can be worked in the hand. Wash this in cold water until the liquid is clear, noting the changes. When the ball no longer gives the iodine test for starch, bake in a hot oven. Repeat, using such grades of flour as are available.

b. Repeat *a*, with rye, barley, and other wheat substitutes. Compare the results with *a*. Why does wheat give the best flour for bread-making?

3. Yeast.

a. Examine under the microscope samples of dry, compressed, and liquid yeast.

b. Demonstration. Making liquid yeast.

PROPORTIONS

1 cup potato water.
1/2 cup dry yeast.
2 tablespoons corn sirup.
2 tablespoons flour.
1 cup mashed potatoes.

Cool the potatoes and 1 cup of the water

II. Doughs and batters using cereal flours (*continued*).

in which they were cooked until lukewarm. Soften the yeast in part of the liquid and combine all the materials, mixing thoroughly. Keep at an even temperature (about 30° C.) overnight (10 to 14 hours).

Other flour substitutes may be used instead of the potato, but at least water in which potatoes have been cooked should be used, as it contains substances which favor the growth of yeast.

Measure the volume of the liquid yeast after it has fermented. What amount of this yeast should be used if a loaf of bread is to be made on the basis of one-half cup of water, using only that present in the liquid yeast? The yeast starter made in this demonstration should be reserved for use by the class at the next lesson.

4. Processes of bread-making.
   a. Methods.
      (1) Long process — overnight process, requiring 12 to 16 hours.
         (a) Starter, sponge, and dough.
         (b) Sponge and dough.
         (c) Off-hand dough.
      (2) Short process — requiring only 4 to 6 hours.
         (a) Sponge and dough.
         (b) Off-hand dough.
   b. Proportions (these should make an 18 to 20 ounce loaf).

II. Doughs and batters using cereal flours (*continued*).

(1) Long process — sponge method.

1/4 cup liquid, 1/4 cake dry yeast } or 1/2 cup liquid and liquid yeast as in B, 2, above, to give 1/2 cup water.
1 tablespoon corn sirup.
1 teaspoon salt.
1 tablespoon vegetable oil.
3 to 4 cups flour.

Heat the liquid to 37° C. and add 1 1/2 cups flour, the sirup, and the yeast. Beat thoroughly and set to rise at an even temperature (30° to 32° C.) overnight. In the morning, add 1 tablespoon fat, 1 teaspoon salt, and the remainder of the flour. Knead thoroughly. Place in bread bowl and allow to rise until double in bulk. Cut or knead down, allow to rise again, and mold into loaves. When it has doubled in bulk, bake about 45 minutes (even temperature 195° C. for 10 minutes, then lowered to 185° C.).

(2) Long process with a starter and sponge.
Starter —

3/4 cup water or potato water, 1/2 cup mashed potato } to make about 1 cup liquid.
1/4 cake dry yeast.
1 tablespoon corn sirup.
1 tablespoon flour.

When the water is lukewarm (37° C.) mix all the ingredients thoroughly. Keep overnight at an even temperature (30°–32° C.). In the morning, add 1

II. Doughs and batters using cereal flours (*continued*).

cup flour, beat well and allow to rise for 1 hour. Then add 1 tablespoon fat, 1 teaspoon salt, and knead in enough flour to make a dough that does not stick to the hands (2 cups). Allow to rise, knead down, let rise again, and mold into loaves. Place in pans and when double in bulk bake (at a temperature of 195° C. lowering to 185° C. after 10 minutes) about 45 minutes.

(3) Short process.

Proportions the same as in *b*, (1), above, but substitute 1/2 cake compressed yeast for 1/4 cake dry yeast.

(a) Sponge method. Soften the yeast in part of the liquid. Make a sponge and follow directions in *b*, (2), above.

(b) Off-hand method. Soften the yeast in part of the liquid, combine all the ingredients to make a dough, and proceed as usual.

5. Demonstration.

a. Plans for demonstration.

The bread made in this demonstration should be carefully made into model loaves for comparison with the Victory breads to be shown later.

In order to show each step of the process, have ready at the beginning of the demonstration the following items:

II. Doughs and batters using cereal flours (*continued*).

(1) All material, carefully measured (or weighed) for 1 loaf of bread. (See *b*, (1), below.) The proportions given below will make a good-sized loaf.

(2) A sponge, light and ready to be made into a stiff dough. Use proportions given in *b*, (1), above. (P. 351.)

(3) A dough which has risen and is ready to be made into the loaf. Use twice the amounts given in *b*, (1), above. It is desirable also to have a loaf which has risen and is ready to be baked, and a baked loaf, but for purposes of economy this may be omitted.)

b. Procedure.

(1) Make a sponge of 1 cup of liquid at 37° C., 1 tablespoon sirup, 1/2 cake compressed yeast, and 1 1/2 cups flour.

Beat thoroughly. Show the consistency and explain that this is to be set to rise at an even, warm temperature.

Use this as an illustration of the sponge process, explaining the differences when the dry and compressed yeasts are used.

Emphasize the fact that it is advisable to make the sponge even for the so-called short process. The quality of the bread is improved and the time is not materially lengthened, if 1/2 hour is allowed for the sponge rising, instead of using the off-hand method.

II. Doughs and batters using cereal flours (*continued*).

Without allowing the above sponge to rise, add 1 teaspoon salt and enough flour (about 1 1/2 cups) to make a stiff dough. This will serve to illustrate the off-hand method. Let the dough rise, mold, and bake it as in the other processes.

(2) Take the sponge (see *a*, (2), above) which is well risen, add 1 teaspoon salt and flour (about 1 1/2 cups) to make a dough that can be handled easily. Rub lightly with fat and set aside to rise.

(3) Use the dough (see *a*, (3), above) which should have risen twice, to illustrate the following processes:

(a) Cutting or kneading down the dough for the second rising.

(b) Kneading and forming the loaf. Use half the dough.

(c) Forming different shapes of rolls.

Brush with fat, allow to rise, and bake. Keep all conditions absolutely uniform, so that the finished loaves may be compared. Save these loaves also to compare with Victory Breads.

G. Victory breads.

1. Purpose.

To show the use of wheat flour substitutes in making yeast breads and rolls.

II. Doughs and batters using cereal flours (*continued*).

2. Wheat-saving substitutes include:

   a. Cereals.

      Whole — rolled oats, rice, barley, hominy.

      Cracked — rice, granulated oat meal, pearl barley, hominy grits.

      Meals — corn, peanut meal, kaffir corn meal, milo meal, barley meal, soy bean meal, shorts, middlings.

      Flours — corn, cornstarch, barley, potato, sweet potato, milo, feterita, banana.

   b. Vegetables.

      Legumes — peas, beans.

      Other vegetables — potatoes, sweet potatoes, dasheens, pumpkins, squashes.

   c. Miscellaneous.

      Alfalfa, bran, bread crumbs.

3. Make as many types of bread as conditions permit, selecting those wheat flour substitutes which are easily obtainable, and substituting a definite percentage by weight of the flour in the type recipe. Include at least one from each of the following groups to show different methods of treatment.

   It is not satisfactory to attempt to carry through the bread-making process in one laboratory period.

   Because of the importance of the subject, arrangements should be made to have the

II. Doughs and batters using cereal flours (*continued*).

students come into the laboratory at such intervals during the day as will be necessary to carry on the process normally.

Each student should make bread by both the long and short processes and should have experience in using both dry and compressed yeast.

4. Preparation of substitute.

a. Cereals.

(1) Whole — type, rolled oats.

(a) Scalded with the liquid to be used in making the bread.

(b) Well cooked. Weigh the water and the cereal to be used in the bread (reserve enough water to soften the yeast). Cook *thoroughly*. Weigh and add enough water to restore to the original weight. Proceed as usual.

(2) Meals — type, corn meal.

(a) Scalded (see above).

(b) Well cooked (see above).

(c) Sifted with flour — no special treatment.

(3) Flours — type, corn, barley, or rice. Sift with the wheat flour.

b. Vegetables.

(1) Legumes — type, beans.

II. Doughs and batters using cereal flours (*continued*).

(a) Cook thoroughly and mash, using the hull and pulp.

(b) Put through sieve or potato ricer, discarding the hull.

(2) Other vegetables — type, white potato. Use mashed.

c. Miscellaneous.

(1) Shorts, middlings, etc., sifted with the flour.

(2) Bread crumbs, softened in water before incorporating. If very fine they may be sifted with flour.

5. Victory bread must contain at least 25% of some substitute. On account of the high moisture content of potatoes, 4 pounds of potatoes will be considered the equivalent of 1 pound of other substitutes.

6. Proportions and methods.

Weigh the amount of flour which was required to make a loaf of bread in the previous lesson. Substitute for 25% of this, an equal weight of any of the above materials. Other ingredients are the same as previously given, with such modifications of methods as are required by the treatment of the substitute. If time permits, make other samples, using 33 1/3%.

For conservation purposes, fat is reduced to a minimum or omitted entirely. Enough

II. Doughs and batters using cereal flours (*continued*).

corn sirup may be used to favor the growth of yeast.[1]

7. Victory rolls.

Convert the Victory bread recipes and those used in *A* into proportions suitable for rolls by adding fat and sugar in the proportions allowed to commercial bakers.

1% of vegetable shortening, either vegetable fats or oils or fat compounds containing not more than 15% of animal fats.

3 1/2% of corn sugar or 3% of cane or beet sugar. (Expressed in per cent of total flour or meal or any mixture thereof.)

Shape and bake in typical roll forms: Parker House, finger, cinnamon.

SECTION VI

ADEQUATE DIET

I. Purpose.

To show the application of the principles of adequate feeding in the preparation of meals for the day.

II. Meals should be shown in amounts suitable for a man at moderate muscular work; a woman at moderate muscular work; and a child of 12, based upon the following table for a man at moderate muscular work.

[1] For the effect of substitution of different amounts of flours see Sprague, E. C., and Laughlin, E., "Breads from Unusual Flours," *American Food Journal*, 12, p. 673. 1917.

	I *Comparatively expensive diet*	II *Comparatively cheap diet*
Vegetables and fruits	from 2 1/2 lbs.	down to 1 1/2 lbs.
Milk	8 oz. (1/2 pint)	8 oz.
Meats, eggs, cheese, etc.,	from 14 oz.	down to 6 oz.
(Use 2 ounces less for every additional half-pint of milk)		
Cereals	from 8 oz.	up to 16 oz.
Sweets	from 3 oz.	down to 1 1/2 oz.
Fats	from 3 oz.	down to 1 1/2 oz.

A. Each group of two students working together may plan, prepare and serve one day's meals based on one of the following:

1. Comparatively expensive diet.
   a. Using figures as given in Table I.
   b. Using high milk allowance.
   c. Using medium milk allowance.
   d. Using expensive foods.
   e. Using cheaper foods.
2. Comparatively cheap diet.

   Using figures as given in Table II, making the same comparisons as given in 1.

B. Calculate the cost and the food value. The protein and calories may be estimated either by determining the exact weight of the materials served and calculating these values from the tables in Rose, *A Laboratory Manual of Dietetics*, or by using the weight in pounds of the materials as purchased and the empirical factors given below which have been developed from the average composition.[1] Note especially

[1] See Hunt, C. S., "A Quick Method of Calculating Food Values," *Journal of Home Economics*, 10, p. 212. May, 1918.

II. Diet for moderate muscular work (*continued*).

that the weights are always used as *pounds* or *fractions of a pound* and that the results are *calories* and *pounds* or *fractions of a pound* of *protein*.

1. Fruits and vegetables.

   Weight of fresh or canned plus (weight of dried fruits and vegetables multiplied by 6) multiplied by 250 = calories.

   Same data divided by 70 = protein (lbs.).

2. Protein rich foods.

   a. The less watery — meat (except salt pork and bacon), fish, eggs, cheese, peanut butter, dried soy beans not included in first group, — use the actual weight.

   b. The more watery — milk, skim milk, oysters, clams, etc. — use 1/4 of the actual weight.

   Sum of *a* and *b* multiplied by 900 = calories.

   Sum of *a* and *b* divided by 7 = protein (lbs.).

3. Cereals.

   The actual weight of dry cereals plus 3/4 the weight of bakery goods multiplied by 1600 = calories.

   The same divided by 9 = protein (lbs.).

4. Sweets.

   The actual weight of sugar plus 3/4 the weight of sirups multiplied by 1800 = calories.

II. Diet for moderate muscular work (*continued*).

5. Fats.

The actual weight of butter, lard, etc., bacon, shelled nuts (except peanuts and chestnuts), and unsweetened chocolate plus 1/2 the weight of cream and ice cream multiplied by 3400 = calories.

The same divided by 30 = protein (lbs.).

6. Example.

APPLICATION OF THE LIBERAL DIET GIVEN ON P. 359

	Calories	*Protein*
Fruits and vegetables.......	2½ lbs. × 250 = 625	2½ lbs. ÷ 70 = .04 lbs.
Meat and milk Meat..............⅞ lb. Milk ¼ × ½ lb. = ⅛ lb. Total............ 1 lb.	1 lb. × 900 = 900	1 lb. ÷ 7 = 0.14 lbs.
Cereals Rice, cereal flour and breakfast cereals	½ lb. × 1600 = 800	½ lb. ÷ 9 = 0.05 lbs.
Sweets Sirup ½ oz. Candy 1 oz. ¾ × 1½ oz. = 1¼ oz. Sugar.......... 1¾ oz. Total ...... 3 oz.	3/16 lb. × 1800 = 338	
Fat Cream 2 oz. × ¼ = ½ oz. Butter, etc........2½ oz. Total............ 3 oz.	3/16 lb. × 3400 = 637	
Total	3300	0.23 lbs.

III. Judge the day's diet also as to ash constituents and other points as given in the Dietary Score Card; Rose, *Laboratory Manual of Dietetics*, p. 69.

IV. The tabulation given on page 363 showing one day's food, conforming to the amounts given in II above, and their arrangement in menus, is suggested as a convenient method of planning.

The method is much more satisfactorily used if the calculations are made for a family than for an individual, and for a week or a month instead of a day. Awkward and inaccurate fractions and irregularities due to daily variations are thereby avoided.

MENUS
(Using foods tabulated below)

Breakfast

Orange
Hominy grits
One egg
Top milk, sugar
Wheatless muffins
Coffee

Luncheon

Jellied salmon
Rice spoon bread
Baked apple
Baked potato
Cheese
Tea

Dinner

Beefsteak
Buttered onion
Tomato and lettuce salad
Strawberries
Mashed potato
Wheatless bread
Sponge cake (wheatless)
Coffee

Food for a man at moderate muscular work for one day (June, 1918)

Kind of food	*Total*	*Distribution*	*Use*
Vegetables	20 oz.		
Potatoes	....	12 oz. (2 medium)	1, Lunch, baked 1, Dinner, mashed
Tomato	....	4 oz. (1 small)	Dinner, salad
Lettuce	....	1 oz.	Dinner, salad
Onion	....	3 oz. (1 medium)	Dinner, cooked
Fruit	20 oz.		
Orange	....	8 oz. (1 medium)	Breakfast
Apple	....	6 oz. (1 medium)	Lunch, baked
Strawberries	....	6 oz. (2 cup)	Dinner, dessert
Milk	8 oz.		
Top milk	....	1/4 cup	Breakfast, cereal
Skim milk	....	1/8 cup	Breakfast, muffins
Skim milk	....	1/2 cup (scant)	Lunch, spoon bread
Skim milk	....	1/8 cup	Dinner, potato
Meat, etc.	14 oz.		
Eggs	....	4 oz. (2 average)	Breakfast, 1 1/4 (egg and muffin)
Eggs	....		Luncheon, 1/4 (spoon bread)
Eggs	....		Dinner, 1/4 (sponge cake) Lunch, 1/4 (salad dressing)
Fish	....	3 oz.	Lunch
Meat	....	6 oz.	Dinner
Cheese		1 oz.	Dinner
Cereals	8 oz.		
Hominy grits	....	1 1/2 oz. (1/4 cup = 3/4 cup cooked)	Breakfast, cereal
Breads	....	3 oz. cereal flours, 3/4 of 4 oz. (two 2-oz. servings)	Breakfast, wheatless bread
Rice	....	1 oz.	
Cereal flours	....	2 oz. for cooking	Lunch, 1 oz. spoon bread Dinner, 1/4 oz. sponge cake Dinner, 1/2 oz. salad dressing
Sweets	3 oz.		
Sugar	....	1 3/4 oz.	Breakfast, 1/4 oz. coffee Breakfast, 1/4 oz. cereal Lunch, 1/4 oz. tea Dinner, 1/2 oz. cake, 1/2 oz. dessert
Sirup	....	1/2 oz. } = 3/4 oz. sugar	
Candy	....	3/4 oz. }	Lunch, baked apple
Fats	3 oz.		
Butter	....	1 1/2 oz.	Each meal, 1/2 oz. fat
Cream	....	1/4 cup = 1/2 oz. fat (1/4 of 2 oz.)	Breakfast, 2 T. for coffee Dinner, 2 T. for salad
Cooking fat	....	1 oz.	Muffins, mashed potato, salad dressing, onion

SECTION VII

PRESERVATION OF FOOD BY CANNING

I. Although at certain seasons there is little material suitable for canning, probably enough can be secured even out of season to illustrate the methods. A demonstration lecture is advised in order that each step of the process may be clearly and carefully shown, emphasizing the following points:

A. Brief summary of principles of food preservation. (See pp. 207–219.)

B. Selection of material.

C. Preparation of material.

D. Methods of canning. Advantages and disadvantages of each method.

E. Types of apparatus.

F. Types of jars and cans and rubber rings.

G. Application of these principles to community canning.

II. Selection of material for canning.

A. Choose fruits and vegetables for canning at the height of the season or to save the surplus at any season.

B. Firm, well-grown, and not over-ripe fruit, and young, quickly grown vegetables are most suitable for canning. All blemishes must be removed.

C. Procure fresh products; if possible, can them the day they are gathered.

III. Preparation of material.

  A. Clean thoroughly.

  B. Pare or otherwise prepare for cooking, removing all blemishes.

  C. For best results, grade as to size, degree of ripeness, and general appearance.

  D. Special preparation of each according to character and method of canning used; e.g., "blanching" by dipping certain fruits and vegetables in scalding water.

IV. General directions for demonstrating canning methods.

  A. For the demonstration or for class work, the steps in each one of the processes given below should be carefully shown and as far as possible the following types of materials included:

    1. Fruits — rhubarb, strawberries, pineapples or apples.

    2. Vegetables.

      a. Those easily sterilized — tomatoes, beets, carrots.

      b. Those difficult to sterilize — beans, peas, spinach, asparagus, dandelion greens.

    3. Meat (probably the most difficult of all foods to can in the home).

  B. The different methods may be illustrated as follows:

    1. Open kettle (hot pack) — beets, carrots, berries, pineapple.

    2. One period or continuous (cold pack).

IV. General directions for demonstrating canning methods (*continued*).

a. Ordinary temperature — tomatoes, berries, or rhubarb.

b. Under pressure — asparagus, beans, peas.

3. Intermittent — asparagus, beans, peas, greens.

4. Combination of open kettle (hot pack) and cold pack (continuous) — meat, carrots, or beets.

For details of some of the manipulation and the length of time required for processing the different foods see the government bulletins given at the end of the section or state bulletins.

V. Methods of canning.

A. Open kettle method. This might well be called the "hot pack" method in contrast with the "cold pack." It is the earliest method used in the household.

1. Method. Cook the fruit and vegetables thoroughly in an open kettle. Fill sterilized jars with the cooked material as nearly at the boiling point as possible. Seal air tight immediately, using all precautions to avoid contamination.

2. Advantages. The boiling point is quickly reached throughout the mass and it is therefore more likely to be completely processed. Little time and only simple equipment is needed.

3. Disadvantages. It requires considerable intelligence to guard against contamination at

V. Methods of canning (*continued*).

various points. It is troublesome because everything must be handled while very hot, as near the boiling point as possible. Fruits and vegetables may be crushed by handling and packing after cooking.

B. The methods in which the food is packed cold.

1. As indicated in the name, in these methods the uncooked or partially cooked food is packed in the cans or jars while still cold or heated only as long as preliminary preparations require. The cooking or processing of the food is accomplished in the container.

2. Advantages. It is convenient because packing process can be carried on at will and requires the least handling of hot materials and utensils; permits careful and symmetrical packing, and crushing can be avoided.

   The flavor, texture and appearance of most fruits and some vegetables are better by this method.

   It is less liable to contamination during canning since there is the least handling of open jars after processing.

3. Disadvantages. It usually requires an extra process, "blanching," partially to soften and shrink material which can then be packed more satisfactorily and in some cases to improve the flavor.

C. The one period process at the ordinary boiling point, widely known as the "One Period Cold Pack" method, although cold packing is practiced in several other methods.

V. Methods of canning (*continued*).

1. Method. The filled jars are heated in a water bath which is kept boiling (100° C.) for varying lengths of time according to the kind of material to be preserved. The water bath is made by supporting the jars on a rack in any kind of closely covered vessel in which they can be surrounded by water at the boiling point. Steam cookers and the "water seal" cookers are modifications of this method.
2. Advantages. For many foods it is the easiest and most convenient method. The apparatus necessary may be contrived by using utensils found in any household, such as kettles, washboilers, or large dishpans.
3. Disadvantages. Because of the slow penetration of heat through the material, sterilization may not be accomplished, unless the time of heating is long continued.

D. One period heating under pressure, from 5 to 15 pounds or from 108° to 120° C. (227° F. to 249° F.).

1. Method. The jars, filled as in C, are heated in a vessel having a closely clamped cover so that steam pressure can be secured in a pressure cooker. Much of the liquid in the jar will be lost unless care is taken to avoid sudden changes in pressure. By observing a few precautions this may be reduced to a minimum.
   a. Allow petcock to remain open until live steam blows from it.

V. Methods of canning (*continued*).

b. Maintain uniform pressure during processing. There should be no fluctuations up or down.

c. When processing is complete, open the petcock when atmospheric pressure (zero on the pressure gage) is reached.

It should be remembered that cooking is continued during the slow cooling and the time of processing may be reduced accordingly.

2. Advantages. It is a quick, safe method with all foods and is especially valuable for community kitchens as a large amount of canning can be completed in a very short time with the least chance of spoilage.

3. Disadvantages. It requires special apparatus not common in the household. The first cost is comparatively high. Overcooking with loss in flavor may easily occur if the high temperature is applied for too long a time.

E. Intermittent method or fractional processing.

The jars, cold packed as in C, are heated in the water bath usually for 1 hour (after the water bath boils) on each of 3 successive days. This is preferred by many to the one period heating for peas, beans, corn and some other vegetables.

Disadvantages. The method is troublesome because it must be carried over several days and the jars must be handled a number of times.

F. Combination of open kettle method and processing in the jar.

V. Methods of canning (*continued*).

Some materials, as carrots and beets, are often cooked in the open kettle, then packed and processed in the jars by the one period method to counteract the effect of possible contamination in handling. Meats may also be previously cooked, sometimes by frying, then packed, and the processing completed. This is probably the simplest and safest way to can beans, peas, and corn about which there is so much debate.

G. Cold water method.

Acid fruits, such as rhubarb and gooseberries, are sometimes kept by merely sealing in sterilized jars with clean (preferably sterile) cold water. The method is not always successful.

VI. Show the penetration of heat from the water bath into the jars by the cold pack method by inserting thermometers in the center of a packed jar and observing the temperature at different stages of the process.

A. At the beginning.

B. When the water in the bath begins to boil.

C. When the water has boiled 15 minutes; 20 minutes; 30 minutes.

For the best results a very long-stemmed thermometer is needed. A hole may be cut in an old jar cover and in a kettle cover for the insertion of the thermometer so that the temperatures may be more nearly normal. If this cannot be arranged, the observations taken in the uncovered jars and kettles will be of interest, though less accurate.

VII. After the demonstrations each student should be given opportunity for as much practice as possible. She must not consider herself skilled until she has canned again and again and found that her products keep. More detailed information of the process will be found in the references below.

REFERENCES

Benson, O. H. *Home Canning by the One Period Cold Pack Method, as Taught to Canning Club Members in the Northern and Western States.* U.S. Department of Agriculture, Farmers' Bulletin 839.

Bitting, A. W. and K. G. *Canning and How to Use Canned Foods.* National Canners Association, 1916.

Bitting, A. W. *Methods Followed in the Commercial Canning of Foods.* U.S. Department of Agriculture, Bulletin 196. 1915.

Bitting, A. W. and K. G. *Bacteriological Examination of Canned Foods.* Research Laboratory, National Canners Association, Bulletin 14, 1917.

Buchanan, E. D. and R. E. *Household Bacteriology.* Macmillan, 1913.

Creswell, M. E., and Powell, O. *Home Canning of Fruits and Vegetables, as Taught to Canning Club Members in the Southern States.* U.S. Department of Agriculture, Farmers' Bulletin 853.

Jordan, E. O. *Food Poisoning.* 1917.

Powell, O. *Successful Canning and Preserving.* Lippincott, 1917.

Similar bulletins on canning are published by many States. Students should become familiar with the instructions given through the extension service of their States.

Round, L. A., and Lang, H. L. *Preservation of Vegetables by Fermentation and Salting.* U.S. Department of Agriculture, Farmers. Bulletin 881.

SECTION VIII

DEMONSTRATIONS

I. Purpose.

To make the student familiar with some of the methods used and to give a little practice in demonstration work so that she may be better able to assist official demonstrators, if opportunity should arise.

II. Each student should be required to present a topic in the form of a demonstration lasting from 15 to 30 minutes. This demonstration must be confined to a simple process which can be easily covered in that time.

A. Such topics as the following are suitable:

1. White sauce, showing the use of substitutes.
2. Cheese soufflés as meat substitutes.
3. Wheatless sponge cake.
4. Wheatless muffins.
5. Wheatless biscuits.
6. Wheatless short cake.
7. Corn bread.

B. When baked dishes are prepared, duplicate samples may be in readiness to show the finished product. Or the dish may be put into the oven at the proper time and the result shown some time later. The former method is the more desirable.

C. The chief value of teaching by the demonstration method lies in the fact that large numbers of people can be reached through a single lecture; that certain details of manipulation, which are not easily understood, can be actually shown; and that better standards may be set through showing methods of work and the finished products. The disadvantage is that only a superficial knowledge is gained and attempts to repeat what has been shown may meet with failure.

D. For these reasons, the student should present carefully written plans so that the aim and the procedure are clearly indicated.

E. If desired, students may demonstrate in groups of two, one acting as assistant to the other.

F. The part of the class serving as the audience should be required to observe the demonstration critically and hand in a written statement judging it on the points noted below. (These demonstration exercises may serve as part of the examination for the course.)

III. Points to be considered in giving demonstrations.

A. Purpose.

The chief purpose of the demonstration should be clearly and definitely stated. In demonstrating an omelet, one may merely show *how* it is made or both *how* and *why* it is so made. The process may also be merely incidental in a demonstration showing the use of meat substitutes.

B. Organization.

1. Of working arrangement — tables, stoves,

III. Points to be considered in giving demonstrations (*continued*).

utensils — their suitability for the purpose; convenience, neatness, and order of arrangement.

2. Of subject-matter — should be clear, systematic, logical, suited to the audience and the locality, and adapted to the time available.

C. Presentation.

1. Personal appearance — details of costume, neatness, and cleanliness.
2. Delivery — manner, voice, interest in the subject, sympathy with the audience.
3. Technique — skill, neatness, orderliness.
4. Use of illustrative material, such as charts, pictures, food samples, etc.
5. Finished product — success in achieving a standard.

IV. If preferred, one lesson may be devoted to a model demonstration given by the instructor with a discussion of the above points rather than to the subject-matter of the demonstration.

INDEX