PRACTICAL

DIETETICS

THOMPSON

APPLETONS

PRACTICAL DIETETICS

WITH SPECIAL REFERENCE TO DIET IN DISEASE

BY

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"Good diet with wisdom best comforteth men"
TUSSER (1520)

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PREFACE TO THE THIRD EDITION

THE third edition of this work has been prepared to meet the demands of a constantly increasing interest in the practical application of dietetic principles. The book has been revised throughout, and much new material has been added, especially in those sections which deal with the dietetic treatment of disease. Important changes have been made in the sections upon Analysis of Gastric Contents, Intestinal Autointoxication, Milk as a Food, Diabetes, etc. In the Appendix a number of new tables will be found which are of practical application. It is rarely feasible to feed the sick upon any system of accurate food weighing, laboratory calculations of calories, or the results of single analyses of gastric contents. Such systems add scientific interest to the general subject of dietetics, but the problems of right feeding in disease must be studied in the light of clinical experience, and modified to meet ever changing conditions. One of the commonest of dietetic errors is the too long continuance of a dietary which, although at first beneficial, may result in anæmia or asthenia by becoming monotonous or failing to meet all the complex demands of nutrition. Diseases apparently demanding opposite dietetic treatment may coexist in the same patient, and without great care starvation may ensue. No one food is curative of any disease, just as no one food may be said to be causative of any disease. These principles, which form the basis of the book, have been still further emphasized in the present edition.

W. G. T.

INTRODUCTION TO THE FIRST EDITION

THE subject of the dietetic treatment of disease has not received the attention in medical literature which it deserves, and it is to be regretted that in the curriculum of medical colleges it is usually either omitted or is disposed of in one or two brief lectures at the end of a course in general therapeutics. Upon examining the standard treatises upon the Theory and Practice of Medicine, as well as monographs upon important diseases, such as those of the circulation, nervous system, and skin, one cannot fail to be impressed with the meagre notice given to the necessity of feeding patients properly, and the subject is usually dismissed with such brief and indefinite phrases as "The value of nutritious diet requires mere mention," "A proper but restricted diet is recommended," and favourite, if not convincing, expressions are, "The patient should be carefully fed," and "General dietetic treatment is of primary importance." With such vague directions the dieting must indeed be very "general."

In many excellent works upon food and dietetics the space devoted to the practical application of dietetics to disease is comparatively insignificant, and much less emphasis is given to this matter in hospitals and in the training of nurses than is demanded in the interests of medical science.

A writer of wide experience in practical dietetics, Mrs. E. H. Richards, says: "At present there are comparatively few persons who are called upon to feed the sick to whom a glass of milk or a pound of beef represent any definite amount of food materials. Still fewer who can tell how much food value a glass of lemon jelly or wine whey represents, and yet the adult patient is dependent upon the attendant even more than the week-old infant for the requisite nutrition."

The present volume has been prepared with the view of in some measure making good such deficiencies by furnishing a text-book in which the practitioner of medicine may find detailed the appropriate diet for each disease which is at all influenced by right feeding.

Quite as much depends upon the suitable preparation of food as upon the selection and limitation of the food itself, and it has therefore been thought advisable to include a general account of the composition and uses of foods, and the changes which may be produced in them by cooking and other processes. In this first portion of the work, however, the practical application of such knowledge to the feeding of the sick has been constantly emphasised rather than unnecessary scientific detail.

The reader will also find a discussion of representative hospital dietaries, the official dietaries of Government institutions, and sections upon the proper feeding of infants and children. Numerous cross references and a complete index have been added to avoid undue repetition.

Bennett wrote, as long ago as 1858: "Of all the means of cure at our disposal, attention to the quantity and quality of the ingesta is by far the most powerful." While fully concurring in this view, that appropriate dieting is often more needed than medication, I distinctly disclaim the advocacy of any special dietetic system as a cure-all, as well as the specific influence of any one food in the general treatment of disease. It cannot be expected that the experience of a single individual should cover so extensive a ground as that which embraces the relative advantages of all foods, and I have therefore impartially introduced the views of others, especially where, as in such diseases as gout, diabetes, and obesity, opposing dietetic theories are held by clinicians of extensive experience and authority. Due acknowledgment of these references is made in the text, but the admirable researches upon foods of our own Government, found in the published reports of the Department of Agriculture, are especially to be commended.

W. Gilman Thompson.

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PART I

FOODS AND FOOD PREPARATIONS

ELEMENTARY COMPOSITION OF FOODS

Of the eighty-two chemical elements, thirteen enter uniformly into the composition of the body and ten more are occasionally found. Of all these, several exist in very small proportion and their uses are unknown, several are found more abundantly but are not indispensable to life, and certain elements—namely, carbon, hydrogen, oxygen, and nitrogen—are necessary ingredients of the tissues of the body. These elements form compounds which, as they occur in the structure of the various tissues, have the following characteristics:

First, although the elements are but few in number, their molecular arrangement is very complex.

Second, their compounds are comparatively unstable and are readily converted in the body or by chemical analysis into other forms.

All food is composed of combinations of these simpler chemical elements which, for the most part, must be subjected to alteration in the body itself to prepare it for assimilation by the tissues. The nutrition of the body, therefore, involves four distinct processes, viz.:

1. The secretion of digestive fluids and their action upon food in the alimentary canal.
2. The absorption of the ingredients of the food when digested into the blood vessels and lymphatic vessels.
3. The assimilation of the absorbed nutritious products by the tissues.
4. The elimination of the waste material.

The following analysis exhibits the relative proportion of the elements of which the human body is composed:

Approximate Chemical Analysis of a Man (Moss)

(Height, 5 feet 8 inches; weight, 148 pounds.)

Oxygen	92.4	pounds.
Hydrogen	14.6	"
Carbon	31.6	"
Nitrogen	4.6	"
Phosphorus	1.4	"
Calcium	2.8	"
Sulphur	0.24	"
Chlorine	0.12	"
Sodium	0.12	"
Iron	0.02	"
Potassium	0.34	"
Magnesium	0.04	"
Silica	?	
Fluorine	0.02	"
Total	148.00	pounds.

All these elements are necessarily derived from food and water plus the oxygen of the air which is breathed.

The three predominating elements—oxygen, hydrogen, and carbon—are the great force producers of the body, although they are tissue formers as well, and to them must be added nitrogen, as serving in this double capacity, although its relation to tissue formation and renewal is greater than its capacity for supplying energy.

The common elements which enter into tissue formation chiefly and which bear no direct relation to the main sources of the force production in the body are chlorine, sulphur, phosphorus, iron, sodium, potassium, calcium, and magnesium in different combinations. Bone tissue, for example, contains about 50 per cent of lime phosphate. If this substance is deficient in the food of the young growing infant, the bones are poorly developed and so soft that they yield to the strain of the weight of the body and become bent and out of shape. This constitutes one of the principal symptoms of rickets.

Lack of iron salts in the food impoverishes the colouring matter of the red blood-corpuscles on which they depend for their power of carrying oxygen to the tissues, and anæmia and other disorders of deficient oxidation result.

The lack of sufficient potash salts, especially potassium carbonate and chloride, is a factor in producing scurvy, and the condition is intensified by the use of common salt. A diet of salt meat and farinaceous foods with absence of potatoes and fresh fruit and vegetables may cause it.

The lack of sodium chloride interferes with many of the functions of the body immediately concerned with nutrition, such as absorption (osmosis), secretion, etc., and alters the density and reactions of the different body fluids.

These few illustrations suggest the diversity of rôles exhibited by the elements and the need for a correctly balanced diet.

In order to determine what such a diet should consist of it is necessary to study the value of the principal classes of foods in force production and in nutrient power or tissue building, but before proceeding further with this discussion it will be advisable to adopt a simple comprehensive classification of the foods in general use by man.

The following table of analyses made by Dujardin-Beaumetz is quoted by Yeo to show the proportion of nitrogen present in different foods, and also the combustible carbon and hydrogen.

" The hydrogen existing in the compound in excess of what is required to form water with the oxygen present is calculated as carbon. It is only necessary to multiply the nitrogen by 6.5 to obtain the amount of dry proteids in 100 grammes of the fresh food substance : "

	Nitrogen.	C + H. Combustibles calculated as carbon.
Beef (uncooked)	3.00	11.00
Roast beef	3.53	17.76
Calf's liver	3.09	15.68
Foie-gras	2.12	65.58
Sheep's kidneys	2.66	12.13
Skate	3.83	12.25
Cod, salted	5.02	16.00
Herring, salted	3.11	23.00
Herring, fresh	1.83	21.00
Whiting	2.41	9.00
Mackerel	3.74	19.26
Sole	1.91	12.25
Salmon	2.09	16.00
Carp	3.49	12.10
Oysters	2.13	7.18
Lobster (uncooked)	2.93	10.96
Eggs	1.90	13.50
Milk (cow's)	0.66	8.00
Cheese (Brie)	2.93	35.00
Cheese (Gruyère)	5.00	38.00
Cheese (Roquefort)	4.21	44.44
Chocolate	1.52	58.00
Wheat (hard southern, variable average)	3.00	41.00
Wheat (soft southern, variable average)	1.81	39.00
Flour, white (Paris)	1.64	38.50
Rye flour	1.75	41.00
Winter barley	1.90	40.00
Maize	1.70	44.00
Buckwheat	2.20	42.50
Rice	1.80	41.00
Oatmeal	1.95	44.00
Bread, white (Paris, thirty per cent water)	1.08	29.50
Bread, brown (soldiers' rations formerly)	1.07	28.00
Bread, brown (soldiers' rations at present)	1.20	30.00
Bread from flour of hard wheat	2.20	31.00
Potatoes	0.33	11.00
Beans	4.50	42.00

	Nitrogen.	C + H. Combustibles calculated as carbon.
Haricots (dry)	3.92	43.00
Lentils (dry)	3.87	43.00
Peas (dry)	3.66	44.00
Carrots	0.31	5.50
Mushrooms	0.60	4.52
Figs (fresh)	0.41	15.50
Figs (dry)	0.92	34.00
Plums	0.75	28.00
Coffee (infusion of 100 grammes)	1.10	9.00
Tea (infusion of 100 grammes)	1.00	10.50
Bacon	1.29	71.14
Butter (fresh)	0.64	83.00
Olive oil	Trace	98.00
Beer, strong	0.05	4.50
Wine	0.15	4.00

To estimate the equivalent chemical elements in the different classes the following standards are adopted:

1. To obtain the amount of nitrogen in proteid foods, divide the quantity of food by 6.50.

2. To obtain the carbon in fat, multiply the quantity of fat by 0.765.

3. To obtain the carbon in carbohydrate food, multiply by 0.444.

4. To obtain the carbon in proteid food, multiply by 0.535.

Estimates vary somewhat as to the average quantity of the elements carbon and nitrogen consumed per diem. In a general way it may be said that the consumption of carbon is 320 grammes, and that of nitrogen about 20 grammes. (See Quantity of Food, page 287.)

FOOD CLASSIFICATION

Foods may be classified in various ways, according to—

1. Their physical properties.
2. Their source.
3. Their composition.
4. The rôle which they perform in the animal body.

Foods are classed in accordance with their general physical properties: First, into solid, semisolid, and liquid foods; secondly, into fibrous, gelatinous, starchy, oleaginous, crystalline, and albuminous foods.

A subdivision sometimes used is that of the "complete" foods, such as eggs or milk, which in a single article comprise all the necessary ingredients and elements to support life, and "incomplete" foods, which are capable of maintaining life but a comparatively short time.

Foods may be classed as to their source primarily into animal and vegetable foods.

Animal foods consist of meats, fish, shellfish, and crustaceans, eggs, milk and its products, animal fats, gelatin. The vegetable foods are subdivided into cereals, vegetables proper, fruits, sugars, vegetable oils.

The simplest chemical classification possible is that advocated by Baron von Liebig, who was the first to suggest a really scientific division of foods. He grouped all foods into two classes—

a. Nitrogenous. *b*. Non-nitrogenous.

Each of these classes contains food materials derived from both the animal and vegetable kingdoms, although the majority of the animal substances belong to the nitrogenous, and the majority of vegetable substances to the non-nitrogenous group.

a. The nitrogenous group von Liebig regarded as containing "plastic" elements—i. e., they are essentially "tissue builders" or "flesh formers."

Nitrogenous foods are sometimes called "azotised foods" or "albuminoids"—that is, substances resembling albumin. They consist chiefly of the four elements carbon, oxygen, hydrogen, and nitrogen, to which a small proportion of sulphur and phosphorus are usually joined. These elements for the most part are combined as some form of albumin.

Nitrogenous or proteid foods are non-crystallisable, but coagulable, principally fluid or semisolid substances. They are fermentable, and under some conditions will putrefy.

The nitrogenous group comprises all forms of animal food, excepting fats, glycogen, and such substances as milk-sugar and honey. It includes, therefore, albumins and gelatins. Its chief representatives are milk, eggs, crustaceans, fish, shellfish, flesh, and fowl. It also contains such nitrogenous substances as exist in the vegetable kingdom or "vegetable albuminoids."

b. The second or non-nitrogenous group von Liebig called "respiratory or calorifacient foods," because their function in the body is to furnish fuel or maintain animal heat. Since this original classification was suggested it has been established that the non-nitrogenous aliments supply energy as force, manifested through muscular action, hence they are also called "force producers," in distinction from the nitrogenous or proteid "tissue builders."

This is a convenient distinction to adopt, but it must not be held too absolutely, for in emergencies the tissue builders are used as force producers and heat producers as well.

The non-nitrogenous group contains strictly only the three elements carbon, hydrogen, and oxygen, although various salts are mixed with both vegetable and animal foods. It includes vegetables, fruits, cereals, starches, sugars, gums, fats and oils (which latter are both animal and vegetable), and organic acids. Many vegetables, besides some fruits, contain considerable nitrogen, but the "carbohydrates"—i. e., starches and sugars—constitute their main bulk.

Many vegetables, and, in fact, all starch granules, contain proteid material which is chiefly used in the formation of outside coverings to afford protection and firmness of resistance to a softer pulp within.

Neither is animal food strictly nitrogenous, on account of its fat and glycogen, nor is vegetable food strictly non-nitrogenous, owing to its albuminoids and other forms of proteids (such as plant albumin, found in the legumes, etc.), yet this classification is a very convenient and simple one which has met with general acceptance. It will be used in this book whenever a further degree of subdivision is not needed, but always with the understanding that it has only a general and not too literal application, and, unless otherwise distinctly specified, "nitrogenous food" will be understood to include animal food, and "non-nitrogenous food" to include vegetable food of all kinds, and *vice versa*.

Table of Composition of Some Common Foods

(Hofmann.)

	Nitrogenous constituents.	Fat.	Carbo-hydrates.	Salts.	Total.
Fat beef	51.4	45.6	....	3.0	100
Lean beef	89.4	5.5	....	5.1	100
Pea flour	27.3	0.8	68.9	3.0	100
Wheat	16.6	0.9	81.9	0.6	100
Rice	7.7	0.4	91.2	0.7	100

Table of Composition of Common Foods

(Abridged from Parkes.)

Articles.	Water.	Proteids.	Fats.	Carbo-hydrates.	Salts.
Beefsteak	74.4	20.5	3.5	....	1.6
Fat pork	39.0	9.8	48.9	....	2.3
Smoked ham	27.8	24.0	36.5	....	10.1
Whitefish	78.0	18.1	2.9	....	1.0
Poultry	74.0	21.0	3.8	....	1.2
White wheat in bread	40.0	8.0	1.5	49.2	1.3
Biscuit	8.0	15.6	1.3	73.4	1.7
Oatmeal	15.0	12.6	5.6	63.0	3.0
Maize	13.5	10.0	6.7	64.5	1.4
Macaroni	13.1	9.0	0.3	76.8	0.8
Arrowroot	15.4	0.8	....	83.3	0.27
Peas (dry)	15.0	22.0	2.0	53.0	2.4
Potatoes	74.0	2.0	0.16	21.0	1.0
Carrots	85.0	1.6	0.25	8.4	1.0
Cabbages	91.0	1.8	5.0	5.8	0.7
Butter	6.0	0.3	91.0	....	2.7
Egg (1-10 for shell)	73.5	13.5	11.6	....	1.0
Cheese	36.8	33.5	24.3	....	5.4
Milk (specific gravity, 1032)	86.8	4.0	3.7	4.8	0.7
Cream	66.0	2.7	26.7	2.8	1.8
Skimmed milk	88.0	4.0	1.8	5.4	0.8
Sugar	3.0	....	....	96.5	0.5

The foregoing analyses by Hofmann and Parkes of several common foods illustrate the mixed character of animal and vegetable foods and the difficulties of a purely chemical basis of classification.

For the purpose of the present work, it is convenient to subdivide foods by the following classification: I. Water; II. Salts; III. Proteids (chiefly albumins and the allied gelatin); IV. Starches; V. Sugars; VI. Fats and oils.

Protein is a comprehensive term used in food calculations to signify all nitrogenous food substances, except the nitrogenous fats. *Proteids* are nitrogenous substances of definite composition forming a portion of the protein class.

Some writers class oxygen in a separate division among foods. This seems unnecessary, unless a separate division is made for hydrogen, and in fact for each element. The primary object of food classification is to obtain a practical working basis of subdivision, and the less complex this is made, the better. Further details of grouping belong to the refinements of physiological or organic chemistry, and are out of place in the present work.

FORCE PRODUCTION. ENERGY FROM FOOD

The two ultimate uses of all food are to supply the body with materials for growth or renewal, and with energy or the capacity for doing work. The energy received in a latent form, stored in the various chemical combinations of foods, is liberated as kinetic or active energy in two chief forms: first, as heat; second, as motion. Force is the manifestation of energy. The force developed by a healthy adult man at ordinary labour averages 3,400 foot tons per diem, a foot ton being the amount of force required to raise a weight of one ton through the height of one foot. Of this, less than one fifth is expended in motion, and more than four fifths, or 2,840 foot tons, in heat, which maintains the body temperature at its normal average. A man weighing one hundred and fifty pounds—or nearly one thirteenth of a ton—obviously expends considerable energy in merely moving his own body about from place to place, aside from carrying any additional burden.

The original force developed in the various functions of animal life which result in heat production and motion is in part obtained from the radiant heat of the sun stored by plants in the latent form of certain chemical compounds—chiefly starches and sugars—which, on being consumed as food by animals, furnish energy.

A useful comparison may be made between the processes of nutrition and development of energy from food in the human body and the energy derived from a steam engine and boiler. In both cases the main source of energy is oxidation, and principally of carbon. In both cases the latent energy of the carbon liberated by oxidation processes is converted into heat and motion, forms of energy which bear a definite relation to one another. If a large part of the original latent energy is converted into heat, less will yield motion, and conversely. The proportion of these two forces to each other is in the case of the most perfectly constructed engine about one of motion to eight of heat; whereas in the human body it was calculated by Helmholtz that the motion obtainable from a given amount of food may stand in relation to the heat in the proportion of one to five. Hence, as regards the production of work through motion, the human body is a more perfectly constructed machine than the engine. Furthermore, after combustion of the carbon by the fires of the boiler a certain amount of waste matter or ash is produced. If this is allowed to accumulate, it obstructs the draught and interferes with active oxidation. In the human body, in like manner, the fuel or food consumed produces ashes, such as urea and other forms of waste material, which, if not removed, accumulate in the system and embarrass or retard the normal oxidation processes. The body possesses the additional power of modifying and distributing the fuel food which it receives so as to develop its energy to the best advantage in different organs.

R. C. Carpenter, in 1898, made an exhaustive study of the energy developed by a bicycle-rider named Miller. He found that the energy developed by this man equalled 45 per cent of the total heat of combustion calculated for his food. Professor Carpenter says: "The best record of any heat engine is probably that of the Deisal motor," which develops 33.7 per cent of the heat energy of its fuel, and "the best record of a steam engine is that of the Nordberg pumping engine at Pittsburg," which develops 22.7 per cent of energy.

"With the exception of the Deisal motor the best record of any oil engine per delivered horse power is about 16.5 per cent efficiency. From this comparison it would seem that the human machine is decidedly superior to any heat engine which has been developed in form so as to be of any value for practical use."

Whether elementary substances are burned outside of the body or oxidised within the body, the resulting products are the same. There can be no loss of matter, and there can be no loss of energy. The matter is simply changed in form by molecular rearrangement, the energy is converted from one type into another. The following simple experiment will illustrate this point: In a large covered glass jar place an ounce of alcohol in a small metal vessel. Also place in the jar a little lime water in a tumbler, and a thermometer. On igniting the alcohol and allowing it to burn away completely, a film of aqueous vapour will accumulate on the surface of the jar, and a film of calcium carbonate will form on the surface of the lime water produced by the union of carbonic-acid gas with the lime water.

The thermometer will indicate a rise in temperature of the air in the jar. An ounce of alcohol consumed as food will be similarly converted into carbonic-acid gas and water, and in this process the body heat will be increased. No substance is a good food unless it fulfils two conditions—viz., easy assimilation and complete combustion. The proportion of any given food actually assimilated (i. e., not rejected in the feces) is called its "coefficient of digestibility."

Metabolism within the body is not alone controlled by muscular work, but by the nervous energy expended in its performance. For example, a day labourer, like an iron founder, may be stronger and do much more mechanical work than an oarsman or foot-ball player in time of contest, yet he expends very little nervous energy in his routine daily work, and requires less protein in his diet than the athlete. In other words, severe muscular work performed for a brief time under conditions of great mental excitement and nervous tension demands an excess of protein, whereas continued muscular effort without great fatigue or mental strain is maintained upon a liberal allowance of food, which may be varied in composition if it be easily digestible.

The relative importance of the different food fuels should be considered. This is well summarised by Charles E. Woodruff:

"For instance, cut off the supply of oxygen, and death ensues in from one to ten minutes. If water is withheld, preventing the transportation of the fuel and oxygen to various parts of the body, death follows in about two to seven days or more, according to climate, exposure, and exercise. If the fuel itself is taken away, death follows in from seven to forty days or more, according to the amount of exposure that would abstract heat and the amount of work that would use up the energy already stored up in the body. If materials for the repair of tissues be excluded, death follows in a variable time, dependent upon the importance of the tissue that is being starved—a time varying from a week if all nitrogen is excluded, to several months if the vegetable acids are excluded, or even to several years" —if certain more obscure substances are withheld.

It still remains extremely difficult in the case of all foods to trace their final uses in the body and determine with any approach to accuracy what proportions of each furnish respectively energy, repair of tissue, and heat, for there are no more complex chemical processes known than those of tissue metabolism. In other words, it is necessary to determine whether the actual physiological value of food in the body as producing energy for muscular activity and body heat corresponds with its calculated or calorimetric value, and to determine standards of "fuel value."

In order to study the quantity of energy which may be derived from different varieties of food, a man or an animal may be placed in an apparatus known as a calorimeter. There are numerous types of such apparatus, and Professor Atwater collected, in 1897, data of 3,661 calorimeter experiments, 2,299 of which have been made by various observers upon man. In the great majority of these experiments the nitrogen balance was determined, and the carbon balance was computed by deduction, but in a few the latter was determined directly. The most elaborate and ingenious apparatus of this sort is the "respiration calorimeter" constructed at Wesleyan University by Profs. W. O. Atwater and E. B. Rosa. It consists of a chamber seven feet long, six feet four inches high, and four feet wide, in which a man may remain day and night, being supplied with fresh air and food. The chamber is practically a many-walled, air-tight box having air spaces between the walls which are so constructed as to maintain a uniform temperature within and prevent all external temperature changes from affecting the interior. There are two inner metal walls composed respectively of copper and zinc, and three outer wooden walls reinforced by thick builders' paper. Between these five walls, which completely surround the box, over top and bottom as well as sides, are four air spaces several inches in thickness, two containing dead air and two circulating air, kept in motion by electric fans and warmed or cooled according to need, so as to maintain a constant temperature within. A glass window constructed with successive layers like the walls serves to admit the man under observation, after which it is hermetically soldered. A small air lock is used to admit food and to pass out excrement for analysis. The chamber contains a folding bed, table, and chair, a pair of scales, and a stationary bicycle which operates a small dynamo and electric light. The heat from the light is measured, together with that dissipated from the man's body within the chamber, and this gives a measure of muscular work converted into the energy of heat. The heat is conveyed away from the chamber by means of a current of cold water passing through copper pipes, and is measured by electric thermometers. Circulating air is supplied to the interior of the chamber, and samples are withdrawn for analysis as it enters and leaves the chamber. In this manner is measured the quantity of CO_2 and water eliminated through the lungs and skin. The volume and temperature of the air is carefully regulated. The subject of experimentation is put upon a measured diet for four days before entering the calorimeter in order to establish nitrogenous equilibrium and record observations upon the food excrement, amount of work performed, etc. He then enters the calorimeter, where he remains four days and five nights. In the "test experiments" the subject makes as little muscular exertion as possible, but in the "work experiments" he operates the stationary bicycle for eight hours a day. The delicacy of the apparatus is shown by the fact that in the thermo-electric measurement system 304 pairs of metallic junctions are distributed throughout the inner wall air space, and the heat generated by such slight movements as turning in bed or rising from a chair at once produces a deflection of the thermal galvanometer. The main value of the experiments thus far conducted in this calorimeter consists in the actual demonstration that the law of the conservation of energy operates within the body in precisely the same manner that it does outside. In man it was found that the measured energy of the food consumed by the subject within the calorimeter was within 99 per cent of the calculated or theoretical energy. A margin of 1 per cent of error is certainly very small in view of the difficulties of such complicated experiments. It is possible that some of the energy was permanently stored within the body, and another physiological source of slight error lies in possible differences in temperature of the whole body between entering and leaving the calorimeter. The other important use of the respiration calorimeter is to determine the fuel value of different foods, alcohol, etc., in furnishing heat and motion for the body. The complete calorimeter experiment comprises: (1) weighing and analysis of food, feces, and urine; (2) determination of the CO_2 and water eliminated by the patient; (3) estimation of the energy produced by the body in the form of heat, both when at rest and in motion, the motion being converted into heat by means of the bicycle and dynamo above described. The results obtained by Professor Atwater in two of his calorimeter experiments are tabulated by him as follows:

Comparison of Daily Income and Outgo of Protein and of Energy in the Rest and Work Experiments (Nos. 9 and 6)

Experiment.	Protein.		Energy.			
	Of food.	Actually oxidised.	Of food.	Of material actually oxidised.	Measured.	Difference in per cent of heat of material actually oxidised.
	Grammes.	*Grammes.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Rest (No. 9).........	119.4	115.0	2,717	2,275	2,310	+ 1.5
Work (No. 6)........	119.4	103.1	3,678	3,830	3,726	− 2.7

Average Daily Income and Outgo of Nitrogen and Carbon in the Rest and Work Experiments (Nos. 9 and 6), with the Estimated Gain or Loss of Protein and of Fat

Experiment.	Nitrogen.				Carbon.					Calculated gain or loss.	
	In food.	In feces.	In urine.	Gain (+) or loss (−).	In food.	In feces.	In urine.	In respiratory products.	Gain (+) or loss (−).	Of protein.	Of fat.
	Gms.	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Rest (No. 9)..	19.1	1.2	18.4	−0.6	261.5	13.3	12.6	223.6	+12.0	−3.6	+18.2
Work (No. 6).	19.1	1.5	16.5	+1.1	336.7	12.4	12.5	345.2	−33.3	+6.9	−48.3

An ingenious device was used to differentiate the feces belonging to the period of experimentation before entering the calorimeter from those following ingestion of food within the apparatus. To do this, just before entering the calorimeter the man is required to take a few grains of lampblack with his food. This harmless substance colours the stool and marks the dividing line.

The unit of measurement used in calorimeter experiments is the calorie, which is the amount of heat required to raise 1 kilogramme of water from 0° to 1° C.; this equals 3,100 foot pounds, or, approximately, it is the heat required to raise one pound of water 4° Fahrenheit. *Fuel value* is a term denoting the total calories derivable from a pound of any given food substance if it be completely combusted within the body. The fuel values are calculated for a given food by the factors of Rubner as follows: 4.1 calories per gramme of either protein or carbohydrate, and 9.3 calories per gramme of fat. This corresponds with 18.6 calories of energy for each hundredth of a pound of protein or carbohydrate and 42.2 calories for the same quantity of fat in any food (W. O. Atwater). Or, as stated by C. F. Langworthy, the fuel value of the three chief classes of nutrients is as follows:

One pound of protein yields........................	1,860 calories.
" " " fats "	4,220 "
" " " carbohydrates........................	1,860 "

" In other words, when we compare the nutrients in respect to their fuel values, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumin of egg is just about equivalent to a pound of sugar or starch, and a little over two pounds of either would be required to equal a pound of the fat of meat or butter or the body fat."

The work of the average man is calculated to be about 2,000,000 foot pounds per diem (R. H. Thurston). This may exceptionally be increased to 3,000,000 foot pounds. According to the study of R. C. Carpenter of a phenomenal athlete named Miller, the latter developed work amounting to over 15,000,000 foot pounds (7,500 foot tons) on the first day of a six-days' bicycle contest, and 5,500,000 foot pounds (2,750 foot tons) on the last day.

Elaborate investigations have been made with all the principal classes of foods in order to estimate their nutrient, their heat-producing, and their force-producing value, and many statistical tables have been compiled. It should be remembered that all this work is merely approximate, and that the liability to error in the various factors is considerable, but in a general way the results are instructive, and they are certainly interesting and not altogether without practical application. " The fuel value of a pound of protein as it is ordinarily burned in the body is very nearly the same as that of a pound of carbohydrates, but fats have a fuel value of two and one quarter times that of protein and carbohydrates, or 4,220 calories per pound" (A. C. True). A day labourer requires 0.28 pound of protein per diem plus enough fat and carbohydrate to yield a total fuel value of 3,500 calories. A professional man requires 0.22 to 0.25 pound of protein to yield 2,700 to 3,000 calories of energy, but more than that is often consumed. Study at the Storrs experiment station in Connecticut (1896) of nine families of professional men showed an actual consumption of 107 grammes of protein, and a diet fuel value of 3,430 calories. The standard for a man at light muscular labour demands 112 grammes of protein and a fuel value of 3,000 calories.

The mere calculation of the nitrogen and carbon in a food does not at all show its force value in the body, unless it can at the same time be demonstrated that it is assimilable. Many substances appear to contain abundant food energy which in reality are not economical foods at all from the point of view of supplying all the needs of the body; thus beef fat is wholesome, but it contains no nitrogen for tissue building, and peas contain a large proportion of flesh formers as compared with heat givers. Wood pulp can be made to furnish cellulose and yield much energy, but it is worse than useless in the stomach of man, although some of the lower animals, like rodents, can digest it and make it available for nutrition. Sugar can be made from old rags in the laboratory, yet no stomach can deal with such material.

Tables are now available for the calculation of the force value of rations for large bodies of men under different conditions, as, for example, soldiers in barracks or on the march, which are based upon the principle of careful comparisons between the income and output of energy of the body. That is to say, a study of the force-producing value of different classes of foods, as obtained by chemical research in the laboratory, is carefully compared with the amount of waste matter which is eliminated by the system while a man is being fed upon a measured quantity of food and kept under uniform conditions as regards the amount of work performed. In this manner a check is established upon the theoretical calculations of food values as compared with their practical uses in maintaining the equilibrium of the body. Obviously these experiments require great care and system, and if they are to be made of intrinsic value they can only be conducted by expert physiological chemists upon persons who are willing to subject themselves from periods varying from several days to several weeks to conditions involving monotony of diet and existence. For this reason the number of actual experiments of this kind which have been made is comparatively small, and the conclusions drawn from them must be accepted with considerable allowance for possible error. A diet system to which a man may be willing to submit for a few weeks is by no means always that which will prove best for him through a longer period, and a too rigid application of the rules established for the computation of the force value of foods yields much less practical results than the experience derived by those who actually control the commissary department with due regard to proper economy and variation in food, but entirely without resort to calculations of grammes of carbon, nitrogen, etc.

A criticism reached me from the inmates of a large girls' college, where the diet was for some time experimentally regulated by an expert in such matters, that "if one half the time were bestowed upon properly serving and selecting the food that is given to computation of its force-producing value, the girls would have very much better appetites and digestion." On the other hand, it is easy to err if the dictates of hunger and capriciousness of appetite are allowed to wholly control diet. In the lower animals the instincts which these factors develop are very much safer guides than in the case of man.

Nevertheless, the knowledge derived from experiments of the kind under discussion is certainly useful and instructive, when allowance is made for its relative value by taking into consideration the wide range of circumstances that will modify its application which occur in the organisation of different persons, in their varying capacity for work, and in the condition of their external surroundings. With this word of explanation the following tables from different authors are reproduced. It will be observed that there are some few discrepancies among them, but the cause has been explained above.

The following table of analyses, given by Major Charles E. Woodruff, M. D., Surgeon, United States Army, differs in some details from the preceding table by Parkes (p. 6), and adds several foods with their calories:

Percentage Composition of Edible Portions of Garrison Ration

	Water.	Protein.	Fats.	Carbohydrates.	Salts.	Energy, calories per lb.
Bacon, fat	20.0	8.00	69.5	....	2.5	3,080
Beans	12.6	23.10	2.0	59.2	3.1	1,615
Pork, salt and fat	12.1	0.90	82.8	....	4.2	3,510
Sugar, ground	2.0	.....	....	97.8	0.2	1,820
Sugar, brown issue	3.c	.....	....	96.5	0.5	1,795
Flour	12.5	11.00	1.0	74.9	0.5	1,644
Beef	55.0	17.10	27.0	....	0.9	1,460
Potatoes	78.9	2.10	0.1	17.9	1.0	375
Onions	87.6	1.4	0.3	10.1	0.6	225
Oatmeal	7.6	15.10	7.1	68.2	2.0	1,850
Cornmeal	15.0	9.20	3.8	70.6	1.4	1,645
Canned apples	83.2	0.20	0.4	15.9	0.3	315
Dried apples	25.0	0.90	1.8	71.5	1.4	1,418
Tapioca or cornstarch	2.0	.....	....	97.8	0.2	1,820

	Water.	Protein.	Fats.	Carbo-hydrates.	Salts.	Energy, calories per lb.
Butter	10.5	1.00	85.0	0.5	3.0	3,615
Sirup	43.7	.....	....	55.0	2.3	1,023
Lard	12.0	0.60	83.4	....	4.0	3,570
Rice	12.4	7.4	0.4	79.4	0.4	1,630
Canned corn	81.3	2.80	1.1	13.2	0.6	345
Canned tomatoes	96.0	0.80	0.4	2.5	0.3	80
Macaroni and vermicelli.	13.1	9.00	0.3	76.8	0.8	1,406
Milk, fresh	14.1	0.843	0.802	1.069	0.164	418
Milk, condensed	25.0	17.00	11.0	44.00	3.0	1,595
Peas	12.3	26.70	1.7	56.40	2.9	1,565
Raisins	40.0	0.40	....	24.00	0.6	440
Cheese	35.0	33.00	22.0	5 00	5.0	1,600
Prunes	30.0	2.50	....	12.0	0.6	140
Cabbage	92.0	2.10	0.6	5.5	1.1	155
Ham	41.5	16.7	39.1	....	2.7	1,960
Apricots, canned	50.0	2.00	....	30.0	0.6	460
Barley	....	13.00	2.7	76.0	3.0	1,800
Chocolate	12.0	20.00	50.0	10.0	4.0	2,650
Sausage	41.2	13.80	42.8	....	2.2	2,065
Oysters	87.1	6.00	1.2	3.7	2.0	230
Salmon, canned	63.6	21.60	13.4	....	1.4	965
Crabs	....	15.0	1.0	....	....	526
Crackers	....	10.3	9.4	70.5	....	1,900

Standards for Daily Dietaries

(Compiled by Atwater.)

Weights of nutrients and calories of energy (heat units) in nutrients required in food per day.

	NUTRIENTS.				Potential energy.
	Protein.	Fats.	Carbo-hydrates.	Total.	
	Grammes.	*Grammes.*	*Grammes.*	*Grms.*	*Calories.*
1. Children up to a year and a half	28 (20–36)	37 (30–45)	75 (60–90)	140	767
2. Children of two to six years	55 (36–70)	40 (35–48)	200 (100–250)	295	1,418
3. Children of six to fifteen years	75 (70–80)	43 (37–50)	325 (250–400)	443	2,041
4. Aged woman	80	50	260	390	1,859
5. Aged man	100	68	350	518	2,477
6. Women at moderate work (Voit)	92	44	400	536	2,426
7. Man at moderate work (Voit)	118	56	500	674	3,055
8. Man at hard work (Voit)	145	100	450	695	3,370
9. Man with moderate exercise (Playfair)	119	51	531	701	3,139
10. Active labour (Playfair)	156	71	568	795	3,629
11. Hard labour (Playfair)	185	71	568	824	3,748
12. Women with light exercise (Atwater)	80	80	300	460	2,300
13. Man with light exercise (Atwater).	100	100	360	460	2,820
14. Man at moderate work (Atwater)	125	125	450	700	3,520
15. Man at hard work (Atwater)	150	150	500	800	4,060
16. Man at moderate work (Moleschott)	130	40	550	720	3,160
17. Man at moderate work (Wolff)	120	35	540	695	3,032

Church furnishes the following table showing the number of tons which it is calculated could be raised through the height of one foot by the *complete* combustion of a single pound of each kind of food. In the body only about a fifth of this energy would develop work, the rest going into heat production:

1 pound	beef fat	raises	5,649	tons	1	foot	high.
"	oatmeal	"	2,439	"	"	"	
"	gelatin	"	2,270	"	"	"	
"	lean beef	"	885	"	"	"	
"	potatoes	"	618	"	"	"	
"	milk	"	390	"	"	"	
"	ground rice	"	2,330	"	"	"	

Landois and Stirling give the following table, which differs somewhat from other estimates in the relative proportion of fats and starches. An adult doing a moderate amount of work takes in as food per diem—

	C.	H.	N.	O.
120 grammes albumin, containing....	64.18	8.60	18.88	28.34
90 " fats, containing........	70.20	10.26	.....	9.54
330 " starches, containing....	146.82	20.33	.....	162.85
	281.20	39.19	18.88	200.73

Add 744.11 grammes O. from the air by respiration.
" 2,818.00 " H_2O.
" 32.00 " inorganic compounds (salts).

The whole is equal to three kilogrammes and a half (seven pounds), i. e., about a twentieth of the body weight, so that about 6 per cent of the water, about 6 per cent of the fat, about 1 per cent of the albumin, and about 0.4 per cent of the salts of the body are daily transformed within the organism.

An adult doing a moderate amount of work eliminates in grammes:

	Water.	C.	H.	N.	O.
By respiration..................	330	248.8	...	?	651.15
By perspiration................	660	2.6	...	....	7.2
By urine.......................	1,700	9.8	3.3	15.8	11.1
By feces.......................	128	20.0	3.0	3.0	12.0
	2,818	281.2	6.3	18.8	681.45

The following table is a fair average work ration in round numbers, based on such data as those in the foregoing tables:

Estimated Work Ration, Maximum and Minimum

(Mrs. E. H. Richards.)

	For one day.
Proteid, grammes	125 / 110
Fat, grammes	125 / 90
Carbohydrates, grammes	450 / 420
Calories	3,500 / 3,000

About thirty grammes of salts should be added to this (Landois). The bare subsistence ration is much less, as follows:

Estimated Ration to barely Sustain Life

(Mrs. E. H. Richards.)

	For one day.
Proteid, grammes	75
Fat, grammes	40
Carbohydrates, grammes	325
Calories	2,000

Professor Egleston's standard of nutrition is high. He places the daily allowance of nutritive material at 700 grammes, divided as follows: Carbohydrates, 400 grammes; fats, 150 grammes; proteid, 150 grammes; yielding in all, 3,650 calories.

The average percentage of the different food classes needed to sustain a man in perfect health is thus given in the Kensington Museum Handbook on Food:

	Percentage.
Water	81.5
Albuminoids or flesh formers	3.9
Starches and sugars	10.6
Fat	3.0
Salt (NaCl)	0.7
Phosphates, potash salts, etc	0.3

An Ideal Ration with Solid Food

(Mrs. E. H. Richards.)

Material.	Amount.		Proteid.		Fats.		Carbohydrates.		Calories.
	Grms.	Oz.	Grms.	Oz.	Grms.	Oz.	Grms.	Oz.	
Bread	453.6	16	31.75	1.12	2.26	0.08	257.28	9.04	1,206.82
Meat	226.8	8	34.02	1.20	11.34	0.40	......	....	243.72
Oysters	226.8	8	12.52	0.44	2.04	0.07	......	....	70.01
Breakfast cocoa.	28.3	1	6.60	0.23	7.50	0.26	9.60	0.34	135.42
Milk	113.4	4	3.63	0.13	4.42	0.16	4.88	0.17	75.55
Broth	453.6	16	18.14	0.64	18.14	0.64	90.72	3.20	613.21
Sugar	28.3	1	......	....	.....	....	27.36	0.96	112.17
Butter	14.17	½	0.14	....	12.27	....	......	....	118.62
Total	......	...	106.80	....	57.97	....	389.84	....	2,575.52

It will be observed that the totals are somewhat less in this diet than those of the table at the top of this page, which was adapted for a working man, who is developing more calories.

Table of Energy estimated in Foot Tons instead of Calories (Yeo)

Energy developed by one ounce of the following foods when oxidised in the body.

Food Stuff.	With usual percentage of water.	One ounce water-free.
	Foot tons.	*Foot tons.*
Beef (best quality), uncooked	48.5	199
Meat (served to soldiers), uncooked	57.8	243
Beef (fattened), uncooked	96.0	280
Meat, cooked	102.6	240
Corned beef (Chicago)	124.0	217
Salt beef	52.0	138
Salt pork	71.6	166
Fat pork	202.0	336
Dried bacon	292.3	346
Smoked ham	179.6	267
Whitefish	44.3	209
Poultry	50.7	204
Bread	87.5	147
Wheat flour	123.6	146
Biscuit	173.3	189
Rice	126.5	141
Oatmeal	130.0	154
Maize	132.0	160
Macaroni	122.7	146
Millet	125.9	149
Arrowroot	116.4	138
Peas (dried)	118.9	151
Potatoes	33.0	141
Carrots	14.3	137
Cabbage	13.0	158
Butter	344.5	367
Eggs	67.3	265
Cheese	149.9	245
Milk (cow's) new	26.9	225
Cream	109.2	365
Skimmed milk	20.4	181
Sugar	126.4	128
Pemmican	270.1	293
Ale (Bass's bottled)	30.0	260
Stout (Guinness)	41.5	360

FORCE-PRODUCING VALUE OF THE DIFFERENT CLASSES OF FOODS

I. **Water.**—Estimated as a force producer within the body, water may be said to have comparatively little value. Much of the water which is either drunk or ingested in combination with foods passes through the body unchanged, and is eliminated from one or more of the excreting surfaces; but some of it is undoubtedly altered or split up into elements which unite with other compounds. The nature of these processes is obscure, and as yet very little understood. It is believed also that a certain quantity of water is produced in the body by the union of oxygen and hydrogen which occurs incident to other chemical change, or by the liberation of water from more complex molecules. Water is entitled to rank as a food because it enters into the structural composition of all the tissues of the body, and, in fact, constitutes rather more than two thirds (70 per cent) of the entire body weight. Its importance is readily appreciated after it has been withheld from the diet for a short time, when striking physical and physiological alterations in the functions of the body occur.

Yeo says that, "assuming the water-free food to be 23 ounces, and a man's weight to be 150 pounds, each pound weight of the body receives in twenty-four hours 0.15 ounce, or the whole body receives nearly a hundredth part of its own weight. But ordinary solid food contains usually between 50 and 60 per cent of water; and if we add this to the water-free solids, the total daily amount of so-called dry food (exclusive of liquids) is about 48 to 60 ounces. But from 50 to 80 ounces of water in the liquid form is usually taken in addition, and this would make the total supply of water equal 70 to 90 ounces, or half an ounce for each pound of body weight."

II. **Salts.**—The salts have practically no force-producing power, but they are concerned in tissue formation to some extent, especially in the bones and teeth, where the lime and magnesium compounds are the most stable of any in the body. Some of the compounds of sulphur and phosphorus which exist in meat and bran are undoubtedly associated with the development of energy in the body, but the salts are already saturated and stable, and, although their functions as laboratory reagents within the body are numerous, they may be left out of calculations of force-producing foods.

III. **Proteids, Carbohydrates, and Fats.**—It is easy to determine with accuracy the force value of a pound of albumin by chemical analysis, but it does not follow from this that the energy contained in it will all be developed in the body at exactly the right time or even within a sufficiently short period to enable the system to utilise it completely. The majority of physiologists are agreed that muscular energy is chiefly derived from non-nitrogenous foods. This statement receives further confirmation in the results of an interesting series of experiments made upon sixteen persons by Prof. Charles E. Waite, of the University of Tennessee (U. S. Department of Agriculture Bulletin No. 89, 1901). The experiments included rest intervals followed by work periods, usually of about four hours per diem. Waite found that the digestibility of the diet was uninfluenced by moderate work, animal protein being more completely digested than vegetable protein. He concludes as follows:

"A study of the nitrogen balance shows that in the majority of cases if there was a gain during the rest period it was increased during the work period, and if there was a loss it was diminished. In other words, comparing the elimination of nitrogen in the urine during the periods of little muscular activity and normal diet with that during periods of increased activity and a diet furnishing energy largely in excess of the heat equivalent of the measured work performed, there seems to be a slight decrease under the latter condition. This is true even when we consider the possibilities of a small loss of nitrogen in the perspiration and a lag of considerable duration between the breaking down of nitrogenous material within the body and the excretion of nitrogen in the urine."

W. O. Atwater and H. C. Sherman state (U. S. Department of Agriculture, Bulletin No. 98, 1901) that:

"Practically all of the recent experimenting with men sustains the view that muscular work normally results in an increased excretion of nitrogen when the work is at all severe and there is not a corresponding increase in the fuel ingredients (fats or carbohydrates) of the diet. It also implies that the increased output of nitrogen continues after the work stops, so that if the experiment continues but one day the larger part of the increase may be found on the succeeding day.

"Well-trained professional athletes when engaged in severe muscular exertion metabolise relatively large amounts of protein, the body tissue being drawn upon unless the protein of the food is very abundant."

The daily quantity of solid food consumed by an adult male at ordinary work will range between 50 and 60 ounces, and that of water drunk is about the same. The requirements of severe labour, if continued, exceed this range, so that as much as 75 ounces of solid food may become necessary, and this should be mainly in the form of albuminates and fats. Fats, compared with carbohydrates, yield two and one fourth parts as much energy. The standard diet for twenty-four hours for a healthy adult male at ordinary work should contain, in round numbers, 20 grammes of nitrogen (contained in 120 grammes of proteid) and 320 grammes of carbon, a proportion of 1 to 16, but, because the food is best taken in the form of a mixed diet, the proportion may be stated as one part of nitrogenous or animal food to three or three and one half of non-nitrogenous or vegetable food. Ordinary albuminous food yields, on the average, about 16 per cent of nitrogen.

Nitrogen Balance.—The nitrogen in the urine and feces may be regarded as an index of the proteid food assimilated, and when these two factors correspond, the body is said to be in "nitrogen equilibrium," i. e., all the nitrogen actually consumed is eliminated without storage in the body. When the body has attained its full adult size, it maintains this equilibrium with but very slight variation. A new diet containing either an excess or diminution of protein temporarily disturbs this equilibrium, but it is soon readjusted.

For an adult male the average consumption of nitrogen being 20 grammes per diem, the ordinary allowance for daily variation does not exceed 3 grammes on either side of this standard. For a man of average weight—that is, 67 kilogrammes, or 160 pounds—the daily allowance of food ranges from 6 to 9 grains of carbon, and 0.25 to 0.36 grain of nitrogen per kilogramme of body weight. Those elementary foods which approach most nearly in composition the economical proportion of nitrogenous to non-nitrogenous material are cow's milk and wheat flour. In the former this proportion is one to three, in the latter one to four and a half. The standard ratio for health of protein to the fuel ingredients—starch, sugar, and fat—is 1 to 5.8. This is the ratio adopted by the Experiment Stations of the United States Department of Agriculture. In metabolism experiments a time allowance must be made for the interval between the ingestion of proteid food and the corresponding nitrogen increase in urine and feces. This interval is known as the "nitrogen lag," and it occupies a number of hours, varying under changing conditions.

The question of the nutritive value of any fixed diet cannot be solely estimated from variations in the body weight, for the loss of water or of albumin may increase while fat is stored up. Neither can the quantity of food eaten be relied upon for this purpose, for from habit one man may eat more than another while doing the same work, and may eat more than he needs. Nor is it possible to determine from the various excreta alone whether the body has had a suitable quantity of nourishment, for they are too constantly changing, and "life will soon become extinct if the nutriment given be measured by the metabolism of starvation" (Bauer).

A man in perfect health might easily lose weight upon the identical diet which would enable an emaciated and feeble invalid to gain flesh. In convalescence from typhoid fever, for example, one often sees evidence of a daily gain in weight while the quantity of food is still far below that necessary to support a healthy man in vigour. The needs of the organism at any particular time must, therefore, be taken into account as well as the strength of the digestive organs in prescribing the quantity of food consumed. In making calculations for the quantity of food required by large numbers of persons under any conditions, somewhat more than the averages above stated should be always included in order to make allowance for variations in absorption and assimilation of the food by different individuals. (See Quantity of Food Required, page 287.)

The carbohydrates are not as available for the repair and growth of the tissues as the fats, but by their oxidation they save tissue waste, and furnish both heat and muscle force. They limit the formation of acetone from fat when the latter is eaten in excess (Schuman-Leclercq).

Bauer says: "The easy metabolism of the carbohydrates in the body must not be regarded as depending on their great affinity for oxygen; its cause is to be sought far more in the properties of the animal tissues. . . . The action of the carbohydrates agrees in many respects with that of fat, since they are in like manner capable of protecting from metabolism a certain amount of the circulating albumin and of assisting its transformation into organic albumin."

But the destruction of carbohydrates in the body is very complete, even when eaten in excess, and herein they differ from the fats, "an excess of which in the food invariably produces an accession of fat." From these and other statements made by Bauer he argues that probably the carbohydrates do not directly form fat in the body, but their well-known fattening action is, when eaten with albumin and fat, to spare the consumption of these latter substances, which are then converted into tissue fat.

Sugar furnishes, in addition to heat, considerable muscle energy, and it has been lately proved by Mosso, Vaughan Harley, and others to have distinct power in relieving muscular fatigue.

Vaughan Harley found that with an exclusive diet of seventeen and one half ounces of sugar dissolved in water he could perform almost as much muscular work as upon a full mixed diet. The effect in lessening muscle fatigue was noticeable in half an hour and reached a maximum in two hours. Three or four ounces of sugar taken before the expected onset of fatigue postponed or entirely inhibited the sensation. Schumberg recommends that the sugar be taken with chocolate or in lemonade. Experiments were made by him upon German soldiers which covered a period of thirty-eight days. The men were given daily ten lumps of sugar (about one sixth pound), and were able to withstand hunger, thirst, and fatigue much better than others whose diet contained no sugar. When a muscle contracts it is not the muscle tissue itself which is consumed, but its supply of glycogen. The candle wick is but very slowly burned so long as its supply of tallow does not fail, and so the muscle is spared while the carbohydrate glycogen furnishes force. When a muscle is much used it increases in size, and needs more nitrogen to build new substance.

The food value of sugar is thus summarised by Mary Hinman Abel (U. S. Department of Agriculture, Farmers' Bulletin No. 93, 1899):

"(1) When the organism is adapted to the digestion of starch, and there is sufficient time for its utilisation, sugar has no advantage over starch as a food for muscular work except as a preventive of fatigue.

"(2) In small quantities and in not too concentrated form sugar will take the place, practically speaking, weight for weight, of starch as a food for muscular work, barring the difference in energy and in time required to digest them, sugar having here the advantage.

"(3) It furnishes the needed carbohydrate material to organisms that have as yet little or no power to digest starch. Thus, milk sugar is part of the natural food of the infant.

"(4) In times of great exertion or exhausting labour, the rapidity with which it is assimilated gives it certain advantages over starch."

The hard-working lumbermen of Canada and Maine eat a very large quantity of sugar in the form of molasses. I have seen them add it to tea and to almost everything they cook. Sugar has also been found of much service upon polar expeditions.

Albumin burned in oxygen outside of the body is almost completely oxidised, but after oxidation in the body, about one third of its substance is excreted, imperfectly consumed, as urea. Pflüger says: "All work of life can be performed by albumin alone, while no other material in the universe can do it. The integral ingredient of the living and working cell is the albumin, indeed often the only organic part of it." On the other hand, the consumption of some carbohydrates, such as alcohol and sugar, appears as complete within the body as it may be outside of it, and the amount of energy actually developed is identical with that which may be theoretically calculated.

The statement is sometimes made that the compounds of carbon and hydrogen are slowly oxidised, and give a more continuous yield of energy than nitrogenous compounds, but with less powerful individual discharges. In other words, they are said to be good "maintainers of energy." There are, however, exceptions to this, such as alcohol.

The proportion of nitrogenous or proteid compounds required is greatest where growth is active. Many nitrogenous substances possess high potential and explosive energy, as illustrated by nitroglycerin and fulminating powder. Proteids are always present where the phenomena of life are exhibited, and bear a direct relation to their activity.

STIMULATING FOODS

In the broadest sense all food is stimulating to the functional activities of the body; but when the digestive and assimilative powers are lowered, less variety and less quantity of food can be tolerated, and foods that in health are never needed may become necessities; such foods, for example, are cod-liver oil and the various preparations of meat, such as albumoses or peptones, meat juice, etc.

Certain food substances have a distinctly stimulating action at all times. The various condiments possess a local action of this kind upon the alimentary organs, but not a general or systemic action. The latter stimulation, manifested especially upon the nerve-muscular apparatus, is derived from such substances as strong beef extracts, coffee, tea, and alcohol, all of which at times are of great service in the dietetic treatment of disease. The effect of sugar as a stimulant to relieve muscular fatigue has been described in the previous section.

ECONOMIC VALUE OF FOOD

It is not within the scope of this work to discuss the details of the economic value of food, but brief reference to one or two facts will emphasise the importance of this topic.

It is estimated that the annual cost of food production in the United States is at least three billion dollars, and the cost of production must be doubled in estimating the price paid by the consumer.

Naturally, many attempts have been made to tabulate the cost of feeding large bodies of men employed by contract, or patients in hospitals and institutions. Some of these studies have been conducted with great care, but on a comparatively small scale, as in the case of the economic diets of the French factory operatives in Massachusetts, the penny dinners furnished to London school children, and the researches made by Mrs. Richards and Miss Talbot upon pupils at the University of Chicago. Calculations upon a much larger scale are available as a basis for the supply of armies and navies. (See the section upon Diet for the Army and Navy.)

The economic value of food cannot be estimated exclusively from its weight, and, as suggested by Williams, a pound of biscuit may contain as much fuel as a pound of beefsteak, and yet the body may be able to assimilate more of the beefsteak and derive more energy therefrom; and it is the chemical processes of Nature which convert such substances as grass, which are not assimilable by the human organism, into the flesh of the ox, which is readily digested by man.

It is economical in employing large bodies of men at manual labour to feed them well, for they will do much more work proportionately.

Carbohydrates check albuminous waste, and, like fats, yield both heat and mechanical work; hence good bread, sugar, and potatoes are all economical foods for the labourer. Unlike the other classes of foods, however, they do not produce brawn, and do not enter into the actual structure of the tissues to any great extent, although the carbohydrates may be found existing as glycogen in some of the tissues, like the muscles and liver. In general, they seem to be more easily metabolised than fats or proteids. Assuming 3,500 calories as the necessary daily standard for a labourer, one pound of flour yields 0.11 pound of protein and 1,650 calories; a pound of dried beans yields 0.22 pound of protein and 1,590 calories; but cabbage yields only 0.02 protein and 150 calories per pound, and oranges 0.01 protein and 160 calories.

Atwater's Table of Digestibility of Nutrients of Food Materials

In the Food Materials Below	Of the total amounts of protein, fats, and carbohydrates the following percentages were digested:		
	Protein.	Fats.	Carbohydrates.
Meat and fish	Practically all	79 to 92	..
Eggs	"	96	..
Milk	88 to 100	93 to 98	?
Butter	....	98	..
Oleomargarine	....	96	..
Wheat bread	81 to 100	?	99
Corn (maize) meal	89	?	97
Rice	84	?	99
Peas	86	?	96
Potatoes	74	?	92
Beets	72	?	82

Calculated Coefficients of Digestibility of Nutrients in Different Classes of Foods

Standards used in calculations by the U. S. Department of Agriculture.

	Protein.	Fats.	Carbohydrates.
	Per cent.	*Per cent.*	*Per cent.*
Animal foods	98	97	100
Cereals and starches	85	90	98
Sugars	..	..	100
Vegetables and fruits	80	90	95

Percentage of Nutrition in Various Articles of Food (Moss)

Raw cucumbers	2	Raw beef	26
Raw melons	3	Raw grapes	27
Boiled turnips	4½	Raw prunes	29
Milk	7	Boiled mutton	30
Cabbage	7½	Oatmeal porridge	75
Currants	10	Rye bread	79
Whipped eggs	13	Boiled beans	87
Beets	14	Boiled rice	88
Apples	16	Barley bread	88
Peaches	20	Wheat bread	90
Boiled codfish	21	Baked corn bread	91
Broiled venison	22	Boiled barley	92
Potatoes	22½	Butter	93
Fried veal	24	Boiled peas	93
Roast poultry	26	Raw oil	96

4

Atwater's Table for Nutrients and Potential Energy in Dietaries of Different People

	NUTRIENTS.				Potential energy of nutrients.
	Protein.	Fats.	Carbo-hydrates.	Total.	
	Grms.	*Grms.*	*Grms.*	*Grms.*	*Calories.*
Sewing girl, London—wages 93 cents (3*s.* 9*d.*) per week	53	33	316	402	1,820
Factory girl, Leipsic, Germany—wages $1.21 per week	52	53	301	406	1,940
Underfed labourers, Lombardy, Italy—diet mostly vegetable	82	40	362	484	2,192
Trappist monk in cloister, very little exercise—vegetable diet	68	11	469	548	2,304
Miners at severe work, Germany	133	113	634	880	4,195
Brickmakers (Italians at contract work), Munich	187	117	675	959	4,641
Brewery labourer, Munich, very severe work, exceptional diet	223	113	909	1,245	5,692
German soldiers, peace footing	114	49	480	633	2,798
German soldiers, war footing	134	58	489	681	3,093
German soldiers, Franco-German War—extraordinary ration	157	285	331	773	4,652
Other factory operatives, mechanics, etc., Massachusetts	127	186	531	844	4,428
Glass blowers, East Cambridge	95	132	481	708	3,590
Private well-to-do family:					
Food purchased	129	183	467	779	4,146
Food eaten	128	177	466	771	4,082
College students from Northern and Eastern States—boarding:					
Food purchased	161	204	680	1,045	5,345
Food eaten	138	184	622	944	4,827
Club, two dietaries of the same club:					
Food purchased	115	163	480	738	3,874
Food eaten	104	136	421	661	3,417
College football team	181	292	557	1,030	5,742
Teamsters, marble workers, etc., with hard work, Boston, Mass	254	363	826	1,443	7,804
Brickmakers, Massachusetts	180	365	1,150	1,695	8,848
United States Army ration	120	161	454	735	3,851
United States Navy ration	143	184	520	847	4,998

The actual cost of elementary foods naturally varies with the market, locality, season of the year, and other considerations. Fortunately, however, many foods which furnish most nutriment are among the cheapest and least variable in price. Breadstuffs, for instance, which may easily furnish one third of the total nutrients required, do not vary greatly in price, and the increase in cost of any diet depends more upon the higher price of green vegetables, fruits, and the better cuts of meats. Hence, when it is necessary to reduce the cost of living, peas, beans, oatmeal, and flour may be economically used to supply protein. Sugar, rice, pork, cornmeal, and potatoes all supply fuel (energy) at small expense. If variety rather than cheapness is desired, it is found in the use of green vegetables, fresh fruits, butter, eggs, and the better cuts of meat. In illustration of these principles are the three following tables from nutrition investigations conducted by Isabel Bevier at Pittsburg, Pa. (U. S. Department of Agriculture Bulletin 52, 1898):

Cost per Pound and Amounts and Fuel Value of the Digestible Nutrients in 1 Pound and in 10 Cents' Worth of the More Important Food Materials used in a Dietary Study of a very Poor Polish Mill-worker's Family in Pittsburg, Pa.

Kind of Food Material.	Actual cost per pound.	Nutrients and energy in 1 pound				Nutrients and energy in 10 cents' worth.			
		Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fats.	Carbohydrates.	Fuel value.
Beef:	*Cents.*	*Pound.*	*Pound.*	*Pound.*	*Cal.*	*Pound.*	*Pounds.*	*Pound.*	*Cal.*
Stew meat.....	5.0	0.176	0.073	....	635	0.15	....	0.35	1,270
Round.........	8.9	.202	.121	....	885	.14	...	.23	995
Bologna sausage	9.4	.176	.191	....	1,130	.20	....	.19	1,205
Pork:									
Ham, boiled...	18.8	.178	.359	....	1,845	.19	....	.09	982
Head-cheese...	8.5	.183	.233	....	1,325	.27	....	.21	1,555
Fish, herring, smoked.....	5.9	.339	.145	....	1,245	.25	....	.57	2,105
Eggs..........	14.2	.126	.089	....	610	.06	....	.09	430
Butter.........	25.5	.010	.843	....	3,575	.33	....	...	1,400
Milk..........	2.8	.031	.025	0.058	270	.09	0.21	.11	970
Flour..........	3.6	.096	.010	.730	1,580	.03	2.03	.27	4,385
Oatmeal.......	5.0	.133	.064	.669	1,760	.13	1.33	.27	3,520
Bread..........	3.4	.078	....	.532	1,135	...	1.56	.23	3,340
Sugar, coffee....	5.9	....	....	.954	1,775	...	1.61	...	3,010
Beans..........	5.8	.178	.016	.561	1,442	.03	.97	.31	2,495
Potatoes.......	1.1	.013	....	.130	265	...	1.18	.12	2,420

Cost per Pound and Amounts and Fuel Value of the Digestible Nutrients in 1 Pound and in 10 Cents' Worth of the More Important Food Materials used in a Dietary Study of a Lawyer's Family in Good Circumstances

Kind of Food Material.	Actual cost per pound.	Nutrients and energy in 1 pound				Nutrients and energy in 10 cents' worth.			
		Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
Beef:	*Cents.*	*Pound.*	*Pound.*	*Pound.*	*Cal.*	*Pound.*	*Pound.*	*Pounds.*	*Cal.*
Ribs...........	15.0	0.120	0.255	....	1,300	0.08	0.17	....	865
Round.........	15.0	.196	.047	....	565	.13	.03	....	375
Shoulder clod..	11.5	.184	.109	....	800	.16	.10	....	700
Veal, chops.....	18.0	.159	.084	....	650	.09	.05	....	360
Lamb, roast.....	15.0	.164	.261	....	1,405	.11	.17	....	935
Eggs..........	13.3	.122	.086	....	590	.09	.06	....	445
Butter.........	28.0	....	.868	....	3,665	...	.31	....	1,310
Milk...........	3.9	.029	.036	0.046	290	.07	.09	0.12	750
Wheat flour.....	2.4	.122	.012	.729	1,635	.51	.05	3.04	6,805
Rolled oats.....	6.2	.144	.070	.702	1,870	.23	.11	1.13	3,015
Bread, baker's...	4.9	.081	.011	.517	1,160	.16	.02	1.06	2,365
Sugar, granulated	5.0	....	....	.966	1,795	...	...	1.93	3,595
Beans, dried....	4.2	.161	.016	.593	1,470	.38	.04	1.41	3,500
Potatoes.......	1.5	.013	....	.120	245	.09	...	.80	1,645
Oranges........	10.0	.008	....	.043	80	...	...	.04	80

Summary of Dietary Studies here reported with Averages of Studies made Elsewhere. Quantities per Man per Day

	Cost.	Protein.	Fats.	Carbohydrates.	Fuel value
	Cents.	*Grms.*	*Grms.*	*Grms.*	*Cal.*
Dietary of a professional man's family..........	21	91	145	380	3,280
Dietary of a mill workman's family	13	85	104	307	2,575
Dietary of a mill workman's family............	9	77	90	314	2,440
Dietary of a boiler tender's family	22	147	173	683	5,010
Dietary of a house decorator's family	20	112	144	368	3,305
Dietary of a glass blower's family...............	16	94	121	385	3,085
Average 14 dietaries of professional men's families	25	104	125	423	3,325
Average 14 dietaries of mechanics' families	20	103	150	402	3,465

The following table is from the U. S. Department of Agriculture Bulletin No. 91, 1900, and summarises dietetic studies made in widely different parts of the United States:

Cost, Nutrients, and Fuel Value of Food per Man per Day in Dietary Studies in Urbana and Elsewhere

	Cost of food.	Protein.	Fats.	Carbohydrates.	Fuel value.	Nutritive ratio.
	Cents.	*Grms.*	*Grms.*	*Grms.*	*Calories.*	
Teacher's family, Illinois:						
Food purchased................	27.0	124	158	487	3,975	......
Food wasted	....	23	45	46	700	......
Food eaten....................	....	101	113	441	3,275	1 : 6.9
Professional men, Connecticut, average of 9 dietaries:						
Food purchased................	25.0	110	136	442	3,530	......
Food wasted	....	3	7	5	100	......
Food eaten....................	....	107	129	437	3,430	1 : 6.8
Professional man's family, Pennsylvania:						
Food purchased................	22.3	98	155	396	3,465	......
Food wasted	....	7	10	16	185	......
Food eaten....................	....	91	145	380	3,280	1 : 7.8
Teacher's family, Indiana:						
Food purchased................	18.0	111	110	349	2,910	......
Food wasted	....	5	8	9	130	......
Food eaten....................	....	106	102	340	2,780	1 : 5.4
Proposed standard for man with little muscular work (Atwater)	....	112	...	...	3,000	1 : 5.5
Mechanics' boarding club, Illinois:						
Food purchased................	23.0	128	171	392	3,720	......
Food wasted	....	11	25	13	330	......
Food eaten....................	....	117	146	379	3,390	1 : 6.1
Mechanics' families, Connecticut, average of 9 dietaries:						
Food purchased................	....	113	153	420	3,605	......
Food wasted	....	7	11	14	185	......
Food eaten....................	....	106	142	406	3,420	1 : 6.9
Mechanic's family, Indiana:						
Food purchased................	26.0	106	157	475	3,840	......
Food wasted	....	16	23	67	555	......
Food eaten....................	....	90	134	408	3,285	1 : 7.9

	Cost of food.	Protein.	Fats.	Carbohy-drates.	Fuel value.	Nutritive ratio.
Mechanic's family, Tennessee:	*Cents.*	*Grms.*	*Grms.*	*Grms.*	*Calories.*	
Food purchased	16.0	119	224	455	4,435	......
Food wasted	....	9	14	43	345	......
Food eaten	....	110	210	412	4,090	1 : 8.1
Mechanic's family, New Jersey:						
Food purchased	28.0	103	144	431	3,530	......
Food wasted	....	3	6	6	95	......
Food eaten	....	100	138	425	3,435	1 : 7.4
Proposed dietary standard for man with moderate work (Atwater)	....	125	...	...	3,500	1 : 6.8

In a study by E. F. Ladd, made in 1900, of eleven women students in North Dakota who averaged nineteen years of age, the result was as follows:

Food Eaten.	Composition and fuel value of food per woman per day.			
	Protein.	Fats.	Carbohydrates.	Fuel value.
	Grammes.	*Grammes.*	*Grammes.*	*Calories.*
Animal food	31	94	5	1,025
Vegetable food	33	5	355	1,635
Total food	64	99	360	2,660

A similar study by Atwater made upon the diet of women students in Connecticut shows a consumption of 84 grammes protein, 128 grammes fat, and 264 grammes carbohydrate, yielding 3,015 calories. The accepted standard for woman at light muscular work calls for 90 grammes of protein and a total fuel value of 2,400 calories of energy, hence both these dietaries were deficient in protein, although the total fuel value was considerably above the standard requirement. This shows that a considerable departure from normal dietetic standards is not incompatible with health.

NUTRITION. ANIMAL AND VEGETABLE FOODS COMPARED

The study of nutrition, or the problem of tracing the food products, after absorption from the alimentary canal, through the various changes which they undergo prior to elimination in the comparatively simple forms of waste matter—namely, water, urea, and CO_2—has long baffled the science of physiological chemistry. There are, however, general principles that are established both by analysis and clinical observation which concern the effect upon the system of these different classes of foods.

Among the lower animals the effect upon the whole system of modifications in nutrition produced by special methods of feeding are much more striking than in man, as, for example, the feeding of the queen bee, and of draught horses as compared with racers.

Animal food is believed by many to make the blood rich in fibrin and corpuscles, and to increase the mineral salts, especially the phosphates; it both repairs the old and forms new tissue; it improves the condition of the muscles, which are made firmer than they are through a vegetable diet, and it favours the reduction of stored-up or surplus fat. Under some conditions it may produce a part of the body fat, although most of it is derived from other sources. (See Obesity.) It also increases the quantity of urates, phosphates, sulphates, and urea normally present in the urine, and tends to make the fluids of the body somewhat more acid or less alkaline.

Bauer (Dietary of the Sick) says: "The functional activity and resisting power of the organism seem to be essentially connected with the presence of an ample supply of albumin."

Animal food requires a considerable quantity of oxygen for its complete combustion, and a diet of this nature increases the demand for oxygen and favours its consumption. Meat in general has a more stimulating effect upon the system and is more "strengthening" than vegetable food, and it gives rise to sensations of energy and activity. A meal consisting of meat remains an hour or two longer in the stomach than a purely vegetable meal. It seems to satisfy the cravings of hunger, bulk for bulk, to a greater extent and for a longer time than vegetable food, and a man can live longer upon exclusive nitrogenous food than upon exclusive carbonaceous food. Animal food occupies less space in the stomach, and is more portable than vegetable food. Moreover, albuminous foods can be eaten longer alone without exciting loathing, as a rule, than can fats, sugars, or even some pure starches. In fact, there is a constant tendency to eat too much meat, and when its effects are not counterbalanced by free outdoor exercise, it produces an excess of waste matter which accumulates and causes biliousness, and sometimes lithiasis, gout, etc. A carbonaceous diet taxes the excretory organs to a lesser degree than animal food.

Sir Henry Thompson says: "It is a vulgar error to regard meat in any form as necessary to life." Nitrogenous food man must have, but it need not necessarily be in the form of meat, which "to many has become partially desirable only by the force of habit, and because their digestive organs have thus been trained to deal with it."

This is but partially true, for the training has become so strongly a matter of heredity through many centuries that those who possess it are certainly in better health for a reasonable allowance of meat in their dietary, and many primitive savage tribes have always subsisted largely upon meat. Errors in diet are far more common on the side of excessive meat eating than the eating of too much vegetable food, especially among civilised communities. In the temperate zones an increase in prosperity, together with the improvements made in the methods of preparing and preserving meat as well as those in breeding cattle for market purposes, tend to increase the habit of meat eating. The common estimate, in which meat should occupy one fourth and vegetable food three fourths of a mixed diet, is overstepped by many persons with whom the proportion may be two or three to four.

The proper association of different foods always keeps healthy men in better condition than too long continuance of any selected diet system.

Sir Henry Thompson, in speaking of the advantages of a well-proportioned diet, says: "A preference for the high flavours and stimulating scents peculiar to the flesh of vertebrate animals mostly subsides after a fair trial of milder foods when supplied in variety. . . . The desire for food is keener, the satisfaction in gratifying appetite is greater and more enjoyable on the part of the general light feeder, than with the almost exclusively flesh feeder. . . . Three fourths at least of the nutrient matters consumed are from the animal kingdom. A reversal of the proportions indicated—that is, a fourth only from the latter source, with three fourths of vegetable produce—would furnish greater variety for the table, tend to maintain a cleaner palate, increased zest for food, a lighter and more active brain, and a better state of health for most people not engaged in the most laborious employments of active life."

This comment is more applicable to the upper classes in England than in this country, where more attention is given to the cultivation and cooking of fresh vegetables and the preparation of vegetable products.

Letheby wrote: "The best proportions for the common wants of the animal system are about nine of fat, twenty-two of flesh-forming substances, and sixty-nine of starch and sugar." An average of eighty-seven practical dietary studies made by the U. S. Department of Agriculture showed that the food consumed was 45 per cent of animal and 55 per cent of vegetable origin.

Meats which are deficient in fat are usually eaten with added fat. Thus bacon is eaten with veal, liver, and chicken, and most fish are cooked with butter or oil. Similarly, butter, eggs, or cream are mixed with amylaceous foods, such as rice, sago, potatoes, etc., which are lacking in fat, and cheese containing fat is added to macaroni. Bacon is added to beans, and pork to greens.

"Whenever one kind of food is wanting in any particular constituent, we invariably associate it with another that contains an excess of it" (Letheby).

If a labouring man is allowed an ordinary meat ration he requires in addition, to obtain his requisite carbon, of fat 346 grammes, and of starch 596 grammes (Voit). But he would soon tire of such a quantity of either of these two food classes alone, and he does better to eat some of each. As pointed out by Voit more than thirty years ago, the available vegetable nutrients are so enclosed in cellulose or woody fibre as to render their absorption difficult. Vegetable food eaten in excess is liable to induce intestinal fermentation, which excites peristalsis, and as the intestine of man is much shorter than that of herbivores, this class of food does not have time for complete absorption.

The carnivorous animal fed upon lean meat alone requires a daily supply equal to one twentieth of his body weight, but if a little fat be added he needs much less.

Animal food is often said to be more stimulating to the passions than vegetable food, and the general character of carnivorous animals is more savage than that of herbivorous, although the angered bull is as fierce as any carnivore. It is doubtful, however, whether this is attributable so much to their different diet as to many other conditions which have contributed through the survival of the fittest to their differentiation. Carnivorous animals are obliged to work and fight for their food; they obtain it at uncertain and infrequent intervals, often when made ravenous by long periods of fasting. Herbivorous animals, on the contrary, always have their food at hand, obtainable with no labour other than that of eating. The Polynesian warrior is more ferocious at times on a diet of plantains than the Eskimo, who eats nothing but fish, meat, and fats.

Formerly nitrogenous foods were believed to furnish the chief supply of energy for the body, especially in the production of muscular force; but the experiments of Parkes and others made some thirty years ago did much to modify this theory, and it is now believed that the chief value of nitrogenous food stuffs lies in tissue formation in distinction from force production, which is maintained by the hydrocarbons. Some energy is undoubtedly derived from nitrogenous material, for no molecular rearrangement or chemical reaction can take place without altering the balance of energy, but the force produced by combustion of proteids is insignificant in comparison with their other uses. In support of this statement, the following facts may be cited as abundantly proved: 1. Severe and long-continued muscular exercise does not cause the quantity of urea in the urine to be materially increased. Urea represents the ashes of proteid material, and increase in its quantity is due to a more active oxidation of animal food, not necessarily to tissue waste. 2. Muscular exercise, on the contrary, does result in a great increase in the amount of CO_2 eliminated from the lungs, which is primarily derived from the combustion of hydrocarbons. 3. Isolated muscles made to contract by artificial stimulation when contained *in vacuo* under a bell glass have been shown to produce by their activity large quantities of CO_2, but no urea. 4. Prolonged muscular exercise or extraordinary exertion can be maintained upon a diet of starchy foods and fat without meat; and during the period following the exertion the urea is not increased beyond a degree which is readily accounted for by a slight wasting of the nitrogenous tissues of the body.

A man cannot perform more actual muscular labour upon an exclusive diet of animal food than of starchy food. He requires abundant animal food to replace the general wear and tear of muscular tissue, but the energy for muscular contraction is not derived from nitrogenous food, but from carbohydrates, the former being used merely to keep the muscles in a state of healthful equilibrium. He who is physically feeble and who lacks muscular power cannot restore that power by an exclusive nitrogenous diet. A man fed upon nitrogenous diet without vegetable food may not work as well in daily labour as when given a fair proportion of the latter; but, on the other hand, he is better fitted for sudden arduous exertion than are exclusive vegetable feeders.

A mixed diet is therefore the only rational one for man, and it is useless to reason otherwise from analogy with the lower animals. The ox is strong and performs daily labour upon a grass diet, but he extracts a large proportion of nitrogen from such food which man's feebler digestive organs do not enable him to do. The proportion of proteid to carbohydrate is 1 to 4.7 in such food. The horse is fed upon oats when it is desired to increase his spirit and activity, and he derives more nitrogen from them than does man from his oatmeal. The lion derives great strength from purely nitrogenous food, but even when trained he is wholly unfit for the continuous exertion that herbivores can endure.

The northern Eskimo, who has absolutely no starchy or saccharine food, eats fat with his proteid diet, and is therefore enabled to acquire energy to resist extreme cold and to take very long and fatiguing sledge journeys; yet he is no stronger, nor as strong, as the Central African negro, who lives upon a diet of manioc and plantains, without meat.

"Some food rich in protein will be found in the daily diet of all peoples. The Mongol eats with his rice, which is largely starch, small quantities of fish, fish eggs, and goose livers, but for his supply of proteid material he relies on his different preparations of bean cheese and on soja sauce made from the soy bean. The Mexican, whose supply of meat is scanty and of a poor quality, uses the native bean or frijole at almost every meal, made into a stew with vegetables and perhaps shreds of sun-dried beef, well spiced with the chili or red pepper" (Mary Hinman Abel).

Man is an animal of extraordinary adaptability to his environment, and one must be consequently guarded in making dogmatic statements in regard to his diet, and such observations as the above must be taken as applying only generally, for it seems possible for either class of foods to supplement to some extent the functions of the other. This fact is illustrated in disease as well as in health. For example, in the earlier stages of diabetes sugar is formed from farinaceous and saccharine food almost exclusively, but in the advanced stages, when these substances are withheld, it can undoubtedly be made from proteid material.

The combinations of foods which are by analysis shown to contain quantities of proteids, starch, and fat, have a very different effect in overtaxing the digestive organs according to the particular form in which their ingredients exist.

It is a popular belief that meat requires more effort for digestion than starchy food, but in health this is probably not true, provided both varieties of food are taken in correct proportion, for it certainly would be a strain upon the digestive system to be obliged to derive all the carbon needed from an exclusive meat diet, just as it overtaxes the alimentary canal to obtain sufficient nitrogenous material from an exclusive vegetable diet. It cannot be said didactically that a piece of beef is more or less digestible than a potato, and that it taxes the energies of the digestive organs to a greater extent, although it is more completely assimilated and leaves less waste in the intestine. The whole question devolves upon a true balance of the ingredients of a mixed diet. As regards the actual complexity of the digestive processes of the several classes of food, there is but little difference: both starches and proteids pass through intermediate stages on the way to the formation of their completed products, and fermentation cannot be said to present greater difficulty in the one case than in the other. For man, certainly, Nature never intended that all the nutrition of the body should be derived from any one class of food stuff which would require the use of certain digestive juices, and imply the disuse of others which are normally present.

A diet of animal food is much less fattening than a vegetable regimen or than carbohydrates with a fair proportion of fats, but a stout man does not endure fatigue, or even starvation, better than a lean man. On the other hand, to increase the proteid substances of the body an albuminous diet with but little carbohydrate is necessary. Men, unless greatly emaciated, have a reserve store of energy in their bodies sufficient to maintain their animal heat and keep them alive for from seven to nine days, and this is true whether they have been meat eaters or vegetarians. Storage of fat will help them out in emergencies, but if it has been overdone—i. e., if there is too much fat in the tissues—they may be weakened by it and, although they have the material for force production on hand, they are unable to utilise it, and are worse off than if they were spare. (See Obesity and Leanness.)

Bauer says: " The material effects of albumin and of fat in the system are in a certain sense opposed, for the former increases the tissue waste and secondarily the oxidation, while fat induces the opposite effects." When the organism is in health albumin constitutes upon the average about 10 per cent of the body weight and fat about 16 per cent, but these proportions may vary within wide limits.

Animal food is easily cooked, requiring less fuel than vegetable food, and in the process develops more flavour than does vegetable food.

VEGETARIANISM

In regard to an exclusive or almost exclusive vegetable diet for man, the universal experience has been that while it may keep him in apparent health for some time, it eventually results in a loss of strength and general resisting power against disease, which becomes evident after some months, if not before.

Of vegetarianism Bauer says: "The beneficial effects of vegetarianism certainly do not depend on the fact that its followers take no meat, and still more no animal food, but on their giving up their former bad habits."

No doubt much of the alleged benefit of vegetarianism is due to the greater freedom of action of the bowels, induced by the use of bran bread and other coarse articles of food.

It is impossible to subsist for any length of time on a diet which does not contain a considerable quantity of nitrogen, which constitutes so important an element in the composition of the great majority of structures of the body, and, in fact, of protoplasm itself.

Attempts have from time to time been made, for economic reasons, to furnish large bodies of labouring men, employed by contract or otherwise, with a purely vegetable diet; but this diet is found to defeat its own ends, in that the maximum of labour cannot be maintained by men who are fed exclusively on vegetable food, although some carbohydrates are essential. It gradually induces a condition of muscular weakness and languor with disinclination for either physical or mental work. In support of this statement Vigsford relates that for the construction of a railway from Paris to Rouen, English and French workmen were employed. The former did one third more work than the French, until in the French diet roast beef, as in the diet of the English, was substituted for *bouille* and soup, after which the work done by the two gangs of men was equalised.

In referring to graminivorous people, like the Bengalese, Chambers wrote: "If required to exert themselves in any unusual way when food is deficient, they simply die. The reason is evident—they have been living on their own tissues, and the small quantity of albuminous matter in grain is a long time in building them up again, so that for weeks, or even months, their muscles are in a state of atrophy." It is found, too, that their food must be very gradually altered if they are to change to a mixed diet.

Animal food in some form must be regarded as absolutely essential for all vigorous races. When the diet of enthusiastic "vegetarians" is carefully investigated it is found that the strictly hydrocarbonaceous food is supplemented by such articles as milk, eggs, etc., which are used in cooking or in other ways, although the consumption of nitrogenous food may appear very much restricted.

It is believed by Gübler and others that an exclusive vegetable diet eventually develops an atheromatous condition of the arteries, on account of the large proportion of mineral salts which thus enter the blood, but the evidence of this is not convincing. It is also claimed that a vegetable diet favours the deposition of mineral salts in different parts of the body, as phosphatic stone, gravel, and the tartar on the teeth, and that living upon coarse cereals alone makes the skin rough, and the individual dull, heavy, and ill-tempered.

While it is quite true that some kinds of vegetables contain a large proportion of nitrogenous substance, it exists in a form in which it is less easily assimilated than animal proteid. In vegetable foods nitrogenous materials are more or less closely mingled with starch. Cellulose itself is often very tough and insoluble in the digestive fluids, so that as large a proportion of protein as 17 per cent may be wasted, while not over 3 per cent of the proteid of animal food remains undigested (Yeo). This is an important illustration of the fact that one must not be guided by chemical composition alone in selecting the proper dietary for man, but the question should rather depend upon the actual nutrient value of the food when absorbed. A food in its ultimate analysis may yield the necessary chemical ingredients for a nutritious diet, and yet from imperfect digestibility it may prove of little service for actual nutriment.

There are many facts in Nature in addition to those already discussed which indicate without doubt that man from his earliest prehistoric days has been omnivorous, adapting himself to his surroundings and eating, in his primitive condition, whatever his environment afforded, with least expenditure of labour to obtain it, now vegetable, now animal food. This is shown in the structure of the teeth in prehistoric skulls, and in the length of the alimentary canal and character of the digestive organs and secretions as at present existing.

The ancient Britons are known to have subsisted largely upon acorns, berries, roots, leaves, etc., but other primitive tribes ate fish, shellfish, and, when they could kill it, game.

A brief glance at the dietetic habits of the more primitive tribes of mankind at present living shows that no arguments can be drawn from them as to the advantages of any particular class of foods.

Many savage tribes to-day live very largely upon vegetable food, although an exclusive vegetable diet is almost unknown among them, and most of them eat meat whenever they can obtain it, or they supplement their food by nitrogenous articles, such as milk, eggs, fish, and insects of various kinds. Even the Chinese and Japanese, who subsist principally upon simple farinaceous food, such as rice, eat also eggs, fish, pork, and chicken. On the other hand, there are tribes of men inhabiting very hot countries who eat considerable quantities of meat, as, for example, the Nubian Arabs and Abyssinians. Some natives along the Congo subsist solely upon fruits (plantains) and insects. The Mongolian lives by his herds—upon milk products and meat—bread being scarcely known to him. The Australian savage is omnivorous, and, having no cereals, he subsists upon berries, beans, pith, nuts, honey, larvæ, ants, etc. The Papuan Islanders live chiefly upon sago, fish, and fruits. The New Caledonians were formerly cannibals, but are now vegetarians by preference, and prefer to trade their pigs and goats with passing ships rather than to eat them.

Vegetarianism in former times has had many famous advocates. Shelley was a vegetarian, so was Jean Jacques Rousseau, and Goldsmith also at one time. There is a vegetarian society in England which has established restaurants in London, Manchester, and several other localities. In London there are upward of 4,000 members of this society. There is a similar organisation in this country. The creed of esoteric Buddhism has induced some persons in this country to adopt vegetarian habits, but few of them adhere to them strictly or for long.

THE CLASSES OF FOODS—I. WATER

It is estimated that water composes about 70 per cent of the entire body weight, and it is an almost universal solvent. Its importance to the system, therefore, cannot be overrated. The elasticity or pliability of muscles, cartilages, and tendons, and even of bones, is in great part due to the water which these tissues contain. As Solis-Cohen says, "the cells of the body are aquatic in their habits." The amount of water required by a healthy man in twenty-four hours is, on the average, between 65 and 70 ounces, besides about 20 ounces taken in as an ingredient of solid food, thus making a total of 85 to 90 ounces. The elimination of this water is divided as follows: 28 per cent through the skin, 20 per cent through the lungs, 50 per cent through the urine, 2 per cent through other secretions and the feces. This is, of course, a very general computation, for there is constant variation in the activity of different organs.

A large proportion of the water is taken in the form of beverages composed chiefly of it, and by many persons they are substituted for plain water altogether. In some countries light wines, beer, and other fermented drinks wholly replace drinking water. This may be due to habit and custom, or to necessity from lack of pure natural water, but in all cases the quantity of water required to maintain the functions of the body in healthful activity remains the same, whether it be drunk pure or in beverages, or taken with succulent fruits and vegetables, or in milk, koumiss, etc.

One of the most universal dietetic failings is neglect to take enough water into the system.

Uses of Water in the Body.—The uses of water in the body may be summarised as follows:

1. It enters into the chemical composition of the tissues.

2. It forms the chief ingredient of all the fluids of the body and maintains their proper degree of dilution.

3. By moistening various surfaces of the body, such as the mucous and serous membranes, it prevents friction and the uncomfortable symptoms which might result from their drying.

4. It furnishes in the blood and lymph a fluid medium by which food may be taken to remote parts of the body and the waste matter removed, thus promoting rapid tissue changes.

5. It serves as a distributer of body heat.

6. It regulates the body temperature by the physical processes of absorption and evaporation.

All protoplasmic activity in cells ceases at once if they become dry. Elementary cells, such as the amœba, cease to move, to digest, or to show any form of irritability or functional activity when dry, but if water be added to them their functions will be resumed, showing that they have been suspended and not necessarily destroyed.

The taking of much water into the stomach by its mechanical pressure excites peristalsis. One or two tumblerfuls of cold water taken into an empty stomach in the morning on rising favour evacuation of the bowels in this way. The water, moreover, is quickly absorbed and temporarily increases the fulness of the blood vessels. This promotes intestinal secretion and peristalsis. The increased activity of the lower bowel is explained in this way rather than by the idea that the water itself reaches the colon and washes out its contents.

Lukewarm water acts as an emetic if drunk in large quantity. This action fails above 95° F. and below 60° F., and is most efficient at about 90° F.

Purity of Water.—Of recent years the importance of insuring the purity of drinking water has become more and more appreciated, and an intelligent public is now aroused to the absolute necessity of protecting their supplies of drinking water from contamination with sewage, decomposing animal matter, etc. So general has the interest in this subject become in this country that new laws are being passed constantly to protect the water supply of large cities and towns. The subject is not confined to water alone, but includes ice as well, for many of the germs and organic impurities of water are not destroyed by freezing, and impure ice added to pure water contaminates it. It has been very clearly proved that many infections may be conveyed through the agency of water; among the most important of these are the germs of typhoid fever, dysentery, and cholera. Possibly, also, the germs of other diseases, such as tuberculosis and diphtheria, can exceptionally be thus conveyed, should they obtain access to drinking water. Water may be further rendered unwholesome by moulds, ferments, and excess of decaying vegetable matter. (For water contaminated with lead, see Lead Poisoning.) Water from shallow wells and wells near drains, barnyards, cesspools, or privies is unfit for drinking.

Varieties of Drinking Water.—Water containing a moderate quantity of mineral salts, 4 or 5 grains to the gallon, is not to be regarded as impure, but the composition as well as the quantity of these salts affect its power as a solvent in the tissues, and may exert a very decided influence upon the digestive system when present in the proportion of 60 or 70 grains to the gallon. The mineral waters may contain much more. Water is usually unwholesome for drinking when derived from volcanic and basaltic mountain regions, and because of organic impurities it is bad in marshy regions.

Hard and Soft Water.—An excess of lime salts and of other mineral matters in water produces constipation, flatulence, indigestion, and favours the formation of calcareous deposits in various parts of the body. "Hard water" unites with soap and makes it less soluble, so that it is difficult to cleanse the hands with it. It also roughens the skin and dries the mucous membranes. By boiling, the hardness of water, which is due to the presence of earthy carbonates, is diminished, for the carbonic acid, which aids in holding them in suspension, is driven off. Water is also improved for drinking by filtering through a filter paper, or clean absorbent cotton on a funnel. Boiling the water does not precipitate neutral and alkaline salts, and a purgative action may still remain if they are present. Hard water is made more digestible by converting it into barley or oatmeal water. Water which contains sulphate of lime causes gastric distress and dyspepsia, and it may form calculi. "Soft water" is simply water which is free from objectionable salts. It is more wholesome than hard water. Hard and soft water have well-known characteristics in regard to their effect upon the cooking of food. Calcareous drinking waters have been believed to be factors in the development of goitre and cretinism, notably in Switzerland, but many cases occur in which such theory is untenable.

Rain Water.—Next to clear mountain-spring water which has run through gravel and been well aërated, rain water at the close of a shower is the purest form of natural water, excepting where it has fallen through a very dusty or smoky atmosphere or has run over a dirty roof. The first drops of a shower carry down with them the impurities of the air, including traces of ammonia and nitric acid. No natural water possesses absolute chemical purity, but water collected at the end of a hard or long shower is very pure, having been distilled by previous evaporation.

River water which has run over a rocky or gravel bed, and has been well aërated, is quite pure and assimilable if properly protected from sources of pollution. Free oxidation makes much organic matter harmless. Flowing water by oxidation and dilution becomes purified to a great extent of injurious organic matter, but is not necessarily deprived of living germs of contagion, such as those of typhoid fever or cholera, and the question whether their number and virulence is at all diminished in such water is still a matter of controversy.

It is now so well recognised that the impurities of water which are chiefly dangerous to man are of organic germ origin that in examining water which is suspected of being the cause of a typhoid-fever epidemic a chemical analysis of the nitrates present, unaccompanied by a proper bacteriological examination, is entirely useless.

Distilled Water.—Distilled water is absolutely pure, but it has a flat or metallic taste from absence of air and salts. It is now extensively furnished for drinking, and is largely in use on vessels at sea. Our modern naval vessels carry apparatus for its preparation. Distilled water has been recommended as a solvent for calculi, but it is of doubtful efficacy. It erodes lead pipes and cisterns.

Filtered Water.—Filtration as employed to render drinking water more pure is a very delusive process, unless great care be taken as to the construction of the filter and the rate of filtration. Extensive experiments made at Providence, R. I., and Lawrence, Mass., have proved that the benefit of sand infiltration of city water results only when the filters are frequently cleaned. The sand layer should not be less than 30 centimetres thick, nor the rate of water flow fall below 100 millimetres per second. Frequent bacteriological examination of the water should be made. Koch has shown that it is not the sand which "filters," but the layer of mud or slime which is deposited upon it and which retains bacteria. Hence the reason for not allowing filters to become clogged with mud in which germs multiply. During the Hamburg cholera epidemic of 1892, the neighbouring town of Altona suffered much less severely from the disease than did Hamburg, for, although the Altona water supply was contaminated by Hamburg sewage, the water was thoroughly filtered. A great variety of patent filters have been devised, and they have the power of making water appear pure by decolourising it and removing the larger organic particles and grosser impurities which it may contain, but it has been conclusively shown that the bed of a filter which has been in use for a short time furnishes a favourable soil or culture medium for the development of germs, which increase very rapidly until they reach such numbers that they are washed out with the filtered water, rendering it much more injurious, in some instances, than it was before. Many of these germs are doubtless harmless, but if the microbes of infectious diseases once gain access to such a soil they multiply and become highly dangerous.

Boiled Water.—Boiled water is antifermentative and antiseptic.

The object of boiling the water which is to be used for drinking purposes, or in the preparation of food, is to free it from all organic impurities, and in some cases to precipitate salts of lime. There are no forms of germs, and there are no ferments which are not killed by a longer or shorter exposure to the temperature of boiling water. The process consists in the application of heat to water in sufficient degree to expand the air which it naturally absorbs and cause it to rise to the surface in bubbles of various sizes. If the water contains gases of decomposition they are expelled, and the odour is most foul just before the boiling point is reached; later it passes off, showing when the water is fit to drink. When boiled water, cooled, is drunk it tastes "flat" or insipid, but it may be freshened by pouring it through the air from one vessel to another or by shaking it with air in a *carafe*. Water should always be boiled before being drunk if there is the slightest suspicion as to its purity. The population of the larger Chinese cities is exceedingly dense, and the water used by the inhabitants is impregnated with all manner of filth, but it is believed that the custom of the natives of drinking tea infused with boiling water, or even drinking hot water, protects them to a great extent from the ravages of certain microbic diseases.

The special dietetic uses of water will receive attention under the appropriate headings of different diseases.

Water may be of service to eliminate waste in various renal diseases, gout, lithiasis, oxaluria, renal inadequacy, fevers, and infectious diseases. If imbibed too freely with meals it lessens the activity of the saliva and gastric juice. Water taken near the end of the gastric digestion of a meal (i. e., two or three hours after taking food) serves to dilute the contents of the stomach and wash it more easily into the intestine. If stomach digestion has been slow and feeble, so that the whole process has been greatly prolonged, the drinking of six or eight ounces of water, either hot or cold, two hours or more after taking food will facilitate its digestion. Water is highly useful in constipation, and it is more quickly absorbed from the stomach when the tension in the gastric vessels is low.

It is imperatively needed after severe hæmorrhage, or after the sudden loss of it from the system from any cause, such as the evacuations of cholera morbus, Asiatic cholera, etc.

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It is to be restricted in dilatation of the stomach, the secretion of weak gastric juice, and sometimes, but not always, in diabetes insipidus, diabetes mellitus, ascites and other dropsies, anasarca, and in some forms of heart disease and obesity.

The daily quantity of water ordinarily drunk varies between two and a half and four pints. About one and a half pint more is taken in the food, and four and a half or five pints are therefore lost through the emunctories.

Foods which contain most water are milk and succulent fruits, such as grapes, oranges, grape fruit, lemons, watermelons, etc., and vegetables like the tomato, squash, and many others of tropical origin. All vegetables contain more water than meats, and many, but not all, ripe fruits contain more than vegetables.

Excess of Water.—There is a remarkable tendency on the part of the blood to maintain an equilibrium as regards its own composition, volume, and density. When a large supply of water is received in the alimentary canal and absorbed by the blood vessels, the blood is momentarily diluted and the blood pressure slightly raised, although the latter effect will depend upon the facility with which the blood vessels are dilated. The blood immediately distributes the water thus absorbed, and the slightly increased pressure, as well as the diluted character of the blood, hastens the elimination of water from the various gland surfaces. The kidneys are particularly sensitive in this respect, and when in normal condition are the great regulators of the composition of the blood and, indirectly, of blood pressure by means of the elimination of water. Perspiration is increased. There is a tendency also for all the tissues to keep abundantly supplied with water; a large amount of aqueous vapour is exhaled from the surface of the lungs, and the digestive secretions are increased in volume. The blood may subsequently become more dense than before, owing to the increased functional activity of different organs. More nutriment is absorbed and more carbonic acid is exhaled, and urea and uric acid may be slightly increased.

If very large quantities of water, or any fluids consisting chiefly of water, are imbibed throughout a long period, they tend to overwork the kidneys and produce various alterations in the tissues. Practically, however, it seldom happens, excepting in some forms of gastric or intestinal disorder, and other instances mentioned above, that too much water is taken. When drunk in such fluids as beer, or diluted liquors, the resulting disturbances of the system are attributable rather to other ingredients.

Laymen are usually more willing to ascribe obesity to supposed excessive consumption of fluids than to overeating. They often say that they suppose water is "fattening." It is so only in the sense that it promotes tissue change or metabolism and washes away waste matter, not in the sense that it is itself a storage substance, as fat is.

Deprivation of Water. Water Starvation.—When water is withheld from the system for a considerable length of time its absence is first apparent in the secretions and excretions, and next in the various tissues of the body, the last of all being those of the nervous system. More than ten or twelve hours of abstention from drinking produces uncomfortable thirst, and one or two hours of violent exercise may do so at once.

Continued deprivation of water causes the blood, by virtue of its self-regulating power, to withhold fluid from the kidneys and digestive glands. The digestive secretions therefore become less fluid, of more intense reaction, and greatly diminished in quantity. The mucous surfaces become dry, and the dryness, owing to the passage of air and the consequent evaporation, is first felt in the mouth and pharynx. The diminution in the digestive secretions, as well as their altered strength, interferes with or retards their normal action upon the ingesta. The proper movement of the food in the stomach and intestines is retarded by its greater solidity and by the increased friction of the mucous walls, especially in the lower bowel. Constipation therefore results. The absorption of fluid through the walls of the alimentary canal is retarded, and nutrition suffers in consequence. Meanwhile the blood, to maintain its normal character, reabsorbs water from the lymph spaces and different tissues of the body. The muscles and other structures become dry and diminish in volume. Emaciation results, which quickly reaches an extraordinary and painful degree. The mind dwells on water constantly, and taste is diminished. Finally, the nervous system suffers from dryness and various nervous symptoms ensue, so that, in addition to extreme muscular weakness and prostration, there may be convulsions, delirium, and finally coma and death.

Thirst.—As far as the individual is concerned, the suffering from deprivation of water is mainly confined to the sensations of thirst and dryness of the mouth. Thirst is commonly, and somewhat erroneously, referred to the mouth and the pharynx. It is true that the mucous membrane in these regions becomes dry when water is withheld, but thirst may be also keen when these surfaces are abundantly moist. The sensation is the result chiefly of the expression through the nervous system of the need of the body tissues in general for fluid, and it is referred to the mouth and throat from force of habit, which associates the act of swallowing fluid, and the use of certain muscles in that process, with the subsequent relief of thirst. In support of the above statement is a fact that I have several times witnessed in patients having a gastric fistula made in consequence of œsophageal stenosis, or in patients nourished wholly through nutrient enemata, that the sensation of thirst referred by them to the mouth is immediately relieved by the injection of water into the stomach through the fistula, or of salt and water into the rectum.

It is asserted that shipwrecked sailors in open boats have relieved their thirst by immersing their bodies in salt water. A very little water is possibly absorbed under these conditions through the skin. Ordinarily, however, the skin is not capable of absorbing fluid of any kind to a practical extent, but immersion in water prevents evaporation from the surface of the body, and by saving its loss in that direction lessens thirst. Sucking a slice of lemon or drinking water acidulated with a few drops of lemon juice or vinegar sometimes allays thirst better than plain water. The same may be said of barley and oatmeal waters. Lime juice and ice is another remedy. Bitartrate of potassium or very weak brandy may be used for the same purpose, and is sometimes more satisfying.

On one of the arctic expeditions which resulted disastrously the men had no water for two months, but ate snow, having no fuel to spare to melt it.

" Hot water, as hot as can be sipped, quenches thirst much better than cold " (Balfour).

Glycerin and water is sometimes used to allay thirst by rinsing the mouth. The glycerin, being viscid, coats the surface of the mucous membrane and prevents to some extent the drying by evaporation, but it is hygroscopic and tends to abstract water if used too strong, and practically it is of little service.

When it is undesirable to give water by the mouth, thirst may be relieved by injection of salt and water beneath the skin (see Hypodermoclysis) or into the rectum.

Thirst may be controlled somewhat when it is desirable to restrict the fluids ingested by giving small doses of opium (Riegel). It may be that part of the benefit derived from this drug in the treatment of diabetes is due to its controlling this symptom. It is taken sometimes by professional fasters, who aim to abstain from all food, and from as much drink as possible. The latter is done because without food water tends to promote tissue waste too rapidly, and loss of strength would be more rapid upon no food and an excess of water than upon no food with water in great moderation.

Temperature of Drinking Water.—Water is drunk at various temperatures from that of melting ice to 110° or 112° F. It is sometimes stated that the temperature of water influences digestion, but the extent to which it does so is much exaggerated. Very cold water swallowed quickly in large amount is said to contract the stomach wall and stimulate the heart action. Lehman says that water drunk at 60° F. causes a fall in the pulse rate and in rectal temperature, but these observations lack confirmation. This subject, as well as that of the local action of hot water, will be found more fully discussed under the heading Temperature and Digestion.

Ice is often useful in the sick-room, but it should not be given to young infants. Cracked ice sometimes soothes an inflamed throat, and occasionally it allays nausea. It relieves thirst only temporarily, and this symptom may be increased by its prolonged use. If too much is swallowed it becomes lukewarm in the stomach and may be vomited.

II. SALTS

Varieties of Salts.—The principal salts derived from the food are as follows:

Chlorides of sodium and potassium; carbonates of sodium, potassium and magnesium; sulphates of sodium, potassium and magnesium; phosphates of sodium, potassium, magnesium, and calcium. The majority of these salts are held to be unaltered by digestive processes and pass into the blood or tissues without necessary chemical change. The reason for this belief is the fact of the readiness with which they can be obtained, unaltered by chemical analysis, from the different tissues of the body and the urine. Some compounds—namely, the salts of iron and salts of the organic acids—are ingested in very minute quantity and their uses are but vaguely understood. Other salts, such as the chlorides, carbonates, and phosphates of the alkalies and alkaline earths, are taken in much larger daily amount and subserve definite purposes.

Uses of Salts in Food.—The uses of the salts derived from the food are summarised as follows:

I. To regulate the specific gravity of the blood and other fluids of the body.

II. To regulate the chemical reaction of the blood and the various secretions and excretions.

III. To preserve the tissues from disorganisation and putrefaction.

IV. To control the rate of absorption by osmosis.

V. To enter into the permanent composition of certain structures, especially the bones and teeth.

VI. To enable the blood to hold certain materials in solution.

VII. To serve special purposes, such, for example, as the influence of sodium chloride on hydrochloric-acid formation, and that of lime salts in favouring coagulation of the blood.

Generally speaking, fruits and nuts contain the least quantity of salts, meats rank next, after them vegetables, and pulses and cereals contain most of all.

Excess of Salt.—Salts of any kind when taken in excess with the food disagree with digestion in various ways. They may prove locally irritant to the gastric or intestinal mucous membrane; they modify the rate of absorption of digestive material, and alter the intensity of reaction of the different digestive fluids. After being absorbed in excess they may interfere with the nutritive and chemical processes of the blood and tissues. Some persons acquire a salt-eating habit and partake too freely of common salt with the food, with the result of the production of more or less dyspepsia or some of the symptoms above mentioned. Too much salt in the food produces thirst, and may even stimulate a craving for strong drink.

Lime salts and phosphates when taken in food or drinking water in large quantities for several weeks or months tend to cause the deposit of renal or vesical calculi.

Deprivation of Salt.—Continued deprivation of any one of the common salts, so long as others are furnished in reasonable abundance in the food, does not result seriously. If, however, all the salts are reduced in quantity, of if they are entirely excluded from the diet, the system very soon begins to evince signs of malnutrition. This is readily accounted for by referring to the uses of salts above described. Animals or men deprived of salts for a long time suffer greatly from indigestion and from lack of bodily nutrition. The body may not diminish in weight, but the tissues become "flabby," the muscles feeble, the mind stupid and dull, the nutrition of the skin is altered, it becomes dry, and there is falling out of the hair. Eventually, in animals with salt starvation death occurs in from six to eight weeks from progressive bodily weakness and inanition—a condition, practically, of marasmus.

Young infants who do not obtain sufficient salts of lime—i. e., if fed upon proprietary "infant foods" instead of good milk—become rhachitic; their bones ossify slowly and bend into deformities. Such children are sometimes given hypophosphite-of-lime biscuits to supply the deficiency, but they should be properly fed upon fresh milk. (See Rhachitis.)

Sodium Chloride.—Sodium chloride, or common table salt, is by far the most important and valuable salt, and is used in the largest amount. It has long been a symbol of wisdom and hospitality in the East. It forms 60 per cent of the salts of the blood, and enters into the structural formation of all the tissues and secretions of the body in greater or less quantity, with the single exception of the enamel of the teeth. It is estimated that the quantity which may be daily appropriated from the food is about fifteen grammes. Salt slightly stimulates the renal secretion, which in turn leads to thirst and to drinking more fluid, which promotes interchange of the juices of the body. It also excites thirst more directly.

Common salt stimulates the appetite and influences beneficially the gastric secretion. It not only furnishes the chlorine for hydrochloric acid, but seems to act locally in the stomach by promoting this secretion as well as the conversion of pepsinogen into active pepsin. Cohn and Voit have proved that the absence of salt from the diet completely checks the production of hydrochloric acid in the stomach.

There are some few tribes of flesh-eating men who do not add salt to their food, relying for their needs upon what they derive from the food itself. This supply is therefore sufficient to maintain life. In fact, as a rule, man derives enough salts from the composition of his food to supply the tissues and juices of the body, and the additional quantity which he takes as table salt is mainly of service as a condiment, to give agreeable flavour to a mixed diet and to sharpen the appetite. The excess of salts in general is promptly eliminated in the urine.

In most men and many of the higher mammalia the craving for sodium chloride is instinctive. Stanley records in his book "In Darkest Africa" instances where savages are accustomed to travel many hundreds of miles under great difficulties to obtain a coveted supply of salt.

Herbivorous animals are even more dependent upon salt than are carnivores; cattle and sheep, for example, must be given salt in addition to that contained in their food to remain in good condition.

Overdoses of salt cause diarrhœa and even gastro-enteritis, and excite irritation of the nerves of the throat.

Large doses of salt have been given in pleurisy with the view of increasing the density of the blood and causing reabsorption of the pleuritic fluid by promoting osmosis towards the vessels. This treatment has not met with success. The popular use of salt to control pulmonary hæmorrhage is of no practical value.

Almost all vegetables contain less sodium chloride than does milk, the food of the young growing animal, although many of them have more potassium.

Sodium chloride is of great service as a preservative of foods, either used as a brine in pickling, corning beef, preserving olives, etc., or in solid form to dry and keep meat and fish from decomposition.

Potassium Salts.—Next in importance to sodium chloride ranks potassium chloride, which is the predominant salt of the muscles, and which, like sodium chloride, is a common ingredient of nearly all the tissues and fluids. The acid and neutral carbonates and phosphates of sodium and potassium are important in regulating the reaction of the digestive secretions and the urine.

Calcium.—The salts of calcium are chiefly of value from their constituting a large percentage of the composition of the bones and teeth, as well as a smaller percentage of many other tissues of the body. Their presence seems to be associated constantly with cell growth and development. The carbonate is often found with the phosphate of lime, but in less quantity. The occurrence of cretinism and goitre has been in part attributed to an excess of lime salts in the food, more especially the drinking water; but this theory is not to be accepted without question. These diseases often occur independently of such cause, and are by no means always prevalent in lime-water areas.

Young growing animals contain a larger percentage of earthy salts than do older ones. Deposits of salts of lime occur in old abscesses, tubercular concretions, tartar on the teeth, atheromatous blood vessels, the arcus senilis of the cornea, and as calculi.

Phosphorus.—Phosphorus is derived from phosphates in meat and its contained blood which is eaten, as well as from vegetables. It enters into the composition of the bones, muscles, blood, etc.

Sulphur.—Sulphur is derived from sulphates contained principally in fibrin, egg albumen, the casein of milk, and from such vegetables as corn, turnips, cauliflower, and asparagus.

Iron.—The iron of the body is found in the blood pigment, where it amounts, all told, to a third of an ounce. It is also present in minute traces in other pigments.

Its chief source is from the blood of animals which is cooked with their meat. Two quarts of milk furnish about one eleventh grain of iron. It is also derived from, and it may be taken with, chalybeate waters. Probably most of the iron of the body is retained and used again and again. The daily quantity of iron ingested with an ordinary mixed diet is about one eighth grain.

Vegetable Acids

The common organic or vegetable acids—citric, tartaric, malic, etc.—are derived from fresh vegetables and fruits, in which they exist usually in combination with the bases Ca, Na, K, etc. They are indispensable articles of food, for when absorbed they form carbonates, which aid in maintaining the alkalinity of the blood. Prolonged deprivation of them usually results in the condition of scurvy.

III. ANIMAL FOODS

Animal foods contain much nutritive matter in a more or less concentrated form which exists in practically the same chemical combination with the body itself. They leave comparatively little residue, being quite thoroughly digested. They are agreeable in flavour, and they hold salts, including iron, which are of special value as force producers. They are, however, inferior to starches in this property unless much fat be incorporated with them.

The varieties of animal foods will be described under the headings, milk, eggs, meat, fish, gelatin, fats.

Milk

The milk of several animals, such as cows, goats, asses, mares, and camels, may be used for food, but in this country very little other than cows' milk is employed. The varieties of milk differ slightly in chemical composition, odour, and taste, but they all contain the elements which are necessary for the maintenance of life in fairly economical proportion, so that for infants they constitute a "complete" food which fully meets the requirements of the growing body, and in adults they will sustain life comfortably for many months.

For these reasons milk ranks among the most important of all foods, and it is necessary to determine to what extent it should be introduced into ordinary diet. A pint of milk may be said to represent approximately the nutrition contained in six ounces of beef or mutton. Although it furnishes so useful a food, milk is by no means essential to a diet designed for increasing bodily strength, and it is usually omitted from the menu of athletes in active training.

Milk taken alone constitutes an insufficient diet for adults in health, for to obtain the requisite 18.3 grammes of nitrogen 2,905 grammes of milk only are needed, against 4,652 which must be taken to obtain the necessary 328.9 grammes of carbon (Bauer). (See Force Production, page 20.)

Adults who are able to eat any kind of food usually maintain their health in better condition by abstaining from milk except as used for cooking purposes, inasmuch as it makes many persons "bilious" to drink it, and produces constipation, particularly when taken in excess with other foods.

Sir Henry Thompson, in condemning the excessive drinking of milk by persons in good health who are at the same time eating large meals of meat, says: "It is altogether superfluous and mostly mischievous as a drink for those who have reached adult age and can digest solid food." There are, however, many diseases in which a partial, or for a time an exclusive, milk diet is to be recommended.

Milk in considerable quantity—i. e., equal to one third or one half the total amount of food consumed—is often highly desirable in such diseases as tuberculosis, chronic Bright's disease, and anæmia.

Exclusive Milk Diet.—An exclusive milk diet is useful in the following conditions and diseases:

1. In infancy for the first year, and sometimes for the first eighteen months.
2. All acute infectious diseases of young children.
3. Typhoid fever.
4. Acute Bright's disease, and at times in chronic nephritis.
5. Acute pyelitis.
6. Chronic gastric catarrh.
7. Gastric ulcer and carcinoma.
8. Neurasthenia.

A milk diet is so easy to prescribe, so cheap, and so easily procurable, that it is always the first resort of those who, from indifference or lack of knowledge of the first principles of dietetics, are unwilling or unable to take pains to study the peculiarities and needs of the individual case. It is an easily measured food, and it becomes a routine practice in hospitals—where almost always more attention is awarded to medication than to diet—to order milk diet for all patients who are not at the convalescent or full house table, and it is doubtless safe to err in this direction, but it is by no means always the best that can be done for the patients.

An exclusive milk diet in time becomes monotonous and wearisome to most adults, and may produce dyspepsia, constipation, and interfere with the functional activity of the liver. Aside from nausea, which the continued use of milk may excite, a positive loathing for the taste of it may be developed, unless the regimen is modified by occasional variation. This is a matter of considerable importance in feeding patients suffering from typhoid fever, chronic Bright's disease, chronic gastric catarrh, and other affections for which milk diet is often prescribed; for if other substances are substituted from time to time in small amounts, while milk is still retained as the chief food, it may be continued as such for a much longer time. On seeking the cause for the disagreement of milk, it is found in the fact that it contains too large a proportion of nitrogenous material as compared with the hydrocarbons, so that, in order to obtain sufficient of the latter, an excess of proteid is ingested, which interferes with normal digestion.

For a man in health a pure milk diet, as Ewald says, is "slow starvation," although it is an excellent food for a short time. If kept too long upon it, he develops a condition akin to scurvy. (See Diet in Scurvy.) This, however, does not invariably follow in disease, and J. K. Mitchell refers to a patient with diabetes and nephritis who lived upon milk alone for seven years, and kept in active business.

Infants and children tire of milk less easily than adults. Whereas the adult needs twenty-three ounces of water-free food per diem to maintain healthful equilibrium, he must consume nine pints of milk at a specific gravity of 1.030 to supply it. The excess of albumin, fat, and water which he would then obtain is wasteful for him, although it is good for the young. But in illness life is comfortably maintained upon a smaller quantity for a few weeks, and in typhoid fever four or five pints is an ample allowance, and it is often better to give less. (See Diet in Typhoid Fever.) In a case of chronic Bright's disease, if the patient is not confined to bed, it may be necessary to give six or seven pints.

In order to digest large quantities of milk it must be taken in measured doses at frequent intervals. In typhoid fever, for example, from three to five ounces may be given every two hours. In some diseases it is best to give two ounces every hour, in others six or eight ounces every three hours.

Milk leaves no coarse waste residue in the intestine like the indigestible fibre of meat or the cellulose of vegetables and fruits. Notwithstanding this fact, an exclusive milk diet yields considerable bulk of fecal matter, and a typhoid-fever patient living on milk alone often has daily evacuations of medium size. Rübner found that in health a diet of milk alone yields larger stools than either roast beef or egg alone. Yet by weight the absorption of milk is shown to be very complete, and four thousand grammes of milk ingested by the mouth, when perfectly digested, yield but one hundred grammes of feces (Rübner). There is a marked loss through the feces of the salts of lime which have been contained in the milk. These facts explain in part why milk is so constipating.

Prof. Charles E. Wait, in the course of nutrition investigations of a club of students at the University of Tennessee (U. S. Department of Agriculture, Bulletin No. 53, 1898), says:

"The average of ten experiments with an exclusive milk diet showed 92.1 per cent of the protein and 86.3 per cent of the carbohydrates to be digested. Five experiments made with an exclusive bread diet or with bread and sugar showed 82 per cent of the protein and 99 per cent of the carbohydrates to be digested. Five experiments with a diet of bread and milk showed 97.1 per cent of the protein and 98.7 per cent of the carbohydrates to be digested. In other words, the protein in milk alone or in bread alone seems to be much less completely digested than when the two are eaten together."

"*Milk Cure.*"—The "milk cure" has been carried out successfully by Pecholier, Weir Mitchell, Karell, and others for the treatment of obstinate hysteria, hepatic congestion, dropsy, and various anomalies of nutrition. The patient is given no food but milk, which Pecholier orders every two hours in small amount, increasing the quantity until three litres a day are taken. Mitchell commences with doses of half an ounce to two ounces every two or three hours, and increases the dosage by half an ounce until sixty ounces or more are taken. If the taste of milk is disagreeable, coffee, salt, or caramel is added. If thirst is complained of, natural water or Seltzer water is given. After three or four weeks, rice, arrowroot, and thin slices of white bread are allowed, and after five weeks raw meat or one or two cutlets. The milk, meanwhile, is continued. After a day or two of this treatment, hunger and thirst are not usually complained of. At first the pulse is accelerated, but there is seldom any conspicuous nervousness. The tongue is coated, the water in the urine is increased, there is obstinate constipation (which must be relieved by enemata or medicines), the stools are hard and ochre or white in colour, and a great deal of epigastric distress and feeling of emptiness are present. The arterial tension is lowered; there may be muscular prostration. There is loss of weight at first. If the treatment is persevered in, at the end of a fortnight there is marked improvement in the feelings and condition of the patient, and after six or eight weeks the cure is usually far advanced.

Chemical Composition of Milk.—The chemical ingredients which make milk valuable as a food are water, salts, fats, milk sugar or lactose, and albuminous materials, chiefly casein, with some albumin. Scheibe and Henkel claim to have found traces of citric acid in normal cow's milk.

The published analyses of milk vary slightly, chiefly in regard to the quantity of fats observed.

The following analyses are placed together for comparison:

	Wanklyn.	London Dairy.	Bell.	Leeds.	E. W. Stewart.
Fat	3.20	4.10	4.01	3.75	3.80
Other solids	9.30	8.80	9.31	8.86	9.20
Total solids	12.50	12.90	13.32	12.61	13.00
Water	87.50	87.10	86.68	87.39	87.00
	100.00	100.00	100.00	100.00	100.00

The above London Dairy analysis is based upon the examination of 120,000 samples of milk conducted by the chemist to the dairy during a period of twelve years. The third analysis is by Dr. J. Carter Bell, an English public analyst, and the fourth is by Prof. Albert H. Leeds.

Fat and Cream.—Milk fat is mainly formed of glycerides of palmitic and oleic acid (Warington), the latter constituting about 50 per cent (Ruppel), with five or six other fatty acids, such as myristic and stearic, represented in minute quantity.

While the percentage of fat in milk, as shown by chemical analysis in the above tables, is about 4 per cent, that of cream itself is considerably higher, but cream is not pure fat. It is simply an aggregation of the oil globules in the top portion of the milk with a little proteid and carbohydrate. Average milk contains 8 to 10 per cent of cream. Alderney milk may have as high as 20 or even 30 per cent. Good milk should form a layer of cream about two inches and a half thick as it stands in a quart bottle.

The globules of milk fat vary in size between 0.0005 and 0.00005 inch in diameter, and the smallest do not rise to the surface as cream, for their albuminous coverings are proportionately heavier (Warington). "The fuel value of a pint of cream is not far from 1,425 calories, or about the same as one and one eighth pounds of bread, or one and one half dozen bananas, or four and one half pounds of potatoes" (A. C. True).

The following table is from the U. S. Department of Agriculture, Farmers' Bulletin No. 74, 1898:

Amounts of Nutrients in a Pound (Pint) of Milk as compared with a Pound of Meat, Bread, and Other Food Products

Food Materials.	Edible Portion.					
	Water.	Nutrients.				Fuel value.
		Protein.	Fat.	Carbo-hydrates.	Mineral matter.	
Milk (1 pint).	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Pound.*	*Calories.*
Whole milk	0.87	0.03	0.04	0.05	0.01	325
Skim milk (0.3 per cent fat).	0.90	0.04	....	0.05	0.01	170
Buttermilk	0.91	0.03	0.01	0.05	0.01	165
Other food materials (1 pound each).						
Cheese	0.34	0.26	0.34	0.02	0.04	1,965
Butter	0.11	0.01	0.85	....	0.03	3,605
Beef, sirloin	0.53	0.16	0.17	....	0.01	1,040
Mutton, side	0.43	0.13	0.24	....	0.01	1,275
Pork:						
Loin	0.44	0.14	0.25	....	0.01	1,340
Ham	0.35	0.13	0.34	....	0.04	1,655
Salt, fat	0.07	0.02	0.87	....	0.04	3,715
Chicken	0.48	0.15	0.01	....	0.01	325
Codfish:						
Fresh	0.58	0.11	....	....	0.01	205
Salt	0.40	0.16	....	....	0.19	315
Mackerel, salt	0.38	0.17	0.17	....	0.10	1,050
Oysters, solids	0.88	0.06	0.02	0.03	0.01	235
Wheat flour	0.12	0.11	0.01	0.75	0.01	1,645
Cornmeal	0.13	0.09	0.02	0.75	0.01	1,655
Oatmeal	0.07	0.16	0.07	0.68	0.02	1,860
Wheat bread	0.35	0.10	0.01	0.53	0.01	1,205
Crackers	0.08	0.11	0.10	0.69	0.02	1,895
Dried beans	0.13	0.22	0.02	0.59	0.04	1,590
Beets	0.70	0.01	....	0.08	0.01	170
Potatoes	0.67	0.02	....	0.15	0.01	325
Turnips	0.62	0.01	....	0.06	0.01	135
Apples	0.62	0.01	....	0.12	....	255

Solids Other than Fat.—These are as follows:

	Wanklyn.	Leeds.	E. W. Stewart.
Ash	0.60	0.68	0.60
Lactose	4.40	4.42	4.55
Albuminoids	4.30	3.76	4.05

Letheby gives the percentage of lactose as 5.2, which is too high for the average.

Lactose.—Lactose is an important ingredient of milk. When chemically pure it is hard, transparent, white, and crystalline. It is now obtainable in much purer commercial form than formerly, when in addition to its diuretic effect, if given therapeutically, it often excited fermentation and even glycosuria. It has but a faintly sweetish taste, and in its properties is allied to both sucrose and starch. Its chief function in human milk is to supply energy for heat production for the infant whose muscles are not yet active in developing this force, and it constitutes about one half of the total solids of milk, exclusive of fat; but the quantity present in cow's milk varies greatly, and, as a general rule, it bears an inverse ratio to the amount of fat and casein present. It is less liable than cane sugar to ferment in the stomach; and alone it is not susceptible to alcoholic fermentation, but in the presence of fermenting nitrogenous material it is converted into lactic acid, making the milk sour. It is promptly absorbed from the alimentary canal, not remaining over an hour in the stomach.

Casein and Albumin.—The principal albuminoid of milk is casein, but there are a half dozen proteids which have been described, showing different behaviour on coagulation, in polariscopic rotation, etc. There is an albumin present called *lactalbumin*, which is coagulable by heat and forms the tenacious "scum" which floats on top of boiled milk. This albumin plays an important rôle by surrounding the minute oil globules of the milk and preventing them from agglutination—in other words, it helps maintain the fat in permanent fine emulsion. It is contained in solution in whey. Traces of peptones have also been found in milk.

Casein itself is non-coagulable by heat, even by boiling, but it is coagulated in firm tough clots by acids, such as the hydrochloric acid of the gastric juice, and by many organic acids which occur as products of malfermentation in the stomach. Lactic acid is the common agent in forming the coagulæ. Casein is also coagulated, but less firmly, by the special milk-curdling ferment "rennin," which is actively present in the infant stomach, and in the third stomach of the calf. The casein clot formed by rennin, unlike that of lactic acid, is not redissolved by neutralisation with alkalies. Casein is present in milk chiefly in an alkaline form as potassium caseinate, and in conjunction with calcium phosphate.

Varieties of Milk.—Cow's milk differs much in quality according to the breed and condition of the animal, quality of its food, and care bestowed upon feeding and hygienic surroundings. The chief variation concerns the quantity of cream produced.

The milk of Alderney, Jersey, and Guernsey cows has more proteid than that of ordinary animals, and Alderneys give more fat than longhorns. Individual cows are liable to vary among themselves and from day to day in the quantity of their milk, and therefore, notwithstanding general belief, it is a disadvantage to feed an infant always upon the milk of the same cow. More uniformity will, on the average, be secured by feeding the mixed milk of several animals, the variations in the components neutralising each other.

"*Strippings*" is the name given to residual milk which may be drawn off shortly after the ordinary milking has been completed.

Contrary to popular belief, it possesses no advantage as food over the rest of the milk, and what little difference in composition exists can be artificially produced. It is richer in fat but poorer in casein than the milk first drawn. For infant use it should be diluted with two parts of water.

Human Milk.—Human milk differs from cow's milk in several important particulars. For this reason it becomes necessary when infants are fed upon the latter to so modify it as to render it more digestible for them.

The important differences between human milk and cow's milk are that woman's milk is sweeter by one third and contains little less than half as much casein. The analyses of the United States Department of Agriculture give the percentage of casein in cow's milk as varying between 3.43 and 3.91, whereas that of mother's milk averages 1.5, hence the importance of diluting cow's milk in the early months of infant feeding. As Leeds says, the calf grows faster and has to manufacture more muscle than the baby—it needs more albumin for tissue building. The casein of mother's milk, moreover, forms smaller coagulæ both with rennet and in the stomach, which are more easily dissolved. The normal reaction of human milk is alkaline. Cow's milk varies from faintly alkaline to neutral, and it often becomes acid, especially when the animals are not pasture-fed. There is nearly one half per cent more fat, and the globules exist in a finer emulsion in woman's than in cow's milk. Cow's milk appears richer, whiter, and more opaque than human milk.

These differences are emphasised by the following comparative analyses by Leeds of average cow's milk and human milk:

	Sound dairy milk.	Human milk.
Reaction	Feebly acid.	Persistently alkaline.
Specific gravity	1029.7	1031.3
Bacteria	Always present.	Absent.
Fats	3.75 per cent.	4.13 per cent.
Lactose	4.42 "	7.0 "
Albuminoids	3.76 "	2.0 "
Ash	0.68 "	0.2 "
Total solids	12.61 "	13.33 "

It requires more acid to precipitate the proteid from woman's milk than from cow's milk. Giving a nursing woman an excess of nitrogenous food does not increase the albuminoid elements of her milk so much as the fats, while giving fatty or rich food in excess does not increase the cream or other ingredients of her milk—it may, indeed, diminish them by disordering her digestion. The nursing mother's diet must therefore be plain but substantial, especially in regard to animal foods. Excessive fat or proteid in the milk disorders the infant's digestion.

The following analyses illustrate the extent of possible variation in good specimens of human milk:

Eight Human Breast-milk Analyses (C. Harrington)

(Infants all digesting well and gaining in weight.)

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Fat	4.37	3.76	3.16	3.82	2.96	2.09	2.02	2.36
Milk sugar	6.30	6.95	7.20	5.70	5.78	6.70	6.55	7.10
Albuminoids	3.27	2.04	1.65	1.08	1.91	1.38	2.12	2.20
Mineral matter	0.16	0.14	0.21	0.20	0.12	0.15	0.15	0.16
Total solids	14.10	12.89	12.22	10.80	10.77	10.32	10.84	11.82
Water	85.90	87.11	87.78	89.20	89.23	89.68	89.16	88.18
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

For the analysis of human milk about half an ounce is required, drawn from the middle nursing period, for the milk becomes progressively richer during nursing.

Prof. Albert H. Leeds (American Text-book of the Diseases of Children, pp. 42, 43) has shown, by a table of analyses of milk from eighty women of different nationalities, ages, and periods of lactation, that although "the average amount of nitrogenous matters [albuminoids] is somewhat greater at beginning of lactation, the difference is not very marked. . . . There is no progressive change in the composition of milk during lactation, but after the function has been normally established the milk remains substantially the same during the entire period. . . . The child obtains more nutriment day by day, but it is by spontaneously increasing the quantity according to the best rule, which is that of normal appetite, and not by absorbing stronger and stronger food."

Somewhat different conclusions are reported by Vanderpoel Adriance and John S. Adriance, based upon analyses of the milk of 120 healthy mothers at the Nursery and Childs' Hospital, New York. In each case the sample was obtained after allowing the infant to nurse for two minutes, and periods studied were from the second day to the fifteenth month of lactation. They found that of all the ingredients of human milk the fat varies most, and varies throughout lactation, the extremes being 7.61 and 1.31 per cent. The fat bears a rough general proportion to the proteid of 3 : 1. The carbohydrate, which weighs during the middle period of lactation more than all the other solids together, increases throughout lactation, and ranges from 5.35 to 7.95 per cent.

The proteid percentage is highest during the colostrum period, when it may reach 8.60 per cent, and falls rapidly towards the end of lactation. Pfeiffer found it as low as 1.52 at the seventh month, but this is extreme reduction. It is increased by worry and nervousness and by lack of exercise; it is lessened by reduction of meat in the dietary, and *vice versa*. The salts diminish from .27 per cent on the second day to .14 at the fifteenth month.

The average specific gravity is given by Adriance as 1.030. It is lessened by increase of fat and increased by increase of proteid.

Human colostrum differs from the later milk as follows: It contains colostrum corpuscles which remain from seven to ten days; it has a yellow colour, which disappears with the corpuscles; it is laxative to the infant; its fat varies greatly; the quantity of sugar is lowest and of proteid and ash highest of any period of lactation.

Drugs in Human Milk.—Many drugs are excreted through the mother's milk, and it is often the case that an infant is affected by suckling such milk. It is possible to act upon infants through this medium, but the strength of solution in which the drug reaches them is far too uncertain. An infant has been killed by nursing from a mother who had taken an overdose of laudanum (Fletcher). Acids given to a nursing mother may cause colic in the child. Neutral salts loosen the bowels, and potassium salts act as diuretics for infants when taken by the mother. Aromatic oils, and probably all volatile oils, reappear in the mother's milk. The agreeable taste of some of these substances causes the child to suck harder, and excites thereby a reflex stimulation of the mammary glands to further secretion.

Among other drugs which have been determined in the mother's milk after ingestion by the stomach are: Senna, rhubarb, scammony, sulphur, castor oil, ammonium salts, turpentine, copaiba, anise, dill, garlic, wormwood, and jalap. Antimony passes readily into mother's milk, and should be given with caution to nursing women. Potassium iodide, corrosive sublimate, and other mercurial salts, arsenic, zinc, and lead, all may be excreted in the milk at periods varying from four hours to several days after their administration and continue to be eliminated for a day or two after the drug has been withheld.

Vegetable acids give rise to carbon dioxide in milk. If nursing mothers partake freely of fresh fruit and green vegetables their milk may gripe and purge their infants. Violent exercise and violent mental emotion are harmful to the milk.

Goat's milk is the least digestible and nutritious of milks, although it contains the most solids. It is scarcely used at all in the United States except sometimes by very poor foreigners, as it is in Switzerland and other mountainous European countries, and for some Eastern tribes it is a staple variety of milk. Cheese is also made from it on a large scale. It has a peculiar strong odour and taste, which are disagreeable to those who are unaccustomed to it, and which are partially expelled by boiling. They are due to a substance called hircin or hircic acid.

Goat's milk contains an excess of fat, and for this reason is too rich for infant food, and gives rise to vomiting and diarrhœa. The coagulæ formed by it are very tough.

Ass's milk contains the least solids of all the edible milks, except mare's milk, and is poor in casein and fat. It has a fair proportion of sugar, more than cow's milk but less than human milk. Ass's milk is sweet and easy of digestion, although it has a tendency to cause diarrhœa.

Experiments in the feeding of children direct from asses were conducted in Paris in 1883 at the Hospice des Enfans Assistés. One ass sufficed to nourish three infants besides her own foal. The asses were kept near the ward and the infants were brought to them to nurse. Syphilitic infants belonging to a class in which death had been the invariable rule were thus nursed, and 70 per cent were saved. The experiment does not seem to have found favour elsewhere. Goats were first tried, but proved of no service for direct nursing.

Mare's milk, like ass's, contains less proteid and less fat, but more lactose than cow's milk.

The casein of mare's milk is intermediate in digestibility between human and cow's milk. Both ass's and mare's milk are used in the steppes of Russia and in Siberia for the manufacture of koumiss. (See Koumiss.)

Reindeer milk contains 18 per cent of solids, and, generally speaking, those domestic animals living farthest north have the most solids in their milk.

Milk Analysis.—An accurate analysis of milk requires much skill and the equipment of a well-organised laboratory, but it is often important for physicians to be able to judge for themselves of the quality of food so universally prescribed by them, and it is therefore deemed appropriate to describe some of the easier methods of qualitative examination. The minimum standard to which milk must conform, as established by the New York City Health Board, is as follows:

	Per cent.
Water	88.00
Fat	3.50
Total solids	12.00
Solids not fat	8.50

Reaction, Colour, Taste, Odour.—Good cow's milk should be almost neutral, reddening blue litmus paper but very slightly if any. The normal colour is white and is due to the fat globules, but it may be slightly yellow, especially if the cow has been feeding in wheat fields (Hind). The taste is sweet and the odour faint and fresh. Bad milk often has a bad odour, either sour or derived from absorption from some neighbouring material. It is sour to the taste, reddens litmus paper strongly, and if held to the light in a test tube or small thin glass it may have a bluish or reddish tinge and appear watery. It curdles in tough, stringy, or glutinous yellowish lumps of large size.

Estimation of Total Solids.—To estimate the total solids of milk several tests are employed. Their object is to furnish data in regard to the nutrient power of the milk and to detect adulteration.

A common method used by health boards is to weigh and evaporate five cubic centimetres of milk to dryness in a small, flat-bottomed, platinum crucible of a known weight. This process takes about an hour. The residue is then dried for an hour more at 100° F. and weighed. The milk dries in two layers. The upper layer consists of a thin film of fat, which is dissolved in petroleum and benzine. The lower honeycombed layer is then washed and dried and weighed again. The loss in weight after removing the upper layer represents the amount of fat present. The soluble salts and soluble proteid are then dissolved out by warm water and alcohol and separated. Ignition over a Bunsen burner drives off all organic matter, and leaves the ash, which is again weighed.

Another less laborious method consists in the use of an instrument called a "lactometer," by which the specific gravity of the milk is taken.

A lactometer is a glass spindle resembling a urinometer, but is about fifteen centimetres long, and it easily floats in a quart measure. It is graduated to measure the specific gravity from 0° (the water line) to 40°. Milk in which it floats at below 29° is almost surely watered, or if it floats above 33° the milk is skimmed. The specific gravity of the milk being taken with the lactometer, the amount of dilution is readily computed by comparing it with the normal standard, 30°. Suppose this specific gravity to be 21° in a given case, then 30 : 21 :: 100 : 70. That is, the normal gravity, 30, is to the gravity of the sample examined as 100 parts of normal milk are to the sample, or, in other words, only 70 parts per hundred of the sample are milk, and 30 parts of water have been added. To facilitate the calculation, the space between 0° and 40° may be divided into 100 parts; each division of the second scale represents 1° or 1 per cent of milk. Thus, if the lactometer stands at 50° of this second scale, there is only 50 per cent of milk in the sample.

There has been much dispute regarding the use of the lactometer, on the ground that an excessive amount of cream, on account of the lightness of the fat, diminishes the specific gravity of a really rich milk. On the other hand, it is claimed that the diminished gravity is always due to increase in the quantity of water, and that milk rich in cream will also contain less water, and therefore maintain the normal standard. The matter has been tested in the courts, and in New York city the lactometer test alone is always sufficient to insure conviction in trials for adulteration of milk with water.

Sometimes in estimating the specific gravity acetic acid is first added to precipitate the casein, which is removed with the fat; the specific gravity of the whey is then taken. Hassell claims that the latter is more constant that the specific gravity of milk itself.

L. Emmet Holt furnishes the following table of variations in specific gravity of human milk and their causes, as determined by a lactometer of his own device:

Human Milk (Holt)

	Specific gravity 70° F.	Cream—24 hours.	Proteids.
Normal average.....	1.031.........	8 per cent..............	1.5 per cent.
Healthy variations...	1.028 to 1.029.	9 to 12 per cent.........	Normal (rich milk).
Healthy variations...	1.032 to 1.033.	5 to 6 per cent..........	Normal (fair milk).
Unhealthy variations.	Below 1.028...	High (above 10 per cent).	Normal or slightly below.
Variations..........	Below 1.028...	Normal (5 to 10 per cent).	Low.
Variations..........	Below 1.028...	Low (below 5 per cent)..	Very low (very poor milk).
Variations..........	Above 1.033..	High.................	Very high (very rich milk).
Variations..........	Above 1.033..	Normal................	High.
Variations..........	Above 1.033..	Low..................	Normal (or nearly so).

"Milk presenting only moderate variations from the average—e. g., specific gravity 1.028, cream 4 per cent, or specific gravity 1.033, cream 10 per cent—can usually be modified by appropriate treatment. If, however, the specific gravity is from 1.018 to 1.024, and cream only 2 per cent to 3 per cent, it is hopeless." (Holt.)

Estimation of the Fat.—To estimate the amount of fat or cream the sample of milk is allowed to stand in a cool place for twenty-four hours in a "creamometer." This is a simple glass tube twenty-five millimetres wide and twenty-five centimetres deep, which is graduated in hundredths from above downward. It is filled with milk to the zero level. The cream rises to the top, and the percentage of volume is read off.

This method is amplified by Marchand's process, in which a similar graduated tube is employed, but the cream is more completely separated by means of the addition of ether and a little liquor sodæ. Ninety-five per cent alcohol is then put into a flask with the milk, and the whole is vigorously shaken, after which it is allowed to stand at 130° to 140° F. In half an hour the fat forms a distinct layer at the top of the graduated tube. The error by this process is said to be less than 0.3 per cent.

Dilution of milk by water is determined in the New York Health Board by use of a Swedish separating machine, the principle of which is as follows: Glass tubes are used having a diameter of about half an inch with a contracted neck graduated in percentages. A minute perforation at the neck admits the entrance of water. The tubes are first nearly filled with sulphuric acid and a measured quantity of milk is added. The tubes are corked with rubber, placed in a pan filled with water at 150° F., and rotated in a centrifugal machine at a speed of 40,000 revolutions a minute. The temperature of the water is then reduced to 52° F., and the percentage of fat is read off from the narrow neck of the tubes. Water is found to have entered through the perforation, and by its intermediate specific gravity it lies between and separates the fat and sulphuric acid. The process requires half an hour's time, and twenty samples may be examined at once.

The richness of the milk in cream, or its dilution with water, may also be measured by its opacity. Five cubic centimetres of water are placed in a glass cell, called a " lactoscope " or " diaphanometer " (Dome), with parallel sides, through which a candle placed at a distance of a metre may be seen. More milk is then added, drop by drop, until the opacity of the cell contents obscures the light. This method is more tedious and less accurate than the previous one. Cream varies in specific gravity between 1.010 and 1.024.

A simple method of roughly determining the quantity of fat in human milk is given by Nias. The milk is placed in a test tube, made distinctly alkaline by a few drops of liquor potassæ, boiled, and left for a few hours in a warm place. The fat, floating on the surface, is then estimated by graduations on the side of the test tube. It is of course necessary to use test tubes of uniform calibre in making comparative tests.

Estimation of Lactose.—The method of quantitative estimation of milk sugar is the same as that employed for glucose in the urine. The casein is first precipitated by acetic acid. The whey is filtered and tested with Fehling's copper solution or with a polariscope. Convenient tables are made to facilitate the calculation.

Estimation of Albuminoids.—In the method of Nias to determine the albuminoids the sample of milk is placed in a graduated test tube, as if to estimate the cream, and after some hours the supernatant fat is drawn off by a pipette. Acetic acid is next added until a strongly acid reaction develops. The milk is then boiled. All the albuminoids are precipitated, and after standing overnight the quantity may be read off on the side of the graduated tube.

MILK ADULTERATION AND IMPURITIES

Of recent years it has been discovered that a very large proportion of infant mortality is traceable to the use of impure milk, and that many diseases, especially diarrhœal disorders of summer, are preventable when proper care is exercised to protect the milk supply. The subject is rapidly claiming public attention, and suitable controlling legislation has been already adopted in most civilised countries.

The prevention of adulteration and contamination of milk is a matter of vital importance from both an economic and hygienic standpoint. Children, who are so largely dependent upon milk, do not well tolerate its adulteration, and milk is so much used as a raw food—perhaps more than any other one article of diet—that its careful inspection in regard to contamination by disease germs or adulterants is imperative, and the constant vigilance of the health boards of large cities is required to protect the public from imposition. According to H. D. Chapin and G. B. Fowler, of the Milk Commission appointed by the Medical Society of the County of New York to investigate the milk supply of that city in 1900, "over 6,000 children under five years died in New York city from diarrhœal diseases largely due to drinking old and contaminated milk."

It is better and simpler, however, for much of the inspection to be done at the dairy farms, and in many parts of this country the State boards of health appreciate the importance of this matter, and the sale of milk from diseased cows is prevented at first hand. When a cream separator at a creamery is cleaned it is often found to contain a residue of manure, hairs, dirt, and perhaps pus and blood from inflamed udders.

The examination of milk requires the adoption of a legal standard of quality. In New York city the Health Board depends chiefly upon the use of the lactometer above described. (See Estimation of Solids in Milk, page 59.) In States such as Massachusetts, Rhode Island, and Maine a chemical analysis is required by law. The normal specific gravity established is 1.030 (in New York 1.029), and the normal average amount of cream is 8 per cent by volume.

The inspection of milk in all large cities and towns is made at the railway stations or ferries where the cans are received. The examination is under the direction of expert officers, usually members of the local health board. It is impossible and unnecessary to examine all the milk brought in, but the officers make frequent seizures and destroy at once all milk found below the legal standard. Milk sold in shops and otherwise must also be occasionally examined, for its dilution and adulteration is very easy and profitable to the unscrupulous. Gross impurities in milk, such as dirt, hair, etc., may be removed by filtration through absorbent cotton. A few germs are also removed in this manner. A noted milk dealer of Berlin, who dispenses 60,000 quarts of milk daily, forces it through gravel filters from below upward, thereby removing the gross impurities.

Milk may be altered by—

1. Addition of water, pure or impure. 2. Addition of colouring matter. 3. Addition of preservatives. 4. Addition of substances used for thickening after dilution.

1. The commonest method of adulterating milk, and the one often most difficult of detection, is by dilution with water. If the water thus used is pure it does no harm other than to defraud the consumer; but if impure, as it often is when drawn from wells near manure heaps, in barnyards, or country privies, it may prove fatal.

2. The normal whiteness and opacity of milk is due to its fat globules. If milk has been much diluted it becomes pale and bluish, and both milk and cream are sometimes artificially coloured with anilines or other pigments. This form of fraud is less injurious to health than the others, for but very minute quantities of colouring matters are employed. Annotto is the commonest dye used to impart a yellow colour to milk, cream, and butter. It is prepared from the seeds of a tropical American tree (*Bixa orellana*). It is detected by allowing the milk to stand in a tall glass, when the lower stratum will contain the pigment associated with the casein instead of remaining colourless, while the naturally yellower cream floats on top (Hird). The cow's food may sometimes colour the milk red or pink, and it may be so stained by traces of blood, in which latter case the lower layers are of deeper hue than the upper.

3. Various substances are added to milk and its products—condensed milk, butter, cheese, and koumiss—to keep them from souring. These are usually sodium bicarbonate, borax, or boric acid. Salicylic acid and formaldehyde are less often used. In small quantities they do not affect its taste or hurt the digestion of adults, but they may be injurious and even fatal to infants, and their use should never be tolerated. Salicylic acid is sometimes put into beer for a similar purpose, although this is prohibited by law. The presence of boric acid is detected by mixing one part of milk with two parts each of hydrochloric acid and saturated turmeric tincture. After drying on a water bath and adding a little ammonia, a dark-blue colour appears which changes to green.

4. Both milk and cream, after dilution with water, are sometimes thickened again with such substances as flour, arrowroot, farina, whiting, chalk, tragacanth, or carbonate of magnesia, which disguise the natural blueness of the attenuated fluid. Effervescence in milk produced by addition of a strong mineral acid shows the presence of carbonates. Sugar is added to raise the specific gravity of diluted skimmed milk.

Milk is contaminated or rendered unfit for use by—

1. Improper or poisonous foods eaten by the animal. 2. Poor condition of the animal, due to nursing, worrying, etc. 3. Contamination by disease germs from the cow. 4. Contamination by extraneous disease germs. 5. Souring and decomposition. 6. Absorption of bad odours.

1. The colour of milk is affected by various substances ingested by the cow; thus madder turns it saffron, rhubarb makes it red or

yellow (Mosler), and it is coloured blue by some drugs. The colour is then uniform throughout the milk, and not superficial as in the case of the blue imparted by the growth of fungi, as described below. If milk be made blue by addition of litmus the solution will be reddened by action of such bacilli as the lactic-acid bacillus, the *bacillus typhosus,* and the *streptococcus pyogenes.*

Cows fed on brewers' swill or refuse of glucose factories, or cows allowed to eat decaying autumn leaves, garlic, certain injurious meadow plants, or strong-smelling plants like cabbages, turnips, and onions, will give unhealthy, strong-smelling, bad-tasting, or deteriorated milk. Beets tend to make cow's milk acid. Cows should not be given unclean water to drink. Offensive odours and tastes imparted to milk through the cow, or by absorption from surrounding substances, are most intense while the milk is fresh; whereas if due to bacteriological influences, they only become apparent after some hours, and go on increasing. H. Weller found nearly 1 per cent of alcohol in milk from cows fed on distillery slops which contained 6 per cent of it.

2. The milk first secreted after calving (colostrum) contains more albumin than casein. It is viscid, turbid, frothy, yellow, slightly acid, and coagulates on boiling. In the cow colostrum has a sickly odour, and is purgative even when cooked. It remains so for about a month after parturition. Colostrum corpuscles may be easily detected by microscopic examination.

The bulling cow may be highly nervous during ovulation, and, as a reflex consequence, her milk becomes acid.

Cows which are teased and worried by dogs or otherwise, or made to exercise too much, give milk which sours easily and disagrees with infants. Underfeeding makes the animal give inferior, watery milk.

3. Cows suffering from certain diseases may transmit them through their milk to man, although this method of infection is less common than that through milk to which germs have had access in process of handling or transportation. The principal diseases which may be derived from the cow through her milk are tuberculosis and diphtheria.

The Massachusetts Society for Promoting Agriculture, in a report upon "The Infectiousness of Milk," confirms the fact that milk from cows having tubercular udders is infectious to man. (This statement is contradicted by Koch, who, in common with several other observers, has claimed that human and bovine tuberculosis are non-interchangeable.) Tubercle bacilli were also demonstrated in the milk of twelve out of thirty-six cows having tuberculosis, but whose udders were not affected. The inference is drawn from the report that 3 per cent of the milk furnished to Boston is infected. It is estimated that 6 per cent of all cows are tubercular.

Tubercular milk is of poorer quality, thinner, and bluer than normal milk.

Cases have been reported of infection of a nursing infant through a tubercular mother's milk, and calves are undoubtedly so infected through cows; but it must be remembered that the infant is much exposed to infection by its mother's sputum, and may inhale dried sputum from beneath her bedclothing or within the room.

However, the presence of tubercle bacilli has been indubitably demonstrated at least a half dozen times in human breast milk. Tabes mesenterica and tubercular meningitis in children have been caused by infected milk.

The foot-and-mouth disease of cattle is transmitted to man if the milk of cows so affected be drunk without boiling, which destroys the germs (Bollinger). This disease is transmitted even when the milk is diluted ten times or taken in coffee or tea, but adults must drink a good deal of it in order to become affected. Butter and cheese made from such milk also carry the infection (Schneider). The foot-and-mouth disease diminishes the quantity of milk given by the cow by one half, and the milk coagulates too quickly and has a yellowish colostrum-like appearance. If the disease be severe the milk separates into slimy coagulæ and whey, and, on boiling, curdles in stringy masses. In other cases the taste is acid, and on standing twelve hours a yellow sediment is precipitated with a nauseous, rancid odour. The milk becomes infected from sores upon the nipples.

4. Extraneous disease germs may find their way into milk through contact with unclean hands, or from polluted water used for dilution, or for washing cans and pans.

Soxhlet says that if mother's milk were sold like cow's milk after as much careless handling, it would produce as much disease. Calves have been known to acquire diarrhœa when fed milk from unclean pails, and the animals were cured by allowing them to suck the very cows that had been milked into the pails. According to Sedgwick, milk may contain a million bacteria to the cubic centimetre after its journey from cow to table.

Cow's milk is too often tainted with excrementitious matter from the stable or cow yard. The cows lie upon foul bedding, or bespatter their udders continually in barnyard filth. Soxhlet has said that in judging the quality of milk one should consider " not so much what the cow fed on, as rather what kind of cow dung the milk contains."

The following data from the report of a commission of disinterested physicians upon the " Walker-Gordon guaranteed milk " from the dairy at Plainsboro, N. J., exhibit an ideal system of cleanliness. Each milkman before milking is required to cleanse his hands in hot water with soap and a nail-brush; he then dons a clean white linen suit from the sterilising chamber, and takes a clean towel and milking-stool; he is not allowed to moisten his hands with the milk in milking, and he must wash his hands each time before milking another cow. All cows must have given a negative tuberculin test, and all are groomed twice a day before milking. Pine shavings are used for bedding. The milk is drawn into pails with small openings, to exclude droppings from the animal's belly. The milk is strained through sterilised absorbent cotton and placed in a cooler, which reduces the temperature to 40° F. within twenty minutes after leaving the udder. It is then bottled and stored in ice water ready for shipment.

William H. Park and L. Emmett Holt analysed the milk bought in stores in the tenement districts in New York city, and its effect upon infant feeding. Some of their conclusions follow: In winter the average number of non-specific bacteria present in store milk is 750,000 per cc., a number which does not appear to be harmful. In summer over 1,000,000 bacteria per cc. of milk are always harmful to young infants, and the number may reach several hundred millions per cc. More than 139 varieties of bacteria were represented in the various samples of milk, no one of which appeared to be especially related to the summer diarrhœas of infancy. After the first year of life the bacteria of milk seemed to produce very little disturbance in children unless present in enormous excess.

Milk carelessly transported promptly absorbs germs from the air or from unclean receptacles, and it is an excellent culture medium for rapid growth of such germs as those of tuberculosis, scarlatina, diphtheria, and typhoid fever, which may gain access to it in that manner. When local epidemics of such diseases break out, there should always be a thorough investigation of the sources of milk supply, and a bacteriological examination of the milk itself should be instituted. Many persons imagine that a chemical analysis is sufficient, but this is useless for detection of disease germs.

George M. Kober reported 330 outbreaks of infectious diseases of various kinds due to milk infection, and which had been recorded prior to 1901. Such epidemics are more common in England than in America, and least often appear in continental Europe, owing to the comparative infrequency with which raw milk is drunk there by both infants and adults.

Severe epidemics of typhoid fever have of late years been attributed to infected milk by H. E. Smith, at Waterbury, Conn.; by L. H. Taylor, at Wilkesbarre, Pa.; and by Littlejohn, who traced the origin of sixty-three cases to one dairy. Fourteen cases of typhoid fever occurring in East Barrington, N. H., in 1896, were traced to the eating of ice-cream contaminated by a milkman who had continued milking while himself suffering from the fever. No one who is nursing a case of typhoid or scarlet fever or diphtheria, or who in any way handles the discharges or clothing of such patients, should be allowed to touch milk or milk receptacles, much less to milk a cow.

Typhoid bacilli have also been proved capable of living in butter.

At Brewster, N. Y., Miller reported twenty-four cases of scarlatina which occurred among those who drank the milk supplied by one dairyman while his daughter had scarlet fever. The disease was not otherwise prevalent in the town at the time.

E. Hart reported at the Seventh International Medical Congress a series of epidemics in England the origin of which he had traced to milk. Of these, fifty were of typhoid fever, fourteen of scarlatina, and seven of diphtheria.

The diphtheria bacillus has not thus far been proved to be transmitted direct from the cow to man, but cows inoculated under the shoulder with diphtheritic microbes exhibit the germs in the milk after developing local lesions of the udders. Those epidemics of diphtheria the spread of which has been attributed to milk have probably been due to contamination through the handling of the milk by milkers or dairymen having the disease themselves or who have been in close contact with it. In this country Goodwin and W. H. Stillwin have both reported such epidemics occurring in Michigan in 1879. W. J. Howard, Jr., studied an epidemic of 100 cases in 49 houses in Ashtabula, Ohio, in 1894, which he is confident was referable to a milk supply delivered by boys who had severe angina at the time, although the bacillus diphtheriæ was not found in their throats. The New York Health Board reported the discovery of the germs in cheese made by a milkman in whose family diphtheria was present.

A mould, the *Oidium lactis*, or *penicillium*, and the *Bacterium cyanogenum* are germs which produce a blue colour in milk and sour it. The mould also grows upon cream cheese. This colour appears first upon the surface if the milk be not agitated, and it differs from the uniform blue imparted by adulteration with water, or by poisonous plants, drugs, etc. Milk thus affected is irritant, and may cause febrile gastritis, stomatitis, or diarrhœa.

Milk is coloured lemon yellow by the *Bacterium synxanthum* (Ehrenberg), and red by chromogenic fungi.

The fungi and germs themselves do not impart the colours, but develop various anilines—aniline blue, fuchsin, etc.—from the casein (Schröter).

" Clouty cream " is produced by germ action.

5. There are ten different varieties of bacteria which are capable of inciting lactic-acid fermentation of the milk sugar (Leeds), all of which cause the milk to " sour " and curdle, and some, but not all, simultaneously develop carbonic acid and alcohol. A large proportion of the bacteria of milk rises with the cream to the surface

(Freeman). Milk may be really decomposing although it has not yet coagulated.

The first process, that of the formation of lactic acid, is a preliminary to the normal digestion of milk, but the second is abnormal and interferes with it. The sour milk curd may be redissolved by neutralisation with alkalies.

The *Bacillus acidi lactici* may sour the milk before it is ingested, or, like many germs, their action may not be apparent before swallowing the milk, but it begins immediately thereafter in the stomach.

Good, clean, uncontaminated milk should keep fresh, exposed in a clean room at the ordinary temperature of 68° F. for forty-eight hours without souring and coagulating. But if the air is much warmer, or if the milk is tainted in any manner, it will sour in a few hours. Boiled milk keeps fresh rather more than half as long again as fresh milk.

6. The absorbent power of milk is strong, and it may acquire a strong odour from substances kept in its vicinity. It may acquire a bad flavour at the same time, or may have the odour alone.

If left in a refrigerator with stale cheese, ham, onions, decomposing meat, etc., it soon becomes spoiled in this manner. Milk easily absorbs the odour of tobacco, camphor, or of turpentine from fresh paint, and, in fact, the odour of almost any volatile substance. It should never be left exposed in the sick-chamber or in a bathroom, or near a waste pipe.

PROPHYLAXIS AGAINST MILK INFECTION

As prophylaxis against milk infection certain precautions are necessary, and it should be the duty of physicians to educate public sentiment in regard to their importance as a means of restricting the spread of infectious and dietetic diseases.

For transportation from the country to the city, milk is usually taken from the farms in forty-quart tin cans, which should be filled full and tightly covered to prevent churning and souring. Some railways supply refrigerator milk cars, which are hung upon specially constructed springs, to prevent as far as possible agitation of the cans. At some dairies the milk is put, directly after milking, into glass bottles previously sterilised by washing and steaming, which are then tightly corked. If pails, pans, or cans are used, their absolute cleanliness must be insured by frequent careful washing and by occasional scalding with hot water. This destroys germs or ferments which would otherwise contaminate the fresh milk and soon sour it. The bottles are sealed and stamped "Certified Milk" before being sent to market.

Many large dairies now employ a veterinarian, whose duty it is to daily examine all the cows and report on their health, and on the hygienic condition of the stables, yards, etc.

Nothing is more disgusting than allowing the manure-besmirched tails of ungroomed cows to contaminate the hands of milkers, or the milk itself, and yet this is constantly happening.

The question of prophylaxis is of such universal interest that the admirable rules formulated by Vaughan are here quoted in full:

"*a.* The cows should be healthy, and the milk of any animal which seems indisposed should not be mixed with that from the healthy animal.

"*b.* Cows must not be fed upon swill or the refuse from breweries or glucose factories, or upon any other fermented food.

"*c.* Milch cows must not be allowed to drink from stagnant pools, but must have access to fresh pure water.

"*d.* The pasture must be freed from noxious weeds, and the barn and yard must be kept clean.

"*e.* The udders should be washed and then wiped dry before each milking.

"*f.* The milk must be at once thoroughly cooled. This is best done in the summer by placing the milk can in a tank of cold water or ice water, the water being of the same depth as the milk in the can. It would be well if the water in the tank could be kept flowing, and this will be necessary unless ice water is used. The tank should be thoroughly cleaned each day to prevent bad odours. The can should remain uncovered during the cooling and the milk should be gently stirred. The temperature should be reduced to 60° F. or lower within an hour. The can should remain in cold water until ready for delivery.

"*g.* Milk should be delivered during the summer in refrigerated cans or in bottles about which ice is packed during transportation.

"*h.* When received by the consumer it must be kept in a clean place and at a temperature some degrees below 60° F.

"If all the milk used in the artificial feeding of infants could be obtained and marketed with the care demanded by the above rules, milk infection would be practically unknown and the sterilisation of the infant's food would be unnecessary."

Laws relating to the marketing of milk have been enacted in 39 States, which comprise such improvements as are summarised in the following list, compiled by the Journal of the American Medical Association (September 19, 1903):

"The registration of all dairies; official indorsement of properly conducted dairies; inspection of all herds, barns, dairy buildings, etc., once a month; better lighting, ventilation, drainage and cleanliness of cow stables; whitewashing the interior of stables; eradication of tuberculosis from dairy herds; branding of condemned cows; cows not to be given swill feed, etc.; cows to be regularly cleaned; pasturage for city cows; aeration of milk in pure air; prompt cooling of milk and holding it at low temperature until final delivery; shipment of milk promptly from farms after milking; delivery of milk and cream in sealed packages (glass bottles or small cans), so as to avoid unnecessary contamination by city dust, etc.; delivery of milk in cities at any hour of the day when it can be supplied in the best condition; restrictions on the sale of milk in markets, candy stores, etc.; delivery of milk from such stores in bottles only; mixing of herd milk so as to get an article of uniform composition; bottling of milk only at the dairy or place of general supply; daily sterilisation of milk utensils; more rigid inspections for preservatives in milk; chemical and bacteriologic examinations of milk; standards for cream and skim milk."

The enactment of these laws is due to the activity of the medical profession, and has largely been accomplished through the influence of county, state, or other medical societies and boards of health, which latter are responsible in most instances for their enforcement.

USES OF MILK

The following are the more important uses of milk:

1. As an infant food.
2. As a food for adults.
3. As a source of special food products and derivatives, such as koumiss, cream, butter, and cheese.
4. As a diuretic.
5. For its soothing effect on diseased mucous membranes of the alimentary canal.
6. To loosen cough (when given hot).
7. As a prophylactic against lead poisoning.
8. As a vehicle for the administration of other foods.
9. As a vehicle for the administration of medicines.
10. For rectal injection.

The first three of these uses are so important that they will receive separate detailed consideration (see Diet in Infancy, page 762, Adaptation of Milk for the Sick, page 74, and Milk Derivatives, page 95; the others may be briefly referred to here.

4. The diuretic action of milk in some persons is very pronounced, while in others it is not noticeable. It is due to the two ingredients, water and lactose or milk sugar. The water acts by increasing the volume of blood and the renal blood pressure. The lactose probably acts directly by stimulating the renal epithelium.

Lactose has been employed with doubtful success as a diuretic in dropsies and some forms of renal disease. The dose is twenty to thirty grains.

The mineral salts and the water of milk are speedily absorbed by the mucous membrane of the stomach, and in some persons this process is so rapid that milk taken by the tumblerful into an empty stomach has a very decided diuretic effect within an hour. This action may be further promoted by drinking a cup of black coffee.

5. Milk is undoubtedly soothing to the mucous membranes of the alimentary canal. It is often the only variety of food which can be borne by an inflamed or irritable stomach or in some forms of intestinal disease. It is equally soothing in the rectum.

6. A few sips of hot milk or hot milk and Vichy will often allay an irritable cough, and favour the expectoration of tenacious bronchial mucus.

7. Milk is sometimes employed among type founders as prophylactic against lead poisoning. It is claimed by Hirt that if a quart or two be drunk daily, poisoning never occurs.

8. As a vehicle for administration of other foods for invalids, such as egg albumin, beef-meal, meat juice, peptonoids, cocoa, spirits, etc., milk is most useful.

9. As a vehicle for the administration of many medicines and insoluble powders, such as calomel, disagreeable-tasting drugs, like potassium iodide, salicylates, opium, etc., milk is often very serviceable. Sulphonal given in hot milk acts better than if prescribed alone.

10. Milk is employed in nutritive enemata, alone or with beef juice, beef peptonoids, spirits, etc. From one to two or more ounces are given at a time, after cleansing the rectum. A little laudanum may be added, and a towel should be held against the perinæum to aid in the retention of the milk. When the circumstances admit, it is advisable to pass a long catheter and inject the milk through it as far as the sigmoid flexure, while the patient is supported upon the hands and knees. The higher up the milk is injected, the more readily it is absorbed, and the circulation of the rectum is such, that whatever ingredients of the milk are taken up by the venous capillaries of the lower portion pass to the vena cava, whereas the ingredients absorbed by the superior hæmorrhoidal or the sigmoid vessels are carried directly to the vena porta and liver, where they are assimilated more promptly. The lymphatic capillaries also assist in the absorption.

The simple mucous secretions of the rectum have no proper digestive action upon milk (Czerny), but they may sometimes cause putrefaction of its albuminous matter, with formation of tyrosin, indol, etc. (Marckwald). It therefore facilitates absorption to have the milk previously digested by pepsin or pancreatin. Patients having ulcer or carcinoma of the stomach, any intestinal obstruction, or irritant vomiting, may be kept alive for many weeks by the exclusive use of nutrient milk enemata. (See Food Enemata.)

Attempts to get milk into the circulation by rubbing it into the skin and by soaking portions of the body in milk baths have proved of no avail, for it is not absorbed in that manner.

The intravenous injection of milk has been occasionally used in cholera collapse, post-partum hæmorrhage, etc., and in some few cases it has been found satisfactory, but since saline injections have proved more efficacious, those of milk have been abandoned. Milk has also been injected into the peritoneal cavity, but without much benefit. It has been given hypodermically in doses of four grammes (Menzel). One patient was kept alive sixty-three days in this manner (Whittaker). The milk thus injected is absorbed within an hour.

MILK DIGESTION

Normal Digestion.—Milk is not altered in the mouth, but on reaching the stomach the casein is precipitated by a curdling ferment, called rennin. The curds, or coagulæ, vary in size and toughness according to the quality of the milk, its degree of dilution, and other circumstances.

The gastric hydrochloric acid also coagulates milk by neutralising the alkali which holds the casein in solution. Hence milk becomes really a solid food almost as soon as it enters the stomach. In coagulating, the curds entangle the fat globules, but they are soon dissolved by the ferment of the gastric juice (pepsin) and converted into peptones or intermediate products called albumoses. The fat globules are again liberated, their albuminous envelopes are dissolved, and they coalesce to larger droplets, in which condition they pass with the chyme into the intestine. The usual period for the digestion of milk in the stomach by normal gastric juice occupies about three hours.

The salts and water of the milk, and possibly to some extent the sugar, are absorbed in great part from the stomach wall. In proof of this is the fact that the diuretic action of milk is often obtainable within half the time required for the complete digestion of the albuminoids. When not absorbed by the stomach they pass into the intestine and are absorbed through the villi.

Those curds which are not fully dissolved by the gastric juice may enter the duodenum, where their digestion is completed by the pancreatic juice. The latter saponifies the fat which is absorbed by the lacteals of the villi. In the digestion experiments of C. H. Woods and L. H. Merrill (U. S. Department of Agriculture Bulletin No. 85, 1900) the digestibility of milk casein was always increased by the addition of bread to the milk.

Rennin.—Rennet is the name given to an infusion of the middle stomach of the calf in brine which possesses special milk-curdling power which is due to a ferment called rennin.

This milk-curdling ferment is believed to be developed by the action of acids from an antecedent material called zymogen. Rennin is not obtainable from the human stomach in large quantity, but it undoubtedly exists in the gastric juice, for pure pepsin has scarcely any curdling action upon milk; moreover, milk may curdle in either neutral or alkaline media in which pepsin is inert. Rennin is most active in an acid medium, but it also works in the alkaline pancreatic juice. It possesses little proteolytic power. It is believed to exist more abundantly in the infant stomach than in that of the adult.

Rennet may be prepared as a powder; it is sold by grocers in alcoholic solution, and when added to milk which is gently warmed, a light coagulum is formed, causing the milk to partially solidify. The coagulum contracts and squeezes out fluid, which constitutes whey. The rennetised milk when flavoured with vanilla or powdered cinnamon or nutmeg makes an agreeable invalid food or dessert, which is highly nutritious, for it still contains all the original ingredients of milk.

Abnormal Digestion.—In cases of indigestion from various causes the curds may remain undissolved in the stomach, eventually irritating it and causing vomiting, or they may pass along the intestine and be voided unaltered in the stools. This occurrence is more frequently noticed in young infants than in adults.

Milk which disagrees in the stomach forms large and somewhat tough coagulæ of casein, which are with difficulty dissolved by the gastric juice. Many substances may be added to milk which by their mechanical presence will prevent this occurrence, and hence favour the action of the gastric juice. Excessive acidity of the stomach due either to hypersecretion of hydrochloric acid or the presence of organic acids, especially lactic, derived from the food or fermentation processes, modifies the digestion of milk; the lactose is altered into lactic acid and the casein is promptly coagulated. The alkaline salts of milk are split up and phosphoric acid is liberated, and complicated fermentative changes ensue which are as yet imperfectly understood. All this causes more or less gastro-enteric irritation, resulting in diarrhœa.

When milk or cheese remains too long in the stomach or intestine a further fermentation is excited accompanied by a neutral or alkaline reaction, and which results in the final production of butyric acid, and sometimes of other substances, such as leucin, tyrosin, and ammonia. But while free hydrochloric acid exists in the contents of the stomach, the organic acids—lactic, butyric and acetic—which are associated with milk fermentation are unlikely to develop.

Cow's milk may readily become acid from alteration in the relative amount of potassium biphosphate and the two-thirds phosphate of potassium. The former, if present in excess, hastens coagulation and an acid reaction. When warm the milk may again become alkaline (Soxhlet, Heintz).

These facts explain the frequent necessity of using antacids, such as lime water or sodium bicarbonate, with infant milk food. Mucous fermentation of the proteids makes the milk slimy, and it becomes stringy on boiling.

Milk, according to Rubner's experiments, yields more bulky residue in the feces than either eggs or meat, yet its nutritive ingredients are very perfectly absorbed. From 8 to 10 per cent approximately of the solids of milk is eliminated in the stools.

ADAPTATION OF MILK FOR THE SICK

When patients object to the taste of milk alone, they can be often induced to take large quantities by using it in various combinations or preparations, or by disguising its taste. Many patients when ordered a milk diet positively assert that they cannot endure the taste of milk; that it always nauseates them, or that it makes them bilious and constipated, and excites headache. They say, perhaps, that they have faithfully tried to drink it before, and never could tolerate it; but scarcely any one person has ever tried all the different methods of taking milk, and it does not follow that because it once disagreed several years before it will again. The objection to the taste can always be overcome by a little tact and perseverance, and there are very few persons who cannot assimilate a more or less exclusive milk diet for a few days or weeks if the milk is properly given, and, if necessary, artificially digested for them. Their previous unhappy experience is probably due to having taken a large dose of undiluted rich milk which promptly coagulated, soured, and was rejected, exciting all the distaste which they have treasured against it.

When, as in some febrile cases or in acute Bright's disease, a milk diet is imperative, such patients should begin with but a teaspoonful or two at a time, repeating it once in ten or fifteen minutes. If milk is only taken slowly enough into the stomach, and mingled on the way with saliva, like other food—eaten rather than drunk—it is impossible for it to form the large tough curds that it does when poured down by the tumblerful, like a dose of salts. By degrees the patient will be convinced of his ability to retain it, and then the dosage may be increased, making such further changes in the preparation of it as occasion demands.

In all cases where there is a tendency for milk to disagree it is better to give it alone to the patient, by which means various expedients used to increase its digestibility may be better tested. Patients will often digest both milk and beef broth or milk and whisky when these substances are given at alternating intervals of one or two hours, whereas if taken in conjunction they give rise to dyspepsia.

The methods of altering milk to suit the taste or digestive requirements are so numerous that it will be found convenient to group them under the following headings, although the classifications are somewhat arbitrary and here and there may overlap:

I. Methods of altering the taste of milk.
II. Methods of improving the digestibility of milk.
III. Methods of predigestion.
IV. Methods of sterilisation and preservation.

The first method beguiles the patient into taking larger quantities of milk without tiring of it; the second aims at preventing the formation in the stomach of dense tough coagulæ which are difficult of solution and digestion by an enfeebled gastric juice; the third, by artificial digestion, relieves a weak stomach of much labour; the fourth prevents the accession of poisonous germs which would excite malfermentation and indigestion.

I. *Methods of altering the Taste of Milk*

When patients object to the taste of raw milk or tire of it, it may be flavoured in a variety of ways. When there is no objection on the score of the nervous system, a teaspoonful or two of black coffee is one of the best means at hand, or a little of the extract of coffee may be added. Very weak tea may be preferred. Caramel is another excellent flavouring substance which may be freely employed, and ginger is also used. Other patients may take a little chocolate or cocoa or cocoa nibs infusion with their glass of milk. Some prefer the addition of common salt or a little black pepper. The various meat extracts, fluid or solid (see Meat Preparations, pages 815, 818), may often be used to advantage. When alcohol is not contraindicated many patients are willing to drink much milk in the form of weak punches, or as eggnog in which cognac, whisky, sherry, or rum may be employed to disguise the pure-milk taste.

The various malt extracts are enjoyed by some when given in milk, and their disagreeable sweetness is thereby removed. A teaspoonful of malt may be added to a pint of milk which is gently warmed for half an hour, after which it is boiled for twenty minutes. This prevents the formation of large curds.

None of these additions materially affect the nutritive value of milk, and the occasional variety which may be secured by experimenting with different substances will usually overcome all prejudices. I have often induced patients to take large quantities of junket flavoured with a little spice (see Receipts for Invalid Foods), not realising that they were really eating only pure milk which had passed into the first stage of digestion. Patients who object to milk because they have to drink so much fluid may take the same quantity in the form of junket because they can eat it with a spoon.

Much milk may be disguised sometimes in custards, gruels, etc., where there is no objection to the addition of other easily digestible foods.

II. *Methods of improving the Digestibility of Milk*

1. Skimming.
2. Boiling.
3. Dilution with water.
4. Dilution with alkaline and aërated waters.
5. Dilution with amylaceous foods.
6. Addition of alkalies, acid and other substances.

1. *Skimmed milk* is the residue after removal of the cream. It contains water, 90.63 per cent; proteid, 3.06 per cent; fat, 0.79 per cent; sugar, 4.77 per cent, and a residue of salts. It thus retains almost 10 per cent of solids.

Skimmed milk is well digested by those patients whose stomachs do not tolerate fat in any form, but it will not long support life, and attempts which have been made to cure certain diseases by a skimmed-milk diet have signally failed. Donkin advocated its use to the extent of six to eight pints daily.

It may be employed temporarily in the milk cure for Bright's disease, dropsies, and in the treatment of neurotic hysterical cases.

Yeo advises gouty subjects to drink ten minutes before each meal a breakfastcupful (eight ounces) of hot skimmed milk and water with the addition of a small saltspoonful each of potassium bicarbonate and salt. This is a good means of prescribing an alkali, but there is no special advantage in the skimmed milk.

2. *Boiling.*—Boiled milk exhibits a thin scum of albumin upon the surface which entangles some of the fat globules, and which is quickly replaced by another after removal. This scum should not be served to invalids. There is much discussion as to whether infants should ever be given raw cow's milk, or only that which has been previously boiled, and authorities are divided upon the matter. Certainly in most cases raw milk, if pure, provokes no harm. Boiling the milk arrests the development of germs and fungi with which it may have become contaminated, and may thus prevent the spread of some diseases, and it retards the process of "souring" and coagulation. Boiling expels about 3 per cent of gases—carbon, nitrogen, and oxygen (Hoppe)—and the loss of oxygen diminishes the formation of lactic acid and consequent souring. It alters the taste of the milk somewhat, and makes it "flat." The flatness is removed by agitating the milk with air by pouring it back and forth into two cups held a little distance apart; or it may be removed by the addition of any aërated water. As a rule, boiled milk is preferred hot, but some persons enjoy it cold.

It is a prevalent idea that milk is in general more digestible if boiled than if raw, but the results of experiment do not wholly confirm this view. Crolas has demonstrated that boiling has no influence upon either the lactose or casein, but it slightly increases the free soluble phosphates, which he regards as an advantage.

Radnitz found by experiment that young animals absorb 9.4 per cent of albuminoids from fresh milk, but only 5.7 per cent from boiled milk, hence a larger quantity of the latter must be drunk to obtain the same nourishment which is derived from raw milk.

According to Vasilieff, the envelopes of the oil globules are altered by heat, and he claims that 50 per cent less fat is absorbed. This seems too high an estimate in view of clinical observation.

Occasionally patients are made bilious and constipated by the use of boiled milk who digest it better raw, but the converse is also true: it is a matter of idiosyncrasy. It has decided advantage in diarrhœal diseases, probably through the absence of germs and gases. In some cases it may be combined with thin chocolate or cocoa.

"Scalded milk" is heated to about 150° F., or practically "Pasteurised," by pouring on boiling water. Thus treated, milk remains fresh a little longer than when raw.

3. *Dilution with Water.*—The dilution of milk is accomplished by adding plain water, either hot or cold, in the proportion of one part to two or three of milk. If the milk is exceptionally rich in cream and casein this simple means will often be sufficient to ensure its better digestion, for the curds become both smaller and softer.

4. *Dilution with Alkaline or Aërated Water.*—Lime water may be added in the proportion of two to four or more tablespoonfuls to each tumbler of milk, taken cold. In cases with much acidity of the stomach the lime water should be mixed in the proportion of one half or even two thirds. When so given, the taste of the milk is so little altered that very few patients object to it, and some even find it more agreeable. If diarrhœa or nausea is present they are controlled to some extent, but on the other hand constipation is increased by the use of lime. When the latter exists it is better to dilute with Vichy or carbonic-acid water. If lime water is added to neutralise the acidity of cow's milk the temperature of the mixture should not be raised above that of Pasteurisation—160° to 170° F.—because the albuminoids are more or less decomposed in a boiling alkaline solution. It is better to separately sterilise the lime water and add it afterwards.

Barley water may be used as a diluent for milk in diarrhœa, but oatmeal water is better for constipation.

Aërated waters, such as carbonic-acid water, alkaline Vichy, bottled plain soda, or Apollinaris, may all be added to milk, in any desired proportion. In cases of fever four ounces of a mixture made with equal parts of the diluent may be given every hour, or eight ounces every two hours, up to two and a half or three pints of milk per diem.

Most of these waters are best used with cold milk, but for many persons hot milk and Vichy make a very agreeable combination, which is often soothing to the obstinate cough of bronchitis. The gaseous waters relieve the "flatness" of the milk, and prevent the after-taste of it in the mouth, of which many patients complain. The mixtures with Vichy and lime water are especially serviceable where extreme irritability of the stomach is present with a tendency to the immediate rejection of all fluids.

5. *Dilution with Amylaceous Foods.*—Any form of starchy food—flour, arrowroot, etc.—serves as a mechanical diluent of milk by mingling with it and preventing the precipitation of tough curds. Bread and milk, or crackers and milk, serve the same purpose, and, being semisolid, have the further advantage that they must be eaten slowly and mixed with saliva.

When infants vomit their milk it may be temporarily attenuated with either barley water or oatmeal water added instead of plain water, and in the same proportion—i. e., one third or one half. The much-extolled starchy "infant foods" are less useful as foods than they are as diluents of milk, and if used temporarily with the latter object solely in view, they are less liable to produce rickets, scurvy, gastric catarrh, and other maladies. Whenever amylaceous substances are selected to dilute milk for infants they should first be as far as possible converted into dextrin and glucose, for gummy dextrin, saccharine, or even gelatinous materials are all better than crude starchy foods.

For adults a tablespoonful of Mellin's or Nestlé's food dissolved in an ounce of hot water and added to a glass of milk is both palatable and nutritious in cases of phthisis or scrofula.

6. *Addition of Alkalies, Acid and Other Substances.*—The addition of alkalies to milk renders it much more digestible for some persons. In hyperacidity of the stomach or in the presence of abnormal fermentation alkalies are beneficial as neutralising agents. On the other hand, in cases in which the gastric juice is very feeble or absent, artificially digested milk may prove more serviceable.

The admixture of alkalies by reducing the acidity of the gastric juice makes the casein coagulate more slowly, and in flocculi rather than in large coagulæ.

Salt may be added—a saltspoonful to the tumbler of milk. This improves its digestibility for most persons, and renders it less likely to cause biliousness. Sodium bicarbonate, ten grains, or a saltspoonful to the tumbler of milk, prevents malfermentation in the stomach. If hyperacidity of the stomach exists, sodium bicarbonate may prove better than lime water, which is but slightly antacid, for it contains but a half grain of lime to the ounce. On the other hand, if the gastric juice is too feeble to digest milk easily, it is sometimes a disadvantage to attenuate it still further with quantities of lime water, and sodium bicarbonate should be substituted to check the acid fermentation of the milk which the hydrochloric acid of the gastric juice fails to control. An excellent combination for an irritable stomach is made by adding five or ten grains of this salt and two grains of cerium oxalate to each glass of milk. The cerium oxalate has a sedative and tonic action upon the mucous membranes and tends to allay nausea and irritation in the stomach.

Other substances sometimes added for gastric ulcer, etc., are sodium phosphate, saccharated lime, or a teaspoonful of milk of magnesia to the pint. A few drops of liquor potassæ to the pint of milk are recommended by Bulkley for infants having eczema.

Starr gives the following receipt for making saccharated lime for diluting milk for infants:

Slaked lime, one ounce; refined powdered sugar, two ounces; mix, triturate, add distilled water, one pint. Shake occasionally for some hours in a bottle, let stand, and siphon out the fluid.

Roberts recommends a powder containing 10 grains each of sodium bicarbonate and common salt, and 5 grains of light magnesia, to be added to a tumblerful of one third hot water and two thirds hot milk.

Edes strongly recommends the addition of hydrochloric acid to milk. Twenty minims of the dilute acid of the pharmacopœia are stirred slowly, drop by drop, into a pint of milk which is gently warmed. A fine flocculent coagulum of casein floats in the whey, and the digestibility of the milk is improved, while a flat or disagreeable taste is avoided.

Gelatin.—Gelatin may be employed in small quantity as an attenuant of milk. Starr gives the following receipt for its use:

Soak a piece of white gelatin an inch square in half a cupful of cold water for three hours. Put the cup in a saucepan of water and boil until the gelatin dissolves. When cold it forms a jelly. For infants one or two teaspoonfuls may be put into each nursing bottle of milk.

III. *Methods of Predigestion*

1. Peptonised milk. 2. Pancreatinised milk. 3. Koumiss, kefir, matzoon, etc.

1. **Peptonised Milk.**—The object of peptonising milk is to complete a portion of the digestive process outside of the body, and thereby relieve the alimentary canal of this work. A great variety of preparations of pepsin, peptonising powders, etc., are offered in market.

In general they are pure, but they vary somewhat in rapidity and strength of action. The powder may be added some time before the milk is swallowed, and in this event it can only act in conjunction with dilute hydrochloric acid. If added to the milk at the time of swallowing, the normal acid of the gastric juice supplies the proper reaction.

The process of artificial peptonising consists in adding one of the numerous preparations of pepsin obtained at the pharmacist's to fresh acidulated milk, and allowing it to stand in a bottle immersed in warm water at approximately the body temperature. A fermentation results in which the casein is more or less completely converted into albumoses.

If the process be too long continued, further fermentation results, and the milk becomes very bitter. It is therefore checked after a few minutes, either by boiling the milk, which has the effect of destroying the pepsin, or by keeping it upon ice until ready for use, which inhibits the action of the ferment.

Either peptonised or pancreatinised milk may be prepared in quantity for use by infants or invalids during the day, and if there is an ice chest to keep it in, it is better to do so, for then it is more uniform in composition. If ice is not at hand, the preparation should be freshly made for use each time, otherwise it will become bitter and spoil.

2. **Pancreatinised Milk.**—Of recent years the use of pepsin for predigestion of milk has been gradually superseded by that of pancreatin, which acts best in an alkaline medium. This ferment, like pepsin, may be preserved almost indefinitely in powdered form. Milk thus prepared is slightly yellow and less opaque than raw milk. The process may be conducted as follows:

Add a pint of fresh milk to a gill of cold water in a clean vessel. Put in a tubeful of Fairchild's "peptonising powder" (pancreatic extract 5 grains, and sodium bicarbonate 15 grains), or, instead of the pancreatic extract, substitute 1 to 2 drachms of "pancreatic solution" made by Parke, Davis & Co., stir well, and place in warm (not boiling) water for half an hour or until a slight bitter taste is present.

This taste means that fermentation has proceeded far enough. To allow it to continue will make the milk unpalatable, and it is almost impossible to disguise the bitterness. Boiling for two or three minutes stops all further fermentation, and the milk should then be placed on ice until ready for use. Such milk will keep well for several hours.

When used, serve alone cold, or add carbonic-acid water to disguise the taste. For adults a little coffee may be used for the same purpose.

Pancreatinised Milk Gruel.—To a pint of cold fresh milk add a pint of thick milk gruel, boiling hot. The gruel may be made of sago, pearl barley, arrowroot, oatmeal, wheat flour, or other farinaceous food, according to taste. The temperature of the mixture should be about 125° F. Add a tubeful of peptonising powder (15 grains), and place on the side of the stove for two or three hours, avoiding great heat. Then boil to stop the fermentation. Strain, and keep on ice ready for use. The gruel disguises admirably the taste of the milk.

When pancreatinisation is long continued the casein is completely digested, but the milk becomes too bitter for use.

Legumin.—Legumin is a vegetable ferment which is said to make milk highly digestible for invalids by converting casein into a soluble albuminoid. This substance, which was lately introduced by Bovet, is also given as a food.

3. **Koumiss.**—Koumiss (spelled also koumys and kumyss) is milk artificially prepared by simultaneous lactic acid and alcoholic fermentation. It was originally made by the natives in the steppes of southeastern Russia and other eastern countries as a refreshing and slightly intoxicating beverage. Of late years the idea has been advanced that it has some beneficial or curative influence in chronic diseases, such as phthisis, chronic bronchitis, chronic gastro-intestinal catarrh, and other wasting diseases, and as a result the manufacture of koumiss has been extensively introduced into the United States, and at many pharmacies it can be obtained daily, freshly prepared, in pint or quart bottles. It is probable that a large share of the benefit claimed for the native "koumiss cure" is attributable, like most "cures," to the favourable climate in which the patients live, especially during the months of May, June, and July, where the air is dry, clear, and aromatic.

Very advanced cases, and those having active fever, may not be benefited by the "cure," but koumiss may be given them at home. Koumiss is of great service as an easily digested food for many cases of obstinate gastric irritation and severe vomiting. In the latter it may be often tolerated when no other nutriment is retained. Its uses are therefore various both for infants and adults, and there are often cases in which it agrees better than pancreatinised milk or milk prepared in any other way.

The Manufacture of Koumiss.—The manufacture of koumiss may be conducted by several different processes. In southeastern Russia, especially in south Samara, the milk of a certain breed of mares is used, which is particularly rich in milk sugar but poor in fat and casein, and the animals are fed upon grasses which contain this sugar-forming material in abundance (Karrick).

Mare's milk, as compared with cow's, contains much more sugar (6 per cent) and less casein and fat (less than 3 per cent) (Biel).

The mares are light-coloured animals, unbroken, and are guarded with greatest care, not being allowed dry food, such as oats and hay. Pastured among mountains containing salt beds, they have access to running water, in which they can bathe frequently. They have large udders and abundant milk secretion, which is milked from four to eight times daily. The best koumiss is made in the early summer by pouring fresh milk into smoked leather bottles or *sabas*, to which is added a little sour cow's milk or old dry koumiss ferment. The skins are kept at a temperature about equal to the body heat and are frequently shaken for thorough mixing, and fermentation is allowed to proceed for three or four days.

In the United States koumiss is manufactured from cow's milk by the addition of some artificial ferment. Such home-made koumiss may be prepared as follows:

Take 2 teaspoonfuls of wheat-flour dough, 2 tablespoonfuls of millet flour, 1 tablespoonful of honey, 1 tablespoonful of beer yeast. Mix into a thin paste with milk. Place in a warm place to ferment. When fermented, put into a linen bag and hang in a covered jar with sixteen pounds of fresh milk. Let stand for twenty-four hours, or until the milk becomes acid, at a temperature of 86° to 90° F. Skim, decant, agitate for an hour, bottle and cork tightly, protecting the corks with wire fastenings. Keep in a refrigerator. Absolute cleanliness must be insisted upon throughout all the various manipulations; otherwise different forms of fermentation will result (Stange).

Properties.—Koumiss when shaken froths readily. It has, when fresh, a slightly sour odour, agreeable bitter taste, and acid reaction. The specific gravity is 1.018 to 1.029. During fermentation alcohol is developed from the milk sugar, which forms lactic acid and glucose, the latter making alcohol and carbonic acid. The alcohol may reach 2.5 per cent, but koumiss made from cow's milk may not contain above 1 per cent. Koumiss becomes stronger in both taste and smell after keeping for a day or two. It is highly sensitive to temperature changes, and easily putrefies.

There are two varieties of koumiss prepared which differ in degree of fermentation and in their exhilarating and intoxicating properties. The lighter form contains less alcohol than the heavier, in which fermentation has proceeded further.

The following analysis by Stange illustrates the changes in composition which koumiss undergoes by prolonged fermentation:

Table of the Percentage Composition of the Several Strengths of Koumiss
(Stange)

	Mare's milk.	KOUMISS—DURATION OF FERMENTATION.			
		6 hours.	18 hours.	30 hours.	4 days.
Carbonic acid	..	3.8	6.0	7.0	11.0
Alcohol	..	18.5	19.5	30.0	30.0
Lactic acid	..	3.9	5.6	6.4	6.4
Milk sugar	51	18.8	16.3	....	....
Albumin	23	22.5	22.6	20.0	16.0
Fat	19	18.9	20.0	19.0	19.0
Salts	5	4.5	4.0	4.0	4.0

The casein, after being first precipitated, is converted into peptones and an acid albumin. It should be remembered that the composition of koumiss is always changing unless the fermentation be constantly held in check by extreme cold. Koumiss grows more and more acid and keeps but a short time when exposed to the air. If spoiled, it may produce severe symptoms of ptomaine poisoning.

Koumiss is prepared in tablet form under the name of *koumysgen*, each tablet, it is claimed, containing 30 per cent of soluble casein. The tablets keep indefinitely in air-tight bottles, and when dissolved in water form a cooling effervescing food, possessing similar properties with koumiss, and it is cheaper. It is doubtful, however, whether any preparation can be made to reproduce all the peculiarities and advantages of fresh koumiss, which is so variable and delicate a substance.

Koumiss Cure.—The "koumiss cure" consists in taking a large quantity of koumiss—in some cases 15 to 20 tumblerfuls a day—in combination with nourishing albuminous food. If perfectly fresh it may be drunk warm, but if it is to be kept for some time it is better to drink it cold. Koumiss which is either too fresh or which has not been kept clean may cause flatulency, colic, and diarrhœa, but old koumiss has the opposite effect upon the bowels, and, like milk, gives rise to constipation. Koumiss resembles whey in being strongly diuretic and diaphoretic, and thus relieves the mucous membranes of congestion. It also alleviates thirst, strengthens the action of the heart, and improves the vascular tone, general nutrition, and complexion. The solids of the urine are increased during its use. The use of koumiss is said to be contraindicated in renal and vascular diseases, gout, plethora, and chronic constipation.

At first but two or three tumblerfuls of koumiss are allowed daily until the stomach becomes accustomed to it; then patients are made to drink a glass at frequent intervals during the day and sometimes as often as once every half hour. Some patients can digest very large quantities of koumiss, and as much as 10 litres have been taken in twenty-four hours, but less is used now than formerly; patients do not often exceed 6 or 8 litres a day, and for the average from 2 to 4 is quite enough. Tender beef and abundant butter, cream, and a moderate supply of bread compose the basis of the other foods allowed. Sweets, salads, and other beverages than koumiss are forbidden.

The treatment should be commenced slowly in order to accustom the digestive system to the fermented drink, which otherwise may excite diarrhœa. The latter accident may be counteracted by lime water or some simple remedy, such as bismuth.

The koumiss prepared from milk in the United States does not seem to possess the peculiar properties and extraordinary nutritive value which is attributed to it when made from mare's milk in Russia, on which patients are said to gain rapidly in weight. In various Russian cities there are special institutions designed for carrying out the koumiss cure, and which are supplied with the genuine article from the steppes.

Special koumiss cures are not in vogue in this country, but in southeastern Russia there are several establishments, notably in the districts of Orenberg and Samara, where patients go for treatment during several months in summer, and derive great improvement. Like other popular " cure " resorts in Europe, these establishments furnish the patient with suitable light and varied amusement during the progress of his treatment, which is highly beneficial, by diverting the mind and relieving an otherwise monotonous *régime*. While undergoing the koumiss cure, patients are made to live outdoors as much as possible, and tent life with free exercise is no doubt a very important adjunct to the treatment when it can be obtained. The climate is both hot and dry, and the elevation is high.

The koumiss cure is particularly available for chronic catarrh of the respiratory and alimentary canal, and in the first stage of pulmonary tuberculosis. It is also especially recommended for general debility resulting from pronounced anæmia, and for various diatheses, such as scrofula, rhachitis, etc. The large percentage of carbonic acid which is produced by koumiss fermentation, together with the alcohol present, acts as a stimulant to the gastric mucous membrane, favourably affects digestion, and lessens irritability of the stomach. Among other effects produced by the use of koumiss may be mentioned occasional drowsiness and lassitude. This food is also said to possess some aphrodisiac influence.

Kefir.—Kefir is another form of fermented milk which resembles koumiss, and has long been used in the Caucasus.

Kefir contains three varieties of ferments which produce complex fermentation processes resulting in the formation of alcohol, lactic acid, modified albumins, and peptones. The casein of milk is in great part digested by them, and the portion which remains is precipitated in flocculi instead of heavy curds. The milk sugar is almost completely converted into alcohol and carbonic-acid gas, which bubbles to the surface. Kefir has a sour taste, due to the organic acids which it contains.

Zoolak.—Zoolak, formerly called Matzoon, is a form of milk in which lactic-acid fermentation has been produced by a ferment much used in Syria. It has the same general properties and effects with koumiss, and is an excellent invalid food.

Lactone is an unfermented milk preparation freed from fat, sterilised and rendered effervescing by means of carbonic-acid gas. According to the late Charles Rice, chemist of Bellevue Hospital, 100 parts by weight contain:

Fat	0.10
Casein and albumin	5.37
Milk sugar	5.80
Salts	1.20
Water	87.53
	100.00

IV. *Methods of Sterilisation and Preservation*

1. Sterilisation. 2. Pasteurisation. 3. "Humanised milk." 4. Modified milk. Milk laboratories.

1. **Sterilised Milk.**—The sterilisation of milk is accomplished by heating it up to the boiling point, 212° F. In a vacuum this may be accomplished by a temperature a few degrees lower.

The construction of steam sterilisers for milk, beef tea, or other foods is based upon a very simple plan. It is a familiar fact that the steam which rises from water heated in a tin or copper can condenses in drops on the lid, and this condensed vapour drips back along the sides of the can. If the lid is raised a little and is made somewhat larger than the can, the condensed steam will drip down on the outside of the can instead of the inside. If a second larger can be inverted like a hood or jacket over the first, the steam condensed between the two cans drips back and may be made to rejoin the water from which it started. In this way a kind of perpetual motion is kept up so long as a flame is applied beneath the water to vapourise it. Bottles containing the food to be sterilised are suspended in racks in the upper part of the inner chamber in the atmosphere of steam, and their contents soon acquire the temperature of boiling water, 212° F.

Siebert removes the grosser impurities of milk by placing it on a thick layer of sterilised absorbent cotton in a clean glass funnel. A quart of milk will pass through in ten or fiteen minutes.

Mobrun preserves milk for six months by warming it in a tin receptacle, the only opening of which is through a lead tube. The milk is rendered sterile by the heat, and all air is driven out through the tube, which is then compressed and soldered.

The taste of sterilised milk is peculiar and resembles that of boiled milk. If put in bottles which have been sterilised by boiling water or steam, by stopping them with pledgets of absorbent cotton which have been baked, the milk will keep fresh for a number of days —long enough to be carried upon a voyage to England or across the continent.

Milk drawn by clean hands fresh from the cow into bottles which have been sterilised by boiling water is germ-free, and need not be further treated; but the milk usually served in cities from large cans which have been hawked about the streets has passed through several receptacles and been exposed to the air. (See Milk Adulteration and Impurities, p. 61.) It is better always to keep milk germ-free, but it is absolutely necessary to do so in summer if it is to be fed to infants. In 1899 sterilising apparatus was introduced at the Children's Hospital, Randall's Island, New York city, with the immediate effect of reducing the annual infant death rate from 44.36 to 19.86. It is often advisable to sterilise milk for feeding to typhoid-fever patients and others in whom asepsis of the alimentary canal is of paramount importance. If milk be too long sterilised it becomes of a brownish hue, owing to the conversion of its lactose into caramel.

It is suggested by Barlow that prolonged sterilisation of milk may lessen its antiscorbutic powers for young infants, but scurvy in infants is due also to other causes, such as feeding with artificial foods, and prolonged exclusive plain milk diet for adults reduces them to a condition resembling scurvy. (See Typhoid Fever, Milk Diet.)

According to Leeds, the following alterations are produced in milk by sterilisation at 212° F.:

1. The amylolytic ferment is destroyed.
2. The casein coagulates less readily by rennin.
3. The digestibility of casein by the gastric and pancreatic juices is somewhat retarded.
4. The fat is less promptly absorbed than normally from the intestine.
5. If the heating is continued for some time, the milk sugar is destroyed.

The mineral salts of milk are also dissociated in some degree from their organic compounds.

It is thus demonstrated that the chief change produced by sterilisation of milk, and even by Pasteurisation at 167° F., is destruction of the enzymes or organic ferments of which this highly complex fluid contains a number. Babcock and Russell of Wisconsin have shown that when milk is rendered aseptic by salicylic acid, sodium fluoride or other germicides, a process of self-digestion goes on, which increases the longer the milk is kept. The result of this natural process is the formation of albumoses at the expense of casein, and the action is due to a ferment which these experimenters named "galactase," resembling trypsin.

Another ferment, an oxydase or anaeroxydase, has been demonstrated in cow's milk by a number of French experimenters. This ferment, as its name implies, causes a peculiar reaction in milk towards oxidising agents, such as turpentine or tincture of guaiac.

Spolverini identified a new ferment in cow's milk which resembles closely the glycolytic ferment of the blood.

A ferment, called by Bourquelot "lipase," has been identified in both human and cow's milk; its action is hydrolytic, resolving monobutyrin into glycerin and butyric acid.

In churning sterilised milk, butter forms more slowly than from raw milk, a period two or three times longer being required. Hirsch attributes this to toughening of the albuminoid envelopes (of lactalbumin) of the fat globules, which is produced by the heat.

For these several reasons an infant to be fully nourished on sterilised milk requires more of it than of raw milk.

Practically, in normal stomachs of either infants or adults these changes are not sufficiently pronounced to seriously interfere with the digestibility of the milk, but dyspeptic and catarrhal conditions of the stomach, especially in infants, make it highly sensitive to very slight modifications in the composition and reaction of milk.

In quite recent years it has been proved that the method of Pasteurisation is preferable to sterilisation (see 2. Pasteurised Milk, p. 88), but there is, at the present time, a decided reaction against the prolonged use of both these types of milk, in distinction from temporary emergency use, and von Behring in common with many American clinicians maintains that when mother's milk is unprocurable, the proper infant food is good, fresh, clean milk, not heated or otherwise modified than by necessary dilution or sweetening. von Behring states that fresh milk contains powerful antibodies which react against the bacillus acidi lactici and colon bacillus. As these are the two types of bacilli commonly present in the infant organism, and as the heat of sterilisation or Pasteurisation promptly destroys the antibodies, by the use of heated milk the infant is deprived of a protective agent against gastro-intestinal disorder.

T. M. Price in 1904 conducted a series of experiments at the Maryland Agricultural Experiment Station to determine the comparative digestibility in the calf of raw, Pasteurised, and sterilised milk. The experiments were decidedly in favour of the raw milk.

After all, in selecting a proper milk for infant feeding, the question of immediate digestibility is less important than that of permanent effect upon nutrition. The difficulty with infant feeding among the poor is to obtain really good, fresh, raw milk; hence in a given case the choice of feeding must ultimately depend upon the character of raw milk obtainable. When this is first-class the relative digestibility, as well as relative permanent nutritive value, stands as follows in order of preference: (1) raw, (2) Pasteurised, (3) sterilised.

The directions for predigestion combined with sterilisation of milk at the Philadelphia Hospital are thus given by Hirst:

"1. Have the nursing bottles prepared clean every morning.

"2. Take cream, five ounces; milk, two and a half ounces.

"3. Put in skillet; add pancreatin powder (pancreatin, two and a half grains; sodium bicarbonate, five grains); heat over alcohol flame for six minutes; stir and sip constantly; *do not overheat.*

"4. Of this mixture put in each bottle six drachms (for a two-ounce bottle). Use funnel.

"5. Add to each bottle ten drachms of sugar solution. (Make sugar solution by dissolving an ounce of sugar of milk (one powder) in a pint of warm water.)

"6. Stopper the mouth of each bottle with dry baked cotton and sterilise for twenty minutes.

"7. Set aside to cool.

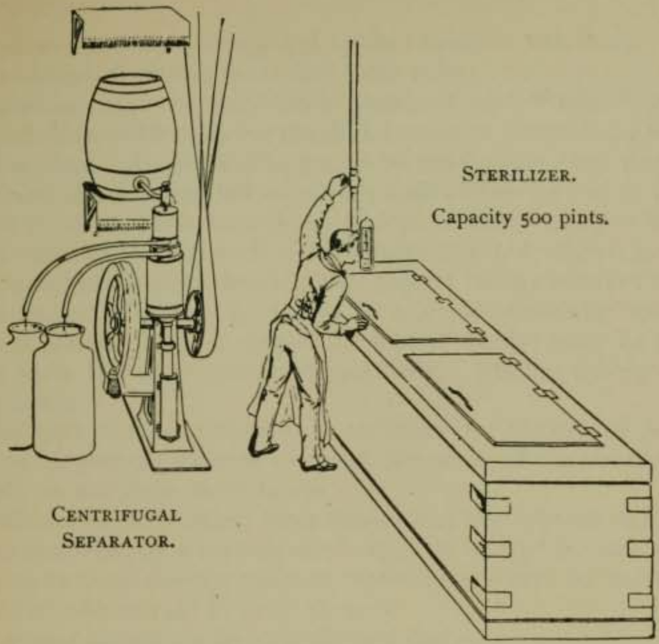
"8. Before use put bottle in warming cup; apply nipple immediately before giving it to infant."

The alimentary canal of the newborn infant is sterile—it contains no bacteria—but after the first few passages of meconium two species of bacilli and one of micrococci are found (Escherich, Beslau), which disappear with the meconium. There are but two species of bacteria found in the stools of healthy nursing infants, the *Bacterium lactis aerogenes*, obtained from the ileum below the duodenum, and *Bacillus coli communis*, from the colon.

In diarrhœal conditions other bacteria, to the number of forty species, have been found (Booker). Their action in different diseases is not yet differentiated, but they are associated more or less directly with malfermentation and the formation within the intestines of gases and irritable or poisonous products. Many of these species thrive and are reproduced in hot weather outside the body in milk, in the atmosphere, and upon diapers and utensils. This explains the importance of absolute aseptic cleanliness in everything that pertains to the nursing and feeding of infants—cleanliness of the breasts and nipples, of the nurse's hands, of all receptacles for milk or other foods, of the child's body, and prompt removal and disinfection of soiled diapers or clothing.

Most of these bacteria grow best in milk, and the diarrhœal diseases which are caused by and associated with them are absolutely preventable when the methods are understood of avoiding milk infection, and of sterilisation when it is infected. Vaughan says with proper emphasis: "If parents were willing to pay for wholesome uninfected milk half the fancy price which they readily give for some prepared baby food, their children would be better nourished and disease among them would be less frequent."

2. **Pasteurised Milk.**—Pasteurised milk is similarly prepared to sterilised milk, and is, in fact, sterile, but the temperature is only raised for twenty minutes to 167° F., instead of the boiling point, 212° F. It is somewhat more easily digested than sterilised milk,



CARE OF MODIFYING MATERIALS. ASEPTIC PRECAUTIONS.

Milk Room and Coolers for modifying materials.

Special Sterilizers for returned packages.

MILK LABORATORY (INTERIOR).

(From Pædiatrics, by T. M. Rotch, M. D.)

but it does not keep so long and spoils in one or two days. It has the advantage of tasting more like fresh milk.

Cleansing Milk Bottles.—Both sterilised and Pasteurised milk should be warmed by placing the milk bottles in warm water without opening them. If the bottles are to be used again they should be rinsed and left standing full of water to which one or two teaspoonfuls of borax or soda have been added. Before filling with milk they should be washed with a fresh swab and hot soapsuds, rinsed again with boiled water, and kept for at least twenty minutes in boiling water, or they may be placed in a steam sterilising apparatus under pressure. Rubber nipples for infants' bottles must be kept in borax water and rinsed several times daily. Rubber tubing should be discarded.

The heat of Pasteurisation is sufficient to destroy all bacteria likely to be present without so much alteration of the properties of the milk as occurs in sterilisation.

Different experimenters have shown that the tubercle bacillus in milk is destroyed by a ten-minutes' exposure at 167° F., whereas the germs of cholera, pneumonia, and typhoid fever may be quickly destroyed in milk at 140° F. (Van Geuns).

Freeman has shown by experiments that—

"1. Pasteurisation of milk at 75° C. (167° F.) affords a safeguard against the deleterious effects of any bacteria which it may contain, without interfering with its nutritive qualities.

"Pasteurisation at about 75° C. (167° F.) destroys efficiently the germs of cholera, typhoid fever, diphtheria, and tuberculosis as well as the *Streptococcus pyogenes*, the *Staphylococcus pyogenes aureus*, and the *Bacillus coli communis*."

The *Bacillus acidi lactici* is also prevented from acting after exposure to a temperature of 160° F.

It is found that by immersing bottles of milk in water which has just been removed, while boiling, from the fire, a fairly uniform temperature of 167° F. is obtained. Naturally, the relation between the volume of water used and the quantity of milk must be properly balanced, and various forms of graduated receptacles are sold which make the process very easy and simple.

A graduated covered pail, into which the boiling water is poured, is fitted with a rack to submerge enough bottles of milk for the day's use, and this is all that is necessary. After half an hour's exposure to the heat the milk, as in the case of sterilised or pancreatinised milk, is set in a refrigerator until ready for use.

Under some conditions both sterilised and Pasteurised milk form smaller curds than raw milk, although this is not the case with the coagulæ formed by gastric juice (Freeman).

The poor in New York city are now supplied with cheap Pasteurised milk through the philanthropy of Mr. Nathan Straus, who in

1893 opened the first milk depot for dispensing pure milk and Pasteurised milk, at a cost of but one and a half cent for an eight-ounce bottle. A sterilised nipple is also furnished with each bottle. The bottles have sloping necks, to facilitate cleansing, and spheroidal bottoms to prevent them from being left standing about uncorked. In an account of this system by Dr. Freeman he states that:

"In addition to Pasteurised ordinary milk and Pasteurised modified milk, a Pasteurised milk diluted with barley water and sweetened with cane sugar, and containing also table salt, has been introduced at the suggestion of Dr. Jacobi. The formula used is:

Table salt	¼ oz.
White cane sugar	10 oz.
Milk	1 gal.
Water	1 gal.

"This barley milk will be dispensed in six-ounce bottles."

3. **Humanised Milk.**—Humanised milk is really Pasteurised milk but with a permanent alkaline reaction and partial predigestion. Leeds claims the credit for the origin of the idea of this form of milk, and his formula is:

Milk	½ pint.
Water	½ "
Cream	4 tablespoonfuls.
Peptogenic milk powder	1 large measure.

Heat to 160° to 170° F. for ten to twenty minutes.

Instead of cream, some other form of fat may be added for invalids, such as olive or cod-liver oil or cacao butter.

The name "humanised milk" is applied somewhat indefinitely to various preparations of cow's milk in which the attempt is made to approach more nearly the composition of human milk by lessening the casein and increasing the sugar and fat. These preparations are partially predigested, but the pancreatinisation is stopped before it has proceeded far, so that the infant stomach shall still have some work to do.

Another good mixture designed to resemble human milk is that of Meigs:

Cream	2 tablespoonfuls.
Milk	1 tablespoonful.
Lime water	2 tablespoonfuls.
Water	3 "
Milk sugar	½ teaspoonful.

4. **Modified Milk. Milk Laboratories.**—The establishment of milk laboratories having in view the object of modifying cow's milk for infant and invalid feeding has demonstrated the practical value of this work. Such milk is now called "modified milk." The first

laboratory founded in Boston during 1892–'93, upon the suggestions of Dr. Rotch, completely fed about twelve hundred infants and was patronised by more than one hundred and fifty physicians in its first year. Many similar laboratories have subsequently been established. The milk is derived from carefully selected animals kept at farms where their food, stabling, drinking water, and pasture are under the scientific supervision of a veterinary surgeon.

It is now generally acceded that infants thrive better in the long run upon mixed milk derived from several cows than by the exclusive use of milk from a single animal, which is more likely to vary with the condition of the cow at different times; but it is possible to avoid all variation in milk and keep it at a standard which can be graded to correspond with the increasing age of the infant, by the employment of proper means in the milk laboratories, where milk can be prepared with its ingredients mixed with the accuracy of a medicinal prescription, while its freshness and purity are absolutely insured. If desired also, the milk may be predigested in the laboratory, and sweet whey and other materials derived from fresh milk may be obtained there.

Physicians are furnished with blank forms upon which they can definitely prescribe the composition of the milk which they wish to order for any individual case. A sample prescription form from the Briarcliff Laboratory is herewith appended:

Per cent.		Remarks.
Fat		Number of feedings?
Milk sugar		
Proteids		Amount at each feeding?
Mineral matter	——	
Total solids		
Water		Infant's age?
	100.00	Infant's weight?

Alkalinity.

Raw. Pasteurised ——° F. Sterilised ——° F.

Ordered for ——

Date. Signature.

M. D.

"If the physician does not care to mention the especial percentage, he can ask for percentages which will correspond to the analysis of human milk, and he can then vary any or all of these percentages later, according to the need of the especial infant prescribed for" (Rotch).

In order to prepare modified milk by Rotch's method it is necessary to have: 1. Pure cream containing the fat. 2. Pure milk containing the albuminoids and no fat. 3. Distilled water. 4. A 20-per-cent solution of milk sugar made fresh daily with distilled water. 5. Lime water.

The milk and cream are separated completely by an apparatus made to revolve 6,800 times per minute, so that they may be recombined in any desired proportion. The resulting cream has an average of 35 per cent of fat, but the percentage may vary between 45 and 18, hence analysis should be made whenever accuracy is essential. After separation of the cream the milk is modified according to the formula prescribed for each case, and Pasteurised.

Rotch gives the following sample prescriptions for modified milk to be sent by the physician to the laboratory:

℞ (1) A girl 6 years old: duodenal jaundice.

Fat	0.50
Milk sugar	6.00
Albuminoids	4.00

Give 4 ounces every two hours.
Send 12 tubes, each 4 ounces; lime water, $\frac{1}{16}$.

NOTE.—This patient made a rapid recovery. No medicines were given.

℞ (2) A boy 6 weeks old: healthy.

Fat	3.00
Milk sugar	7.00
Albuminoids	1.50

Send 12 tubes, each 2 ounces.
Lime water, $\frac{1}{16}$.
Pasteurise at 167° F.

℞ (3) A boy 6 months old: healthy.

Fat	4.00
Milk sugar	7.00
Albuminoids	2.00

Send 8 tubes, each 6 ounces.
Lime water, $\frac{1}{16}$.
Pasteurise at 167°.

℞ (4) A girl 4 months old: albuminoid digestion weak.

Fat	4.00
Milk sugar	7.00
Albuminoids	0.75

Send 8 tubes, each 4 ounces.
Lime water, $\frac{1}{16}$.
Pasteurise at 167°.

℞ (5) A boy 6 months old: sugar digestion weak.

Fat	3.00
Milk sugar	4.00
Albuminoids	2.00

Send 8 tubes, each 6 ounces.
Lime water, $\frac{1}{16}$.
Pasteurise at 167°.

℞ (6) A girl 4 months old: summer diarrhœa. Food has to be sent out of town by express.

Fat 2.00
Milk sugar 5.00
Albuminoids 1.00

Send 20 tubes, each 1 ounce and 1 drachm.
At time of each feeding add lime water, 3 drachms.
Sterilise at 212°.

NOTE.—In this case the diarrhœa had not been sufficiently studied to determine whether it was putrefactive or fermentative, so that a safe general prescription was sent to begin with. The lime water had to be introduced at each feeding on account of the 212° sterilisation necessitated by the hot weather and the distance to be sent.

An ingenious measuring glass is recommended by L. Emmet Holt for the home modifying of milk. The glass, which is sold under the name of the "Materna" (Estraus), holds sixteen ounces and has seven panelled sides. On one side is graduated the quantity of separate ingredients of normal milk and on each of the other panels is graduated the ratio of ingredients of milk modified to suit a certain age of infancy. Milk sugar is placed in the bottom of the glass, water is added to a marked level, then, in turn, lime water, cream, and milk. The formulas given are the following (Holt):

Formula	1	2	3	4	5		6
Fat Sugar Proteids	2% 6% 0,6%	2½% 6% 0,8%	3% 6% 1%	3½% 7% 1½%	4% 7% 2%	For this Formula 6 see special instructions below.	3½% 3½% 2½%
	3d day to 14th day.	2d wk. to 6th wk.	6th wk. to 11th wk.	11th wk. to 5th mo.	5th mo. to 9th month		9th mo. to 12th mo.
Milk parts	1¼	1⅝	2	4½	6	Milk parts	9¾
Cream "	1¼	1⅝	2	2	2	Cream "	1
Lime water "	1	1	¾	¾	¾	Barleygruel "	5¼
Water "	12½	11¾	11¼	8¾	7¼	Gran. sugar "	¼
Milk sugar "	1	1	1	1	1¼		

Directions for Formula 6

SUGAR.—In formula 6 granulated sugar should be used instead of milk sugar. Introduce the same into the vessel to the line thus marked.

BARLEY GRUEL.—In formula 6 barley gruel should be used instead of water and filled to the line thus marked. Barley gruel should be prepared as follows:

To one tablespoonful of pearl barley (after soaking several hours) add one pint of water, a pinch of salt, and boil for five or six hours, adding water as it boils away. Strain through muslin. Or add:

One rounded tablespoonful of Robinson's barley flour; rub up with cold water, and add to one pint of boiling water; cook fifteen minutes, stirring, and strain if lumpy.

According to Rotch, "certain breeds of cows are better than others for copying human milks."

List of Breeds best Adapted for Modified Milk, with Analyses (Rotch)

	Fat.	Milk sugar.	Albuminoids.	Mineral matter.	Total solids.	Water.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Durham	4.04	4.34	4.17	0.73	13.28	86.72
Devon	4.09	4.32	4.04	0.76	13.21	86.79
Ayrshire	3.89	4.41	4.01	0.73	13.04	86.96
Holstein-Friesian	2.88	4.33	3.99	0.74	11.94	88.06
American grades	4.01	4.36	4.06	0.74	13.17	86 83
Common natives	3.69	4.35	4.09	0.73	12.86	87.14

The Jersey cow may yield more than 6 per cent of fat.

"The time of the year, the food and care given to the cattle, the month of lactation, and manner of milking—all exert such a profound influence, that the fat may be lower than 2.5 per cent or as high as 8 per cent" (C. E. Woodruff, U. S. A.).

Many so-called "milk foods" are sold for infant and invalid use. Their object is to furnish a ready-made substitute for fresh milk, which is easy of preparation even by an unintelligent nurse. Generally speaking, the continued use of such foods, especially for young growing infants, is to be condemned whenever fresh milk is obtainable, but in travelling at sea, or wherever good milk is not procurable, and in other emergencies, they may be resorted to with advantage, until more favourable conditions obtain. Analyses of some of the best known of these foods are appended below, and compared with the composition of mother's milk.

Name of Food.	Analysed by.	Water.	Sugar.	Dextrin.	Starch.	Fat.	Albuminoids.	Ash.	Solubility in water.
Ideal mother's milk	......	4.00	46.78	.....	.....	23.39	23.39	2.44	Very soluble.
Malted milk	Rach.	3.27	46.63	17.16	.....	6.78	22.26	3.90	"
Nestlé's milk food	"	4.51	37.47	4.84	33.22	5.37	13.00	1.59	Insoluble.
Carnrick's soluble food	"	5.93	30.12	9.14	38.08	2.96	10.75	3.02	"
Lacto preparata	"	5.80	63.38	.....	.....	12.35	14.51	3.66	"
Lactated food	"	7.80	28.66	10.33	35.17	1.82	13.48	2 77	"
Malted milk	Leeds.	2.18	50.40	16.09	5.57	3.30	16.88	3.13	....
Nestlé's milk food	"	4.72	38.95	.....	40.10	1.91	8.23	1.59	....
Carnrick's soluble food	"	3.42	27.08	.....	37.37	7.45	10.25	4.42	Soluble.
Lactated food	"	7.76	29.65	9.35	36.43	1.64	11.85	2.61	....
Carnrick's soluble food	Stutzer.	5.17	28.11	.....	41.50	5.53	16.69	3.00	Soluble.
Lactated food	"	6.52	25.52	.....	52.92	2.19	9.05	2.26	....

Lacto preparata is a preparation of pure selected milk from which the cream has been removed by centrifugal force, and for it is substituted cacao butter, which keeps better and is quite nutritious. Lime water is then added and the mixture is sterilised, evaporated, powdered, and sealed hermetically in cans.

The other foods of the list above given all contain considerable starch, and will therefore be described in the section upon Prepared Farinaceous Foods.

Gustav Gaertner's *Mother Milk*, according to Theodore Escherich, contains in percentages, albumin, 1.76; cream, 3.0 to 3.5; lactose, 2.5; ash, 0.35, thus closely approximating the composition of human milk, except that it has less sugar. The fresh cow's milk is mixed with sterilised water and placed in a centrifugal separator to remove impurities and separate the superfluous casein, without removing the fat, to form proportions more closely resembling those of human milk. The casein curds of this prepared milk are much more flocculent than those of the original cow's milk. By this process the milk also loses a half of the original salts and sugar, but the latter is easily added again when desired. The milk is sealed hermetically in tin cans, in which it keeps fresh for a year or two.

Milk Derivatives

The principal foods derived from milk which are in common use are:

1. Condensed milk. 2. Cream. 3. Butter. 4. Buttermilk. 5. Cheese. 6. Whey.

1. **Condensed Milk.**—Condensed milk is prepared by slowly evaporating the water of milk by moderate heat *in vacuo* to the consistence of honey. There are two varieties: the "plain," which is condensed to about one fourth of its bulk and superheated, and to which little or no sugar is added; a stronger, more condensed sort, with which cane sugar is mixed in excess. Such milk yields from 39 to 48 per cent of sugar among its solid ingredients, but sometimes as much as 75 per cent is added. A good deal of the Swiss condensed milk sold in market, as well as that made in this country, contains 40 per cent of sugar.

The sugar prevents fermentation and decomposition, and when condensed milk is put up while hot in hermetically sealed tin cans it will keep fresh for years. It will even remain fresh for several days after a can is opened. It is soluble in water added to any degree of dilution. Condensed milk is largely used for the nourishment of infants, especially among the poorer classes. They thrive upon it for a time, occasionally even better than on raw milk, and it makes them fat, owing to the extra sugar which it contains. It does not constipate, and may be even slightly laxative. But although such babies may appear robust, their flesh is not firm, they develop poorly, are unable to resist disease, and become rhachitic.

Condensed milk should be diluted ten times for a child a month or two old, and cream should be added in liberal proportion.

The formula recommended by Starr is:

Condensed milk	ʒj;
Cream	f℥ ss.;
Hot water	f℥ ijss.

This milk, when diluted, speedily undergoes lactic-acid fermentation and causes diarrhœa and thrush.

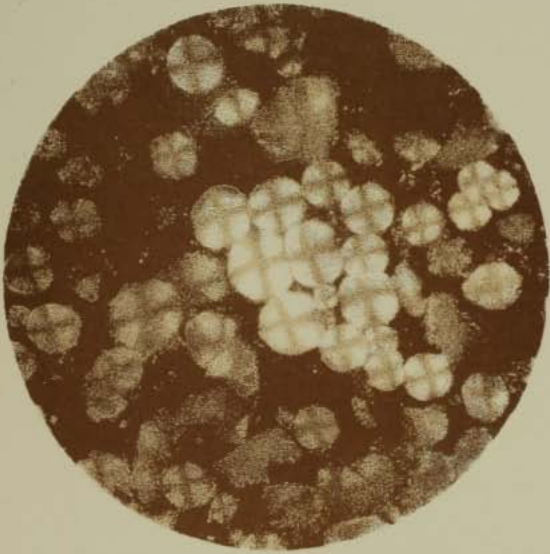
Condensed milk has been used with advantage in the treatment of dysentery (Hübner) and as a prophylactic against scurvy. It is serviceable on long voyages and expeditions where fresh milk cannot be obtained for use with tea, coffee, etc.

Unsweetened condensed milk made of fresh Swiss Alpine milk, and sold under various brands in this country, is prepared by evaporation by heat sufficiently strong to render the milk aseptic, so that no preservative materials are added. The water is reduced from the normal standard of 88 per cent to about 61 per cent. It is open to the same objections as the use of sterilised milk (see Sterilised Milk, p. 85), but it is better for infants than those forms of condensed milk in which preservation is secured by the addition of too large a proportion of cane sugar. An analysis of one brand of this milk is given by Professor Goodfellow, as follows:

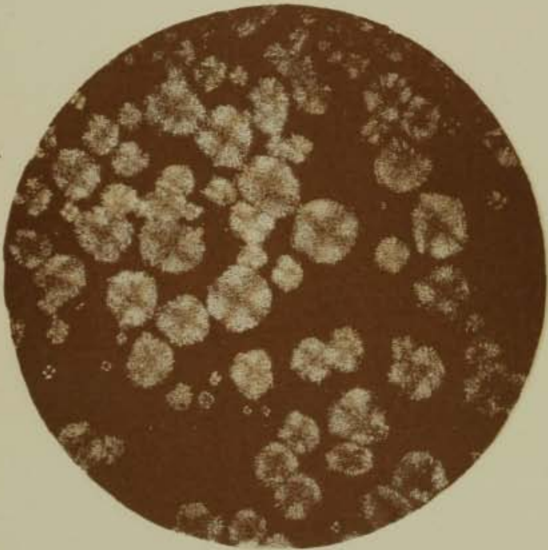
Water	61.3
Casein	9.1
Albumin	1.5
Fat	11.7
Lactose	14.3
Salts (mineral matter)	2.1
	100.0

Milk may be preserved for some time in hermetically sealed cans or bottles without previous condensation, but a separation of the cream eventually takes place, and butter forms in the can.

2. **Cream.**—Cream is the fat of milk, which, by virtue of its light specific gravity, floats to the top of vessels in which milk is allowed to stand for some hours. The globules collect in a yellow layer of varying thickness. The rise of the cream is retarded by coagulation, but favoured by a cool temperature and by richness of the milk. Cream is best obtained by placing the milk in broad, shallow pans. The fatty material is complex, and consists of glycerides of stearic, palmitic, myristic, oleic, butyric, and soluble fatty acids. Churning the milk causes the globules of fat to coalesce in small lumps and form butter. It is a popular fallacy that a little warm water added to milk increases the cream formation. It lessens the specific gravity of the milk and hastens the floating of the globules, but the ultimate quantity of cream is not affected. If the cream falls below 5 per cent of the volume of milk, the milk has been watered. The normal average quantity of cream is over 8 or 9 per cent, but there may be above 20 per cent. The breed, age, and feed of the cow have a marked influence upon the quantity of cream. Alderney milk is rich in fat; longhorns give proportionately more casein.



BUTTER X 40



BUTTERINE X 40

ANIMAL FATS, MAGNIFIED.

(From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau).

PHOTO BY CLIFFORD RICHARDSON.

The milk which comes from the cow towards the end of milking contains more cream than that which is first drawn. This fact should be borne in mind by those who use milk drawn direct from the cow into separate small vessels. Afternoon milk is richer than morning milk in both protein and fat.

Centrifugal or Separator Cream.—Cream may be separated from milk by centrifugal force. A small and large drum are placed one within the other, leaving a space of a few inches between. The inner drum is made of porous material. It is filled with milk and set in rapid revolution. The lighter cream remains in the inner drum, while the other ingredients are thrown with such violence against the porous wall that they are forced through it into the outer drum. It is claimed that the cream is more thoroughly separated in this manner than when it is allowed to rise on standing, and the process is far more rapid. Separator cream does not remain fresh so long as that obtained by natural means, for it is separated at a temperature favourable to the growth of bacteria.

Condensed or *evaporated cream,* which is offered in market, consists of about one fourth cream and three fourths other ingredients of milk, the whole milk having been evaporated by machinery. It is therefore a natural product, easily digestible on account of the dilution of the cream with the nitrogenous ingredients of the milk, and, unlike much condensed milk, it is not artificially sweetened. It is sometimes mixed with malt extract.

Clotted or *Devonshire cream* is skimmed from heated milk, so that the albumin is coagulated with it. It is warmed over a slow fire not above 150° F. Fothergill wrote, "Devonshire cream is delicious with preserved ginger, while cream and maraschino form a nutritive drink for the affluent consumptive."

In cooking, suet is sometimes added to replace cream and impart additional colour and flavour to milk.

Cream is one of the most wholesome and agreeable forms of fat. It is often eaten too rich, and may disagree on that account, whereas, diluted with an equal bulk of water or of lime water, it is well borne. It is an excellent substitute for cod-liver oil in tuberculosis, for, although not quite so digestible, most persons prefer to take it. It is an excellent food in tuberculosis and long-continued suppurative diseases, such as empyema or tubercular joint diseases. It should be avoided in flatulent dyspepsia, in most forms of gastric disease, obesity, and gallstones.

It is useful as a substitute for milk when diarrhœa or marasmus, etc., occurs in infants. It should be considerably diluted when so given.

The addition of strong liquors to cream lessens its digestibility just as heat does, for alcohol coagulates and toughens the proteid envelopes of the fat globules.

Ice cream, when very simply made, is nutritious, and may be allowed many patients. It is soothing to inflamed throats and enjoyed by convalescents from fevers, and children who object to milk will often take it. It should be eaten very slowly, so that it may become well warmed in its passage to the stomach; otherwise it retards digestion.

3. **Butter.**—Butter is made from cream by the mechanical rupture of the albuminous envelopes which inclose the fat globules. The globules then adhere together in small masses. The rupture is accomplished by churning, and after the butter is of sufficient density, salt in small proportion is added, and the butter is "worked" over with a spatula and frequently washed.

An average sample of good butter contains: Water, 11.83 per cent; fat, 82.76 per cent; casein, 0.18 per cent; milk salt, 5.22 per cent (König). The fats comprise six neutral varieties, four of which, being volatile, give to it taste and odour (Chevreu).

The quantity of casein in butter can be roughly estimated by melting a specimen in a test tube, when the casein forms a layer at the bottom.

Butter should not have less than 0.5 to 2 per cent nor more than 8 per cent of salt added.

Perfectly fresh butter made without salt is comparatively tasteless and keeps poorly. The decomposition of its nitrogenous material liberates a ferment which separates fatty acids and glycerin.

Butter is adulterated by dealers by beating it up with water and by adding other fats, especially suet and oleomargarine. The sophistication with water is easily detected by melting, when the sample separates into two layers.

Fresh butter if kept too long, especially in hot weather, soon becomes rancid, bitter, and unwholesome.

Butter which contains too much water and too many ingredients other than the fat has not been sufficiently "worked," and is also likely to become rancid and cause violent gastric derangement. Very thorough washing of butter when first made will remove much of its proteid substance and tend to prevent its fermentation; and fresh butter which has once become rancid may be rendered less so by melting and shaking it in boiling water which is several times renewed and then pouring it into ice-cold water. It is then called "smalt." The addition of salt to butter in the strength of twenty to twenty-five grammes per kilogramme postpones or prevents the fermentation, and sugars or sirups in which the butter may be immersed have the same effect. So also does protecting it from atmospheric air in hermetically sealed jars set in cold water, or simply keeping it under fresh water which is renewed two or three times a day. Sometimes weak solutions of tartaric or acetic acid, three grammes to the litre (Hayem), are employed for this purpose.

Pure fresh-butter fat is not crystalline, but old or rancid butter fat becomes so.

Strong-tasting butter is not necessarily unwholesome, for the flavour may have been derived from the cow having fed upon dead leaves or turnips, and butter is even more sensitive than milk in transmitting unpleasant flavours.

Butter will not support life for any length of time when taken alone, although 100 grains furnish 837 calories. Carnivora fed upon an exclusive diet of meat and fat do not grow fat, therefore the original Banting treatment for obesity (see Obesity) has been modified by Ebstein and others by the free addition of butter to the diet. Taken in connection with other foods, however, butter is a highly digestible and nutritious food, and is often fattening, and it has been wittily said that " if bread is the staff of life, butter is its golden head."

In weak stomachs the digestion of butter is improved by spreading it thoroughly in thin layers upon bread, or allowing it to soak into hot toast. It is thus prevented from floating about in the manner which coats the food and walls of the stomach and retards gastric secretion (Brunton). Most persons eat about an ounce a day of butter, but many eat double that quantity. Its annual production in the United States exceeds one billion pounds.

The use of oleomargarine and butterine as substitutes for butter are described under the heading Fats and Oils.

4. **Buttermilk.**—Buttermilk is the residual milk left after churning and removing the fat. It is wholesome and diuretic, and makes a capital beverage for those patients who fancy its peculiar sour taste. It contains albumin and finely coagulated casein, salts, water, and sugar, which is largely converted into lactic acid. Its fuel value is about that of skimmed milk—165 calories per pint—and its composition resembles skimmed milk, but it contains a little less protein and carbohydrate and a little more fat. A pint of it contains as much nourishment as two ounces of bread or a large potato (A. C. True). It should be drunk fresh, for it soon decomposes. Some patients can digest it who are unable to take ordinary milk. In those disorders in which the digestion of protein and fats is poor it may be better borne than milk.

It is of especial value in chronic gastric catarrh with atrophy of the gastric glands (Eulenburg). A " buttermilk cure " is sometimes practised after the manner of the " whey cure " (see Dietetic " Cures "), but buttermilk cannot long be depended upon as an exclusive diet.

5. **Cheese.**—Cheese is the casein of milk separated by rennet, which includes some of the fat and salts, but the potassium salts are removed by the rennet. There are many varieties, prepared in different ways, but the two chief classes are hard cheeses and soft

cheeses, the former being pressed and salted. Cheese forms a highly nutritious food and an important article of commerce. In countries where meat is scarce and dear the peasantry consume large quantities to supply the nitrogenous element of their diet, and, weight for weight, cheese contains about twice as much protein as meat (Parkes). They use for this purpose the heavier, less highly flavoured cheeses. The wealthy classes eat cheese more as a condiment, taken after meals, and therefore they require higher flavoured varieties, which please the palate and excite the secretion of gastric juice. Eaten in moderation, such cheeses are an aid to digestion. Taken with milk, cheese tends to reduce the size of the coagulæ in the stomach. Old "poor" cheese—i. e., cheese made without fat, consisting of almost pure casein—is difficult to masticate thoroughly, and is slowly dissolved in the gastric juice, hence it is slowly digested. It may act as a gastric irritant and be hurried into the intestine to excite indigestion there. Such cheese may be rendered more digestible by cooking it after grating with bicarbonate of potassium in the proportion of a quarter of an ounce to the pound of cheese. Cheese which retains some fat is friable, light, and easy of digestion.

About 250,000,000 pounds of cheese are annually produced in the United States alone, and much so-called foreign cheese is produced in this country.

The kinds of cheese differ somewhat in composition, but in general they may be said to contain from 35 to 55 per cent of water and from 10 to 20 per cent of fats, 20 to 30 per cent of casein, and about 6 per cent of salts.

Cheese is rich in fat or in flavour according as it is made from whole or skimmed milk. Cream cheese contains about 77 per cent of fat, and the highly flavoured Roquefort, Edamer, Cheshire, and Emmenthaler, or Schweizer cheeses have a similar quantity, and are nutritive when they can be digested.

Bauer's analysis of cream cheese places the fats much lower, and the casein is also at a minimum.

Bauer's Analysis of Cream Cheese

	Water.	Nitrogenous matter.	Fat.	Extractives.	Ash
Cream cheese	35.75	7.16	30.43	2.53	4.13
Whole milk	46.82	27.62	20.54	2.97	3.05
Skimmed milk	48.02	32.65	8.41	6.80	4.12

Cheese is usually prepared from sweet milk. The coagulation is accomplished in a few minutes by the addition of the ferment rennin with gentle heat (120° F.). The heat secures firmer coagulation. Casein may also be coagulated by acids. A little salt is added; the curd is strongly pressed in a mould, and the expressed fluid is called "whey." The curd is then salted and dried on the surface by frequent turning in the air. The harder cheeses are made under higher temperature and pressure. Cheese is kept for a time to "ripen," by fermentation or decomposition. If the decomposition goes too far, it develops leucin and tyrosin. The casein may become soluble in water, producing soda albuminate and peptones. The "riper" a cheese the greater is its value as a condiment.

During the ripening volatile fatty acids are evolved from the fatty matter present, which occasion the odour and flavour. The casein also undergoes change, and is partially converted into fat (Foster). It may putrefy and evolve ammonia, or even become poisonous. Ripening, when not carried too far, makes cheese more friable, and hence more digestible.

Cream cheese is fresh, and usually not ripened, but Neuchâtel is ripened.

Pot cheese is eaten fresh after the whey has been expressed. It contains: Water, 60.27 per cent; casein, 24.84 per cent; fat, 7.33 per cent; ash, 4.02 per cent; milk sugar and lactic acid, 3.54 per cent.

The quality of cheese depends upon the richness of the milk in fat. In the richest cheeses made of whole milk, such as Stilton, double Gloucester, Gorgonzola, and Roquefort, cream is added. Single Gloucester, American, and similar cheeses are made from milk from which the cream has been removed. Dutch, Suffolk, and Parmesan cheeses are also made from skimmed milk, and are "poor." Being nearly pure casein, they are hard to digest in bulk. These latter varieties keep well, and become hard enough to be grated. Fat separates the flocculi of casein and makes cheeses soft, friable, and rich, but they sooner decay.

The two soft cheeses most used in this country are Camembert and Brie.

Camembert is a cheese made of whole milk, which is very carefully dried under regulated temperature. It requires three or four weeks to ripen. This cheese, as well as the following variety, is made in St. Lawrence County, Pa., as well as in Europe.

Brie cheeses are manufactured in three grades of richness, according to whether the milk is whole, partly skimmed, or skimmed.

Roquefort is a hard cheese made in the department of Aveyron from goat's milk, partly skimmed and coagulated with rennin. The curd is then pressed for half a day, dried for ten or twelve days, and ripened in caves. This cheese is streaked with bluish lines, which are formed by the addition of a mould which grows on stale rye bread. This cheese is also made along the shores of the Great Lakes in this country, where conditions of climate, pasturage, and water favour its production.

Gruyère was originally a hard Swiss cheese, but is now made also in France and elsewhere. It is dry, aërated with large holes, and it can be crumbled. It is manufactured in three grades, according to the degree of skimming of the milk, and the curd is cooked a short time before it is pressed. It has a somewhat saltish taste.

Gorgonzola is a Piedmontese cheese made with hot and cold curds from two milkings, which do not perfectly unite, but which form minute interstices in which a green mould called "parsley" grows and imparts a high flavour (Clark). The curd is hung in hempen cloths to ferment. It is well salted.

In the United States much of the cheese manufactured is of the common sort called "American cheddar," but Neuchâtel, Stilton, pineapple, and other more highly flavoured varieties are also extensively produced. "Swiss" cheese is made in Ohio and Wisconsin. An imitation cheese is also prepared from a mixture of one part lard and two or three parts milk, mixed or emulsionised at 140° F. This emulsion is then added with buttermilk to skimmed milk, so that the finished product contains about 14 per cent of lard (Caldwell).

Toasted cheese is one of the most indigestible articles of diet, unless the cheese is new, "poor," and cut thin. "Welch rarebits" are notoriously difficult of digestion, although highly nutritious when absorbed. It is an old saying of such cheese that it is "gold in the morning but lead at night."

Certain low organisms, moulds, fungi, etc., flourish in cheese and make it very irritant to the stomach. Such are the *Aspergillus glaucus* and *Sporendoneum casei*, both of which give a red colour, the cheese mite (*Acarus domesticus*) and the maggots of a fly (*Piophilia casei*). Bad cheese has been known to produce poisonous symptoms (see Ptomaine Poisoning) resembling those of poisoning by sausage meat.

Plasmon is an albumin food made from milk from which the fat has been removed. It is practically a dried form of casein. It is a tasteless, odourless, white, dry powder, soluble in water. It may be given every hour or two in teaspoonful doses in ten tablespoonfuls of water, or with an equal quantity of sugar an ounce of plasmon may be stirred into half a pint of boiling milk (C. Virchow). It may be added to broths and gruels, or to such starchy foods as boiled rice or mashed potatoes. This food contains over 90 per cent of pure protein in very digestible form. Plasmon biscuits and a plasmon chocolate are also manufactured.

Nutrose or casein-sodium is a form of milk casein which may be added in half-ounce doses to broths, gruels, or cocoa, in which it is soluble. It contains, according to Bruno Oppler, about 90 per cent of pure proteid. It furnishes a small volume of feces when this is desirable after operations upon the intestines.

Sanose is an albuminous food consisting of 80 per cent of powdered casein and 20 per cent of egg albumin. It is a white, odourless, tasteless powder forming an emulsion in water. It may be given in milk, cocoa, *purées*, or soups. From two to six tablespoonfuls may be given daily.

6. **Whey.**—Whey is the residuum of milk from which the casein and fat have been removed as cheese by the action of rennin or otherwise. It contains, in addition to water, salts, especially of potassium, a little lactalbumin, and lactose. It is apt to turn sour, but is fairly digestible even then, and its taste may be disguised by the addition of nutmeg and sugar.

It makes a palatable, mildly diuretic drink, which is enjoyed by invalids. In Europe several "whey cures" have been established for the treatment of renal disease, dropsical affections, etc., but whey is not in any case a specific, and its dietetic value is greatly overrated.

Yeo gives the following simple directions for the preparation of whey for invalids: Boil a pint of milk with one to two teaspoonfuls of lemon juice, strain in muslin, and express all fluid from the curd. Break the curd up first, and much fat and some finely divided casein will go into whey. Add beef tea or milk juice, or egg yolk in hot water.

Eggs

About nine billion eggs are produced annually in the United States (Clark). Eggs contain all the ingredients necessary to support life and develop the organism. Like milk, they constitute a complete food, for out of an egg the entire structure of the bird—its bones, nerves, muscles, viscera, and on some birds even feathers—are developed previous to hatching. The inner portion of the shell is dissolved by phosphoric acid to furnish phosphates for the bones.

The average weight of a hen's egg, according to Bauer, is 50 grammes, or about 2 ounces, divided as follows: Shell, 7; white, 27; yolk, 16 grammes. The eggs of pullets are smaller than those of old hens.

Composition of a Hen's Egg (Lawes and Gilbert)

Fresh weight	1.8 ounce.
Dry weight	0.45 "
Fat	0.198 "
Mineral matter	0.025 "
Nitrogen	0.036 "
Carbon	0.275 "
Or in percentage:	
Water	70.00 per cent.
Dry matter	30.00 "
	100.00 per cent.
Nitrogen	2.00 per cent.
Carbon	17.52 "

In artificial digestion experiments it is customary to estimate about four hundred grains of albumin to the egg.

Hens' eggs principally are used for food, but the eggs of ducks, geese, and guinea-fowl are also eaten, and occasionally those of such wild birds as the plover and sea birds. Along the Texan coast the eggs of gulls, terns, and herons were formerly gathered for food, those of the gull and murre on the Farallone Islands off the coast of California, and those of the laughing gull off the eastern coast of Virginia. Terrapin eggs are eaten with the flesh of the animal, and various forms of fish eggs are esteemed for food, as those of the sturgeon (caviare) and shad (roe).

The shell of a hen's egg weighs about one hundred grains. Its colour bears no relation to the nutrient value of the egg, but white shells are heavier than brown. An egg consists approximately of—

Shell—11 parts		Carbonate of lime.
Yolk—32 parts:	Proteid (vitellin)	15.7 per cent.
	Fat	33.3 "
	Ash	1.1 "
	Water	49.5 "
Total calories		1,705
White—57 parts:	Proteid	12.3 per cent.
	Fat	.2 "
	Ash	.6 "
	Water	86.2 "
Total calories		250

The yolk is very complex. Besides the proteid vitellin, it contains three fats, colouring matter, nuclein, lecithin, and salts of iron, calcium, magnesium, and potassium.

Egg albumin is not pure, but consists of four albuminoid and mucoid bodies, the chief of which is ovalbumin, together with a trace of carbohydrate. The phosphorus equivalent is 0.03 per cent phosphoric acid (C. F. Langworthy), whereas that of the yolk exceeds 1 per cent.

If the absorption of eggs from the intestine is delayed, decomposition ensues with production of sulphuretted hydrogen and ammonia, which cause considerable gastro-enteric disorder. The yolk of egg is particularly responsible for this. It is therefore a matter of great importance to serve only eggs which are absolutely fresh to invalids. No egg having an odour of stale, old straw should ever be offered. There are two simple methods by which the nurse may test the freshness of an egg:

1. Hold the egg between the hands so that the light of a candle shines through it. If fresh, it is more transparent in the centre; if stale, at the ends.

2. Make a solution of two ounces of common salt in a pint of

water. An egg one day old will sink in this solution, but will not quite reach the bottom; an egg three days old will barely float beneath the surface, and an egg a fortnight old will float above the surface, only partially dipping beneath it (Siebel). This difference is due in part to loss of water, which after ten days equals 1.60 per cent; after twenty days, 3.16 per cent; and after thirty days, 5 per cent. It is also due in part to development of gases of putrefaction.

With some persons eggs have a slight aphrodisiac effect, and they also promote costiveness. They should not be eaten in the following diseases: Flatulent dyspepsia, gastric dilatation, or any form of severe gastric derangement, severe acute Bright's disease. The flavour of eggs is modified by the food of the hen, those from hens fed on nitrogenous food instead of carbohydrates have poor odour and flavour and small yolks. An excess of onions in the hen's diet imparts the strong odour and taste of the vegetable to the eggs, about fifteen days after such food has been eaten. Eggs packed in stale bran or straw, or kept near decaying apples, acquire a bad flavour. Micro-organisms may penetrate the egg-shells and give rise to fermentation and decomposition.

Raw Eggs.—Whole raw eggs are very popular in dietetics at present, and they are often prescribed when a nutritious, highly concentrated diet is desired, and in cases of tuberculosis, some forms of anæmia, and various wasting diseases; sometimes from eight to ten or twelve are given daily if they can be digested. They may be advantageously combined for such purposes with milk and salt or cod-liver oil, meat broths, soups, and *purées*. Beaten white of egg may be added to coffee, cocoa, wine, cream, or sweetened water.

Eggnog is very nutritious, and is extensively prescribed in some non-febrile diseases, especially for the forced alimentation of phthisis and melancholia, and there are occasional cases of bilious habit in which eggs can only be digested when beaten in wine, but the combination of egg, milk, and sugar with alcohol, which constitutes eggnog, may produce nausea and vomiting in a feeble stomach, particularly in fever. For this reason whole eggs are unfit for fever patients, and if eggs are employed at all for them, the whites only should be used, prepared in the manner described in the following section:

Egg Albumin, when eaten raw or almost raw and properly diluted with milk or water, is well absorbed. It may also be predigested, and it should be flavoured with lemon juice, or sherry or other wine, coffee, cocoa, or cream, and sweetened water; otherwise it is tasteless and disagreeable, and but few can continue to eat it in any considerable quantity. (See Receipts, Preparations of Eggs.) When the fresh white egg albumin is beaten it incloses bubbles of air which expand by heat when the albumin is mixed with dough, making it porous, as in the case of sponge-cake. Old eggs lose this quality of frothiness.

Egg albumin is used by Ewald to prepare fresh albuminate of iron. He adds two tablespoonfuls of a solution of one part of white of egg in two of water, to a teaspoonful of a 2- or 3-per-cent solution of ferric chloride. To be taken through a tube.

Protogen is an uncoagulable form of egg albumin prepared by action of formalin. It may be given either by mouth or in nutrient enema.

The Cooking of Eggs.—Albumin, or the "white" of an egg, is altered physically but not chemically by processes of cooking. At about 134° F. delicate fibrillæ of coagulated albuminous material begin to stretch through the substance, and they increase with the temperature up to 160° F. The fibrillæ are so numerous that the entire mass is coagulated, but is still of a soft or gelatinous consistence.

It has been observed by Tarchnoff that the coagulum thus formed in the eggs of birds which, like the chick, are hatched with feathers, becomes white and opaque; whereas that of the eggs of birds which, like the plover, are hatched without feathers, is more transparent. If the coagulated albumin is heated still further, it becomes more and more dense, hard, dry, and brittle. When heated beyond the boiling point, or 212° F., it forms a very tenacious, gluey substance, which can be used as a cement for mending broken china.

Eggs baked in puddings or in any other manner form one of the most insoluble varieties of albumin possible. A raw egg is ordinarily digested in the stomach in one and a half hour, but a baked egg requires from three and a half to four hours.

The principle involved in this account of the cooking of an egg is further illustrated by the process of overcooking beefsteak. When strong heat is too long applied in the process of broiling, the albumin of the meat becomes dried, shrivelled, and comparatively tasteless; and eggs cooked for persons with delicate digestions, instead of being "boiled" in water at 212° F., should be placed in water at a temperature between 170° and 180° F., and immersed for fully ten minutes, at the end of which time they will be found of a uniform gelatinous consistence, very palatable, and not too tough to be readily acted upon by the gastric juice. If a cooking thermometer is not at hand, the water may be previously brought to the boiling point and then set aside, when in a moment or two it will cool to the proper temperature. This should be a little above the coagulation point of the egg albumin (134° F.), because the process of raising the temperature of the egg is a slow one, and the water loses heat in warming the egg (Williams). Eggs cooked in this manner are found to have the yolks more firmly coagulated than the white, which remains quite tender. A practical way of attaining the above result is to pour a quart of recently boiled water over two eggs in a bowl and let them stand for ten or twelve minutes.

Another excellent way to cook an egg, as suggested by Henry, is to immerse a teacup in boiling water until it becomes thoroughly heated. It is then removed and the egg is broken and dropped into it, and the cup may be wrapped in a cloth. Sufficient heat is retained by it to cook the egg without water and remove any raw taste.

The yolk really coagulates at a lower temperature than the white, although as eggs are commonly cooked it does not have an opportunity to coagulate first. The former is composed of albumin and casein with fat (Lehmann). In the ordinary rapid cooking of eggs in boiling water the white is firmly set before there is time for the temperature of the interior of the egg to be thoroughly raised, and consequently the yolk is softer than the white. The shell of the egg facilitates the process of slow cooking of the albumin by protecting the interior and preventing the escape of the contents by solution, just as in the cooking of fish or flesh in water, the latter should be hot enough to immediately form an external coagulum of albumin sufficiently dense to prevent the diffusion of albuminous material and salts into the water.

Custards composed largely of eggs, although unfit for active fever, are very useful adjuncts to a convalescent dietary in recovery from typhoid fever or other acute diseases.

In the making of omelettes and "scrambled" eggs the white is thoroughly mixed with the yolk, and the egg is more digestible than when fried or cooked so much that the albumin is hard.

Preservation of Eggs.—Eggs decompose from the admission of germs through their porous shells. To prevent this occurrence it is necessary to protect the eggs from contact with air. When first laid, eggs have a protective mucilaginous coating, which is, however, removed by washing. They may be coated with varnish, paraffin, tin foil, butter, glycerin, vaseline, or any fat or oil not liable to become rancid. A 2- or 3-per-cent solution of salicylic acid may be added to the oil. Packing in sawdust or bran also excludes the air to a slight extent. Lime with cream of tartar preserves eggs, but alters their taste.

According to C. F. Langworthy (U. S. Department of Agriculture Bulletin No. 128, 1901) the best preservative substance is a 10-per-cent solution of water-glass, in which eggs will keep fresh for three and one half months. Eggs also preserve their freshness for as much as a year in cold storage at 30° to 40° F. Eggs so stored must be turned twice a week to prevent gravitation of the yolk, causing its adhesion to the shell.

Eggs are also preserved by drying, canning, and similar processes, when designed for shipment upon long voyages.

Evaporated or *desiccated eggs* are dried *in vacuo* or otherwise by currents of warm air. Salt or sugar may be added, and the eggs are ground. Such eggs keep well, and are often used by bakers.

Meats

The Consumption of Meat.—The universal consumption of meat by civilised man is of more recent origin than is generally supposed. McCulloch states (Statistical Account of the British Empire, vol. ii, p. 502) that "so late as 1763 the slaughter of bullocks for the supply of the public markets was a thing wholly unknown even in Glasgow, though the city had then a population of thirty thousand."

In the past decade or two the consumption of meat has increased enormously, especially in England, owing to the development of cheap refrigerating processes, canning, and increased facilities of transportation of live cattle. The beef from Australian and New Zealand cattle is obtainable in London, and that of Texan cattle in New York in a state of perfection and cheapness which far exceeds that of animals raised close at hand. In London during the last twenty years of the nineteenth century the per capita consumption of meat rose from 112 to 122 pounds. There is a popular belief that the eating of meat increases both bodily vigour and mental capacity, and that a man fed upon animal food is livelier, keener, and stronger than the exclusive vegetarian. (See Animal and Vegetable Foods Compared, p. 33.) This comparison may not hold in all cases, nor with all people and tribes of man—as, for example, the Japanese and many African tribes—but it applies very well to those who have to meet the exigencies of advanced civilisation. Liebig, in extolling the advantages of a liberal meat diet, wrote: "It is certain that three men, one of whom has had a full meal of meat and bread, the second cheese or salt fish, and the third potatoes, regard a difficulty which presents itself from entirely different points of view."

It is true, however, that too much meat is eaten by many persons for maintenance of the best health. The annual per capita consumption of meat has almost doubled during the past half century. It is estimated in pounds as follows: In the United States, 120; England, 105; France, 74; Germany, 69.

Very large quantities of meat—much more than is necessary for sustenance—are absorbed when eaten, although a few undigested muscle fibres may appear in the stools.

A meat diet, if long continued, tends to produce scurvy, and the absence of meat favours the occurrence of anæmia in many persons. In general, those diseases in which an exclusive meat diet, or a diet composed almost exclusively of animal food, with perhaps a minimum of dry bread, is found beneficial, are the following: Flatulent dyspepsia, chronic gastritis and gastric catarrh and dilatation, diabetes, intestinal dyspepsia, phosphaturia, obesity, and some cases of chronic dysentery. Meat should also enter largely into the diet of consumptives and anæmic subjects.

It is well to prohibit the consumption of meat in fevers, acute and severe chronic Bright's disease, gout and rheumatism, and to reduce it in lithæmia and oxaluria.

Composition of Meats.—Meat from any animal is composed of muscular fibres, but it necessarily contains those structures which were intimately associated with them, such as connective tissues, blood vessels, nerves, and lymphatic vessels, and more or less adipose tissue. Meat which is very fat contains comparatively little water, as well as less nitrogenous matter than lean meat.

In one hundred parts of flesh there are, according to Schlossberger and v. Bibra:

	Ox.	Pig.	Man.	Fowl.	Carp.
Water	77.50	78.30	74.45	77.30	79.78
Solids	22.50	21.70	25.55	22.7	20.22
Soluble albumin, colouring matter	2.20	2.40	1.93	3.0	2.35
Glutin	1.30	0.80	2.07	1.2	1.98
Alcoholic extract	1.50	1.70	3.71	1.4	3.47
Fats	.....	.....	2.30	.....	1.11
Insoluble albumin, blood vessels, etc.	17.50	16.81	15.54	16.5	13.31

Composition of Various Meats

Constituents.	Lean beef (Pavy).	Fat beef (Pavy).	Lean mutton (Pavy).	Fat mutton (Pavy).	Veal (Pavy).
Nitrogenous matters	19.3	14.8	18.3	12.4	16.5
Fat	3.6	29.8	4.9	31.1	15.8
Carbohydrates	....	....	....	....	....
Saline matters	5.1	4.4	4.8	3.5	4.7
Non-nitrogenised organic matters, and loss	....	....	....	....	....
Water	72.0	51.0	72.0	53.0	63.0
Total	100.0	100.0	100.0	100.0	100.0

Constituents.	Fat pork (Pavy).	Dried bacon (Pavy).	Calves' liver (Payen).	Fois gras (Payen).	Sheep's kidneys (Payen).
Nitrogenous matters	9.8	8.8	20.10	13.75	17.250
Fat	48.9	73.3	5.58	54.57	2.125
Carbohydrates	....	....	0.45	6.40	
Saline matters	2.3	2.9	1.54	2.58	1.100
Non-nitrogenised organic matters, and loss	....	....	.....	.....	1.325
Water	39.0	15.0	72.33	20.70	78.200
Total	100.0	100.0	100.00	100.00	100.000

Raw Meats.—There is a prevalent fashion of prescribing raw meat, and in some diseases, such as dysentery or chronic gastritis, it is useful, but it should not be given with the idea that it possesses any special curative virtue from the fact of being raw. Beef, mutton, and ham are all eaten in this condition. Meat is distasteful to most persons in this state and soon palls upon the appetite, and may excite positive loathing. There is a natural aversion to raw flesh among even the lowest tribes of man, who only consume their meat raw from excessive hunger or when fire is unobtainable. Even the primitive Australian savage cooks his reptiles and worms. Raw meat has no advantage either in digestibility or nutrient power over moderately cooked or "underdone" meat. Some danger has been attributed to eating raw meat on account of the possibility of acquiring intestinal worms through it, but the fear of this is much exaggerated.

On the other hand, meat is easily altered and made innutritious by prolonged cooking. Overdone meat is indigestible and tasteless.

If meat is too long boiled it becomes insipid and useless as an aliment, and the resulting soup is not a full substitute for it. Meat should never be cooked during *rigor mortis.*

Hall and Kane both declared that in their arctic experience fresh raw meat was a preventive of scurvy, but that cooked meat was not.

Digestibility of Meats.—Among the circumstances which affect the digestibility and nutrient power of meats are the age at which the animals eaten were killed, and the care bestowed upon them in feeding, shelter, and transportation. Animals which have been underfed, ill-treated, and worried yield very inferior meat.

Almost all meat is tougher immediately after killing, and improves on being kept for a day or two. Violent exercise is believed to increase the tenderness of the meat of hunted animals.

In general, the flesh of young is more digestible than that of old animals, provided they are not still suckling.

It would be convenient if meats and animal foods of all kinds could be arranged in a table of comparative digestibility, but such tables are necessarily inaccurate, if not actually misleading, owing to the great variations produced by the character of the particular samples of food used, by the time and manner of cooking, by the condition of the digestive organs, and by personal idiosyncrasy. No two tables of this kind given by different authors are found to agree in all respects.

The following table is offered as an average of the ease of digestibility of animal foods, the time required for the completion of gastric digestion being the chief standard, but some foods may be well enough digested although they require half an hour or so longer time than others.

Table of Comparative Digestibility (commencing with the Most Digestible, and ending with the Least Digestible of Meats and Other Common Animal Foods)

Oysters.
Soft-cooked eggs.
Sweetbread.
White fish, boiled or broiled, such as bluefish, shad, red snapper, weakfish, smelt.
Chicken, boiled or broiled.
Lean roast beef or beefsteak.
Eggs, scrambled, omelette.
Mutton, roasted or boiled.
Squab, partridge.
Bacon (crisp).
Roast fowl, chicken, capon, turkey.
Tripe, brains, liver.
Roast lamb.
Chops, mutton or lamb.
Corned beef.
Veal.
Ham.
Duck, snipe, venison, rabbit, and other game.
Salmon, mackerel, herring.
Roast goose.
Lobsters and crabs.
Pork.
Smoked, dried, or pickled fish and meats in general.

The table given below is published by E. Jessen as the result of giving test meals of single articles of food. The stomach was first cleansed and emptied by siphonage, then a hundred grains of meat were introduced with eight ounces of water. Samples of the digested stomach contents were from time to time withdrawn, and the complete disappearance of all muscular fibre when examined by the microscope occurred as follows:

Beef, raw, chopped fine	2 hours.
Beef, half cooked	2½ "
Beef, well cooked	3 "
Beef, thoroughly roasted	4 "
Mutton, raw	2 "
Veal, cooked	2½ "
Pork, cooked	3 "

These estimates fall somewhat below those of other writers, and for comparison he gives the time for digestion of six hundred cubic centimetres of raw cow's and goat's milk as three and a half hours, and that of boiled milk as four hours, which is too long.

Beef.—The composition of beef varies with the feeding of the animal. A young steer from two and a half to five years old furnishes the best meat. If the animal is lean the meat may yield from 70 to 75 per cent of water and about 20 per cent of nitrogenous material, furnishing about 415 calories per pound, with 2 or 3 per cent of fat; but if very fat when killed, the percentage of both water and nitrogenous material is considerably reduced, while that of the fat may be as high as 25 per cent, or even more. As a general average, one third of beef is nutritious material, the remainder is water and bone.

Beef fat is composed of glycerides of fatty acids. It melts at from 41° to 50° C. Stearic and palmitic acids are present in the proportion of three to one of oleic acid.

The equivalent of beef is sometimes stated in terms of other foods. A pound of lean beef is believed to equal in nutrient value two and a half pints of milk, half a pound of bread, and about three eggs, but these are only approximate figures.

Fresh beef can be eaten longer continuously than any other kind of meat. In this respect it resembles bread and rice. Attempts have sometimes been made on wagers to eat quail or partridge three times a day consecutively for a month, but disgust is sure to follow after a week or two, no matter how much such food is varied in the cooking, and by the end of a month it may excite extreme loathing, and even nausea and vomiting.

Chipped beef is prepared, like corned beef, by pickling for a month, when it is smoked for two days and dried for a fortnight, after which it is sliced thin by machinery and is ready for packing.

Beef Preparations for the Sick.—Beef is so important a food for well and sick alike that many attempts have been made to improve its digestibility for the latter.

Most of these efforts are aimed at concentrating the meat by removing all indigestible connective-tissue fibre, the muscle sheaths, sarcolemma, and blood vessels.

In some cases the process of concentration is carried still further and water is driven off by evaporation, or some of the active principles of the meat are extracted and condensed. Sometimes the meat is predigested. Different meats may be prepared in these ways, but the best lean beef free from coarse fibre is usually preferred.

It is impossible within the limits of this work to even name all the meat extracts, powders, etc., that have been produced, but a few of the typical ones which are most in use will be described below.

It was long ago shown by Schiff that many fluid substances, such as meat extract, soups, peptones, and even vegetable *purées* when taken at the commencement of a meal, on being absorbed into the blood, favour the flow of gastric juice. This is true also of peptones injected into the rectum, so the effect is not wholly due to local stimulation of the inner surface of the stomach.

Much attention has of late been given to the predigestion of meat, and especially to the production of albumoses, which are more soluble and assimilable than undigested meat albumin, and which are said to possess greater nutritive property than peptones.

The beef extracts made in this country usually have a less disagreeable taste and odour, and are lighter in colour than those made of South or Central American beef.

In general, about three grammes of meat extract constitute a good soup ration, and such preparations are often valuable for addition to invalid soups and broths when thickened with eggs, rice, sago, pearl barley, macaroni, ground toast, etc.

The preparations of meat for the sick are both solid and fluid.

Solid Meat Preparations.—*Scraped meat* is best made from tender beefsteak, broiled for a few minutes over a brisk fire, but rare roast beef or mutton chops may be used. With a dull knife or an iron spoon the pulp is scraped out. The indigestible and less nutritious connective-tissue sheaths of the muscle fasciculi are broken and left behind, while the fibres themselves (or their myosin) are obtained in the form of a soft unirritating mass which is readily acted upon by the gastric juice. The pulp may be run through a sieve. It is then salted, and it may be made into little balls and browned just before eating. This is done by placing the balls on a hot frying pan, which is not greasy, and turning them over so that the outside becomes well seared. They should then be set aside on a cooler part of the stove or oven and allowed to remain until the raw red colour of the interior turns slightly to drab.

Some patients prefer to eat the meat lightly cooked, spread as a sandwich between thin slices of bread and butter. This meat may be fed to infants in their second year, and the meat balls and sandwiches are invaluable in the treatment of chronic gastritis, dilatation of the stomach, typhoid convalescence, and other affections.

Mosquera's beef meal is made by digesting fresh tender lean beef with pineapple juice until the muscle fibre is almost completely converted into peptones. After digestion the preparation is desiccated. Chittenden's analysis of this meal shows it to contain 90 per cent of nutriment, 13 per cent of which is fat and 77 per cent is protein. Of the latter, almost half consists of albumöses and peptones fit for prompt absorption. The remaining portion is believed to be in a condition in which it is more digestible than plain meat. The beef meal is tasteless and odourless, which are decided advantages, as it can be flavoured according to preference. It should be salted, and it may be added to broths and soups. D. D. Stewart advises its use with equal parts of sugar and cocoa. This mixture is added to hot mlik.

Mosquera's beef jelly is made in a similar manner, but is evaporated to the consistence of a solid extract. Analysed by Ludwig, it was found to contain only 3 per cent of insoluble material, and of the soluble portion 53 per cent consists of albuminoids which were nearly all peptones. It is of pleasant taste and odour, and is highly nutritious. Dissolved in boiling water, it may be given alone with a pinch of salt or added to re-enforce any broth, gruel, *consommé*, beaten eggs, or milk. The beef jelly is even more digestible than the meal. It is sometimes combined with cocoa.

The beef meal and jelly are both excellent for use in gastritis, gastric catarrh, ulcer, and carcinoma, and many forms of enfeebled assimilation.

Benger's peptonised beef jelly is another good beef preparation much in vogue in England for the same purposes as Mosquera's preparations. It may be taken cold or dissolved in hot water as a concentrated beef tea, representing a large amount of meat fibre. It is a useful stimulant for the aged who have feeble digestive power. It may be given to them in teaspoonful doses.

Tropon is a condensed proteid preparation of granular consistence, said to contain 89 per cent of protein (Kleine). It is tasteless, insoluble, and may be added to milk, broth, rice, or other food, and several drachms may be given daily.

Darby's fluid meat is a moist extract which has a strong meaty taste. It can be eaten spread on thin bread and butter or cracker, or it may be dissolved in hot water.

Powdered beef is made as follows:

Chop lean beef into small pieces, dry on a water bath or in an oven with a slow fire, and powder in a coffee mill or with a machine constructed for the purpose. Do not overdry. This powder can be mixed with hot water or any form of soup, milk, chocolate, grog, or punch. In process of drying, which occupies from five to twenty-four hours, the meat loses rather more than four fifths of its weight (Huggard).

Dujardin-Beaumetz's "*grog de la poudre de viande*" is prepared as follows: Take two tablespoonfuls of meat powder, three dessert-spoonfuls of essence or sirup of rum punch, and add milk enough to make quite fluid. In this way he claims that the equivalent of three and a half pounds of meat may be given daily.

Debove, Dujardin-Beaumetz, and Peiper strongly recommend powdered meat for forced alimentation (see Suralimentation in Phthisis) to replace feeding by the stomach tube.

Professor Finkler, of Bonn, has made a proteid food which he claims—

"1. Has the greatest amount of albumin possible up to 90 per cent.

"2. Is digestible up to almost its entire weight.

"3. Can be made equal in amount for each day.

"4. Keeps well indefinitely in all climates.

"5. Its flavour and taste do not interfere with that of other food.

"6. Its price is the lowest possible."

This food consists of the nitrogenous parts of meat, fish, and legumes. It is odourless, tasteless, and forms a light yellow granular powder. König's analysis of this food follows:

Protein	89.87 per cent.
Water	8.89 " "
Ash	1.24 " "
Fat	0.20 " "

Beef blood.—Dried beef blood, powdered, has been recommended by Regnard and others for use by addition to soups and various forms of foods. The taste and odour of dried blood is disagreeable, and the idea of eating it in any form is repugnant to most persons.

It has also been used for rectal injection, but I have always observed it to cake inside the bowel, and there is very little evidence that it is absorbed at all.

Meat lozenges are prepared by Mason as a convenient and portable form of condensed food. Soup lozenges and capsules are also made.

Beef peptonoids are prepared in powdered form by several manufacturers; one variety contains predigested and sterilised beef, milk, and gluten.

Rudisch's beef peptone (or sarco-peptone) is a dark-brown, semi-solid paste, having a strong meaty odour and flavour. One pound of this preparation represents eight pounds of fresh lean beef. In addition to the extractive materials which are obtainable in ordinary beef tea, it contains predigested proteids in a form suited for prompt absorption. It may be eaten spread upon crackers or toast, or it may be dissolved in chocolate or almost any suitable fluid, either hot or cold. It is given in doses varying from half a teaspoonful or less for young children, up to a teaspoonful or tablespoonful for adults. If its flavour when dissolved in water alone is disagreeable or becomes tiresome, it may be altered by giving it ice cold, or by the addition of salt, celery salt, pepper, or Worcestershire sauce, and for children it may be sweetened with sugar. It is often added to milk, sherry, eggnog, gluten, and farinaceous gruels of oatmeal, rice, or arrowroot, or it may be used to re-enforce soups, broths, and jellies.

The Maltine Company furnish a similar preparation which contains 70 per cent of albuminous material with phosphates, fat, and carbohydrates.

The South American beef extract is a predigested preparation which, by the analysis of Kemmerich, contains, with other proteid matter, a large proportion—over 27 per cent—of albumoses and peptones, ready for immediate absorption.

Somatose is a granular predigested meat powder which, according to analysis reported by Hildebrandt, contains 90 per cent of albumoses (deutero- and hetero-albumose), and is free from peptones. It is of a yellowish colour, amorphous, finely granular, having but faint taste and odour. Dissolved in water, it forms a clear, light yellow or brownish solution, almost tasteless. It is not precipitated by heat or by strong acids. The latter, in fact, redissolve a precipitate which is formed by very weak acids. It is claimed for it that it is eight times as nutritious as meat, but estimates of this kind applied to artificial foods are always fallacious. Of course for an invalid who cannot digest any meat such preparations are indefinitely "stronger," but for those who can assimilate meat they are much weaker. Somatose can be injected in hypodermic solution without local irritation. It may be given as fine powder with bread and butter or spread upon toast. It is also administered like similar preparations in milk, mucilage, soup, cocoa, or coffee. When mixed with such substances it should be first stirred into a thin paste with an equal volume of the fluid and then added to the remainder.

It is well tolerated by irritable stomachs and is speedily absorbed, and it possesses the advantage of having a less disagreeable taste than many preparations of meat.

Eskay's Food is an albuminised food suitable for emergency feeding of infants and for adults with disordered stomach or bowels.

Fluid Meat Preparations.—*Beef juice* contains serum, lymph, and blood. It is prepared as follows: A tender, thick, juicy beefsteak is broiled for several minutes over a quick fire so as to coagulate the outside and retain the juice well within. It is then cut into small pieces an inch or two in diameter and squeezed in a common lemon squeezer or, better, in a meat press, which is sold in hardware shops for this special purpose. The juice is salted, and for adults a little pepper may be added. It is best served warm, but if preferred it may be eaten frozen. This preparation is quite nutritious, although less so than scraped beef.

When beef is chopped and squeezed under great pressure, juice is obtained from it in the proportion of two hundred and thirty grammes per one thousand of meat, but only about 6 per cent is albumin (Bauer).

Fresh beef juice is serviceable for feeding in many cases of severe gastric disturbance with vomiting and pain; also in typhoid fever, and for feeding infants at the end of the first and in the second year. From one to three tablespoonfuls may be given at once, and it forms a good introduction for the stomach to solid food. It is usually much to be preferred to any of the foregoing extracts and other preparations. If desired, it may be pancreatinised like milk (see Pancreatinised Milk, p. 80).

Beef Tea.—The nutritive strength of beef tea has formed a subject for much discussion. The assertion is often made that it is a comparatively useless preparation, and it is said that a pint of it contains scarcely a quarter of an ounce of anything. Hassell estimates that fourteen pounds and a half of beef would be required to make enough tea to counterbalance the daily nitrogenous waste of one man. If rightly made, however, it may be nutritious, although the quantity of albuminous material which can be dissolved in it at any time is much less than that which exists in a similar volume of milk or in an egg. The preparation of beef tea should be conducted as follows: Tender lean raw beef is chopped into small pieces about a quarter of an inch in diameter and macerated in cold water for five or six hours. The water is to be added in the proportion of a pint to a pound of lean beef; ten drops of hydrochloric acid are then added, and the solution is gradually heated up to 160° F., but not more, for from fifteen to thirty minutes. This is best accomplished by placing the vessel in a larger outer vessel of boiling water. The water of the outer vessel communicates its heat to the inner one, but the contents of the latter does not boil because the evaporation from its surface prevents its temperature from rising to that of the outside water, which is nearer the fire. Various forms of water baths, which the French call "*bain marie*" or milk scalders, are sold which are conveniently adapted for the process of making beef tea.

The prolonged soaking of meat in cold water dissolves its mineral ingredients—chiefly chlorides and sulphates of potassium, and also extractives, principally creatin and creatinin and some lactid acid derived from the muscle fibres. There may also be a little albumin present, but the albumin of meat or muscle is very sparingly soluble in simple aqueous solutions, and hence it does not diffuse out readily into the water, but the addition of hydrochloric acid converts the insoluble myosin into an acid albumin called syntonin, which is soluble in water.

In making beef tea, more or less fat is apt to be derived from the meat which floats upon the surface and presents a very unappetising appearance. This should always be skimmed or strained, and if it collects on cooling, the operation can be repeated. A crust of bread dipped beneath the surface will remove the supernatant layer of fat. The materials which are present in beef tea prepared in this manner are not very nutritious, but they are mildly stimulating to the mucous membrane of the stomach and to the nervous system, and it is probable that they are for the most part absorbed directly from the gastric mucous membrane without passing beyond into the intestine.

It is always desirable to give special attention to the proper flavouring of food for fever patients. In cases where a fluid diet is necessitated for many days in succession, much depends upon the willingness of the patient to take the food offered him, and a dread of too frequently recurring intervals of feeding and the positive dislike which the monotonous taste of certain meat preparations begets, react unfavourably upon the digestion. It is advisable to consult the individual taste of patients in this regard, and when they positively assert that they cannot take beef tea or bouillon or meat extracts in any form, their opposition may often be overcome by adding the expressed juice of some fresh vegetables of which they are fond. Carrots, turnips, celery, parsnips, and endives may be boiled alone or with an aromatic herb, such as parsley or green mint, and afterwards chopped fine and their juice expressed by squeezing them in a muslin bag. Such juices added to beef tea and broth impart an altogether different flavour, which may be varied from time to time by changing the vegetables (Yeo).

The total quantity of albuminous material which can be obtained in the manner above described in a reasonable bulk of fluid is very little, but in febrile conditions it is usually good for the patient to ingest abundant water, and there is no objection to part of the fluid being taken in the form of beef tea. On the other hand, if patients have absolute anorexia they are soon wearied by the effort of swallowing, and it is preferable to give nitrogenous food in some more concentrated form.

In fever, albuminous and gelatinous solutions aid in maintaining strength and diminish the tendency to exhaustion, and for this purpose the chief value of beef tea and beef essences is found to exist, rather than for furnishing additional substance to the tissues.

The objections to the use of beef tea are that its preparation requires time and care, and the taste soon becomes monotonous. It may be advantageously given, however, with vegetable extracts or beaten eggs, or gelatin may be put in to stiffen the mass into a jelly, which, when properly seasoned, is palatable. It may also be thickened with broken crackers, and with the addition of a little butter, pepper, and salt, it becomes much more nutritious; or sago, arrowroot, or chocolate may be mixed with it.

For infants the tea may be made weaker than for adults by using half a pound of lean rump steak to the pint of water.

Bouillon, or the French *pot au feu*, is of little more value as an aliment or heat producer than beef tea or extractum carnis. It is a good vehicle for giving beaten or dropped eggs, flour, etc. It stimulates the nerves, but in a much less degree than alcohol. It has the advantage over the latter and over condiments that it is never poisonous. A good meat *purée* may be made by adding a tablespoonful of scraped beef to three or four tablespoonfuls of bouillon, warming over a brisk fire until the meat turns of a faint drab colour, and seasoning with pepper and salt or a little butter.

Beef broth is agreeable to invalids, but on the whole it is less nutritive than that made from chicken, veal, or mutton. As ordinarily made, it contains, besides salts and extractives, ½ per cent each of fat and albumin and 1 per cent of gelatin.

Liebig's extract of meat, or extractum carnis, consists of the flavouring extractive matters such as kreatin, isolin, decomposable hæmatin, and salts. Some of these substances are excrementitious, and on this account Masterman compares it to urine, although it contains less urea.

A pound of mutton is represented by two fifths of an ounce of the extract. It contains no albumin or fibrin, and has in all but 2 per cent of solids, hence its nutritive power is practically *nil*, but when regarded as a stimulant and so used, it removes fatigue, strengthens the action of the heart and nervous system, and improves the functional activity of the stomach, and in this manner aids the digestion of foods. There is no occasion for taking it in large quantities, and when this has been done, symptoms of slight ptomaine poisoning have been observed, such as heaviness and stupor (Yeo). The extract has the advantage of keeping for years without decomposition, and it has been found that sometimes in cases of shock, especially after wounds received on the battlefield, its stimulant action has been considered almost equal to that of alcohol, and, bulk for bulk, it is certainly greater.

Johnson's fluid beef is a digestible preparation, somewhat less disagreeable in taste than many extracts of meat.

Valentine's meat juice is a much-used preparation which resembles Liebig's somewhat in its properties.

Valentine's meat juice is a clear fluid of a deep claret-colour, having a meaty odour and strong meaty taste. It is prescribed in doses of one half to two teaspoonfuls, diluted in eight times its bulk of cold water, or it may be mixed with cracked ice. Its taste, which is disagreeable to many patients, is easily disguised by the addition of half a tumblerful of milk, or it may be mixed with light, farinaceous gruels (after they have cooled to 130° F.), or used to re-enforce soups and broths or cod-liver oil. Like Liebig's extract, it may be given by the rectum. An ounce of this preparation is said to represent the concentrated pure juice of two pounds of the best lean beef or the condensed essence of three fourths of a pint of natural expressed beef juice. Among other ingredients it contains hæmoglobin and some albumin. It keeps well in all climates when tightly corked. It should not be diluted with hot water, strong liquors, or acid medicines, as these substances alter it and lessen its value. It may be given in champagne and in tea which is not too hot.

Bovinine is the concentrated expressed juice of raw lean beef obtained without use of heat or acid. It is claimed that each ounce represents nearly one pound of beef, that it contains 26 per cent of coagulable albumin, and that it keeps well without decomposition owing to the addition of glycerin and alcohol. It is said to contain egg albumin also. It may be given *per os* in doses of a teaspoonful or more, or in ounce doses with pancreatin for rectal injection. Not being predigested, it may be pancreatinised like milk just before its administration in cases where it is desirable to give absolute rest to an irritable or ulcerated stomach.

Bovinine has been used topically for injection around indolent ulcers with the idea of improving local nutrition, but it is doubtful whether this procedure is of any value.

Beef Peptones.—There are innumerable fluid preparations of peptonised beef which are recommended for invalid consumption; but, as a rule, they are not so good as those which are freshly made by the addition of pancreatin powder, although their use saves time and trouble. They may be sometimes employed to tide over an emergency after a severe operation or collapse from hæmorrhage, uncontrollable emesis, etc. The use of peptones for invalid foods is open to the objection that after a short time they excite disgust, and may cause vomiting and diarrhœa. The more complete the conversion of albumin into peptone the more bitter it becomes.

Voit, Politzer, Gerlach, and others maintain that true peptone possesses little if any nutritive power, and that the albumoses can be directly absorbed from the alimentary canal without further fermentation into peptones.

Of the numerous commercial preparations sold under the general names of peptones, peptonoids, predigested meat extracts, etc., those have proved the most nutritious which, in reality, contain the least peptone, and the most albumose.

Bread and beef peptone, or panopeptone, is a preparation in which wheat starch and beef are both predigested and preserved in sound sherry. It may be taken cold in doses of one to four teaspoonfuls iced, or with carbonic-acid water, or wines, but it should not be mixed with milk or other foods. Beef peptonoids are also mixed with predigested milk and gluten.

Summary.—Most of these preparations are given in doses of one or two tablespoonfuls once in four hours. Usually they are tired of soon, and do not support life long, for, beyond the means employed of condensation of food by evaporation of water and compression, it is not possible to " concentrate " nourishment very much. Making food assimilable and more useful is another matter from concentrating it in the sense that it can be made to support an able-bodied man and supply him with energy for a day's work, for example, of mountain climbing.

Neither does such predigested aliment represent concentration for an invalid; the bulk of food given is certainly reduced, and its assimilation may be improved, but it does not convey into the body any phenomenal quantity of latent force units or of heat units. It is important to understand this fact; otherwise serious misconceptions arise as to the actual amount of nutrition which a patient fed exclusively on peptonoids and similar food preparations is receiving.

The following analyses illustrate the comparative composition of some of the preceding preparations as given by Chester:

Composition of Meat Extracts

(Albert H. Chester.)

	Water.	Organic matter.	Ash.	Soluble albumin.	Alcoholic extract.
Liebig's extract	18.27	58.48	23.25	0.05	44.11
Benger's extract of beef	40.65	39.85	19.50	1.11	13.18
Starr's extract of beef	37.00	55.65	7.35	1.10	10.13
Johnston's fluid beef	41.20	50.40	8.40	1.17	15.93
Valentine's meat juice	54.40	31.84	13.75	0.44	26.32

Various Meats

Beef tongue is a tender form of meat, but it contains rather too much fat to agree well with delicate stomachs.

Veal.—Veal, especially when obtained from animals killed too young, is usually tough, pale, dry, and indigestible; but when the animals are slaughtered at the right age the meat is sometimes tender, and is regarded by many as nutritious. It differs considerably from beef in flavour, and contains more gelatin. Veal broth is nutritious, and affords a wholesome variety in the dietary for the sick. When too much is given it may excite diarrhœa. Veal is much more used for invalids in Germany than elsewhere, although it figures less conspicuously in hospital dietaries there now than formerly. Bauer declares it to be more digestible than beef, but Pavy says, referring to both veal and lamb, "they are meats that it is desirable to avoid, generally speaking, in case of dyspepsia," and this opinion is prevalent in America as well as in England. Veal contains more water and less fat and protein than ox flesh.

Mutton.—Mutton is rated as more digestible than beef by English writers upon dietetics. That can hardly be said to be the case in this country, where the quality of beef has been so much improved of late years, and where average mutton is not so tender as in England. For example, Balfour writes in his work upon the Senile Heart (1894): "We also recommend meat with short fibre, such as chicken, rabbit, game, mutton, or well-grown lamb, in preference to such meats as beef, whose fibres are long and tough." Fat mutton is richer in fat than beef, and is certainly less digestible than lean beef.

Undoubtedly tough mutton is quite as difficult of digestion as tough beef, and it is harder to obtain it tender. Mutton fat contains a larger percentage of stearic acid, which makes it firmer and less digestible than beef fat. Fat mutton is more likely to disagree with those whose digestion is enfeebled. When properly assimilated after digestion, mutton possesses equal nutrient value with beef.

Mutton should not be eaten until the sheep is at least three years old, and the best English mutton is obtained from animals which are six years of age. Mutton broth is wholesome and suitable for the sick. It may be given in typhoid and other fevers. It is somewhat constipating.

Lamb.—Lamb, when very tender and of just the right age, is quite as digestible as beef or mutton, but the flesh contains too large a proportion of fat—more than is present in veal. Good lamb is expensive, and, on account of the uncertainty of the character of the meat, it is not usually to be recommended for invalids.

Venison.—Venison is a tender meat with short fibres, which is very digestible when obtained from young deer, but it is regarded as somewhat stimulating to the stomach, and it is often eaten when aged to a degree which, while some think it improves the flavour, unfits it for dyspeptics. The meat corresponds very closely in chemical composition to lean beef.

Pork is a tender-fibred meat, but it is notoriously indigestible on account of the high percentage of fat present, which may exceed 37 per cent, or considerably more than the quantity of its nitrogenous material. Pork ribs may have as much as 42 per cent of fat. The fat is composed chiefly of palmitic and oleic glycerides.

Ham and Bacon.—Bacon is much more digestible than pork, and ham occupies an intermediate position. "On an average, 100 grammes of ham give 30 of albuminates and 32 of fat; the salt ranges between 7 and 10 per cent" (Bauer).

In Germany, and especially at Carlsbad and other mineral springs, ham is much prescribed in invalid dietaries. It is often given scraped or "rasped." Bauer says (Dietary of the Sick, p. 91): "The flesh of the hog seems to be better adapted for smoking than that of other animals, and long experience compels us to recognise smoked ham as one of the wholesomest forms of meat. Whether boiled or eaten raw, it seems, as a rule, to be more easily digested by weak organs than almost any other." An opposite view is prevalent in England and America, where it is less used for the sick. So distinguished a dietitian as Pavy omits mention of it in his book upon Food and Dietetics. Ham is much more digestible when thoroughly boiled, cut thin, and eaten cold. It should not be fried for invalids. Hot ham fat is very indigestible.

If cut thin and cooked crisp, fat bacon is friable and easily broken into small particles during digestion. It can often be eaten by dyspeptics, and forms an excellent variety of fatty food for consumptives. According to Letheby, prime bacon should not lose over one tenth of its weight by boiling, and ham should lose less. It furnishes ample body heat, and is a valuable ingredient of the army emergency ration. In the ordinary ration of armies or institutions it proves less monotonous than corned beef or boiled beef. Besides its food value, its presence in the ration makes it possible to use various foods which could not otherwise be as easily cooked. When our troops in the Philippines were deprived of bacon in their ration, it was found that they were spending their wages to buy lard for frying.

Horseflesh is a nutritious meat for those who are not fastidious. It is consumed in large quantities by the poor in France (where over 5,000 tons are eaten annually in Paris alone), and to some extent in Denmark, Sweden, Germany, and Austria. It has never found favour in England or the United States, and most of the horseflesh butchered in this country is canned for consumption by foreigners. It contains neurin, and its excessive use may cause diarrhœa.

Rabbit has white meat, and Belgian hare meat is partially white, but they are not proper invalid foods.

Fowl.—*Chicken* is among the most digestible of meats for invalids, whether cooked by broiling, roasting, or boiling. The white meat is more easily digested than the dark, although it differs but slightly in chemical composition. Dark meat of fowl contains more pigment, extractives and a little more nitrogenous material than white meat. The breast of chicken may be given to a typhoid convalescent or a patient recovering from any severe illness before beef and mutton are allowed. Chicken broth is almost universally liked, and when thickened with rice, and sometimes with an egg, it forms a highly desirable invalid food.

"Broilers" contain about 20.7 per cent of proteid and 7 to 8 per cent of fat. In young chickens the dark meat contains only one per cent less proteid than the white meat and one per cent more fat.

Capon, or the emasculated cock, develops a larger proportion of white meat than the chicken, and is very digestible.

Turkey is sometimes as digestible as chicken, as to the white meat, but it is often tough, and the dark meat is much less digestible. Guineafowl and peafowl are very digestible and wholesome when young or caponised. These birds are somewhat richer in proteid than chicken, but poorer in fat.

Young pigeons are quite digestible, and the breast of a squab may be given to a convalescent from fever before other meat is allowed.

Tame ducks and *geese* are indigestible unless quite young and tender, on account of containing too much fat. Goose meat may sometimes hold over 40 per cent of fat, with which it is thoroughly infiltrated, and ducklings 38 per cent of fat, as against 14 per cent of proteid.

Game, such as the flesh of partridge, grouse, woodcock, snipe, quail, pheasants, wild ducks, prairie chicken, etc., is by many persons preferred when it is "high"—that is, when it has been kept long enough for putrefactive changes to occur. These may originate in the meat itself or in the viscera which have not been removed and from which the odour and flavour of commencing putrefaction are derived and penetrate the meat. When the meat itself is not perfectly fresh it may produce violent gastro-intestinal disorder, but many persons with good digestive organs are not disturbed by the consumption of such food in moderation, provided it is well cooked. The process of cooking disinfects it by heat. The fat of old birds is too strongly flavoured, and their meat is tough. Young birds are digestible if properly cooked.

The white meat of game and fowl is popularly supposed to contain less proteid, and therefore be less "heavy" as an article of diet than red meat, such as steak or roast beef. The chemical differences are, however, very slight. Chicken contains between 3 and 4 per cent more proteid than sirloin steak and about half as much fat. Red meat contains more pigment, but somewhat less of kreatin and other extractives than the white meat of chicken. The fibre of the latter is somewhat more tender, as a rule, and hence slightly more digestible than that of beef or mutton, although the proteid content is somewhat greater. As the white meat of chicken and game is relatively expensive, patients are less likely to eat too much of it, as they may do with beef. Helen W. Atwater says:

"As far as the nutritive value alone is concerned, the general advantage of poultry over the other meats thus appears to be that, pound for pound, it contains very slightly more of the building materials needed by the body; its disadvantage is that it furnishes less of the energy-giving material than the fatter meats.

"As regards poultry of different sorts, in general the light-fleshed birds are richer in protein and poorer in fat than the others."

The clinical significance of these observations is very important, for in cases of chronic nephritis, gout, rheumatism, lithæmia and allied conditions, patients are often told that they must abstain from mutton, beef and other red meats, but are allowed to eat the white meat of chicken, turkey, etc. In reality, however, there is but little advantage in this from the standpoint of the quantity of proteid material introduced into the system and of resultant proteid waste. The question is, therefore, almost entirely one of relative digestibility, of physical rather than chemical properties, a fact which should be more widely appreciated.

Other forms of meats derived from the larger animals, such as the wild boar, wild sheep and goats, etc., are too numerous for detailed mention here, as they are rarely made use of except by hunters, explorers, or natives of wild countries. It is a peculiarity of game in general that it usually cannot be eaten continuously as long as beef without palling very much sooner upon the appetite.

Animal Viscera.—Animal viscera are eaten to some extent in this country, and some of them are digestible, although none are as nutritious as good meat, and they contain but little nitrogen. With the exception of sweetbread, and in some cases the thyroid gland, they should not be given to the sick.

Sweetbread is most useful in the invalid dietary. It consists of the pancreas of the calf, called by butchers "stomach sweetbread" to distinguish it from the thymus gland of the same animal, called also the "neck" or "throat sweetbread." Either gland is tender and digestible, the thymus somewhat more so than the pancreas, which has larger, more "stringy" blood vessels.

The thyroid gland has been lately shown to possess remarkable power in regulating disordered nutrition in cases of myxœdema, chronic skin diseases, etc. It is usually given as a powdered extract in five-grain doses, but it is sometimes cooked fresh and eaten as a food.

Tripe, made from the third stomach of the cow, when tender and well cooked, is easy to digest, although somewhat too fat. It contains about 16 per cent of fat and 13 per cent of albuminoids—rather more than most viscera.

The heart is sometimes eaten, but the meat is tough and undesirable.

Liver and *kidneys* are eaten more than any other viscera. If cooked too long they become very hard and tough. Calf's liver is always better flavoured and more tender if the animal has had fresh milk for food and not boiled skimmed milk and slops. Tender liver is more easily digested than kidney, and is fairly nutritious. It should not be allowed diabetics. These foods are often fried or stewed in rich sauces or "devilled," all of which are indigestible modes of cooking.

Brains are fairly digestible, but not nutritious; they contain too much fat and cholesterin for invalids.

Blood has sometimes been used as a fluid food. At one time there was a fashion among consumptives of going to the abattoirs to drink it warm, in the belief that it had some specific curative value for tuberculosis. This, however, is not the case, and it nauseates most persons to taste it, if not to look at it.

Isinglass—Gelatin

Isinglass is derived from the membrane of the swimming bladder of the sturgeon, but that of other fishes is occasionally used. It is not very soluble in the crude state, but is hygroscopic and swells very much in cold water. It dissolves in boiling water, and when the water is evaporated again hardens.

Gelatin.—Gelatin is a substance the potential energy of which is calculated as being even more than that of some fats and albuminates, yet in the body it is very inferior in the production of force. It is obtained from bones, ligaments, and other connective tissues.

It is a curious and interesting property of gelatin that used alone it fails to have much nutritive power, but in proper combination with other foods it is a useful aliment. "By the addition of gelatin very large quantities of albumin can be spared in the body or devoted to increase of bulk, just as by the supply of fats and carbohydrates" (Bauer).

Gelatin itself takes no part in repair and growth of tissues—it must be regarded solely as an "albumin-sparer." It cannot, therefore, replace albumin, the loss of which still goes on to some extent even when gelatin is eaten in large quantity. It also slightly spares the consumption of non-nitrogenous materials. This is a question of considerable importance in the feeding of invalids, because, while many jellies are easily digested and are agreeable to the palate, it is useless to burden the stomach with them if they do not possess nutritive properties in proportion to other foods, and the matter must therefore be discussed somewhat in detail. The " Bone Soup Commission " of the French Academy of Sciences was constituted to determine the nutritive value of prolonged boiling of bones in order to obtain, if possible, an inexpensive form of aliment for hospital patients. The commission made elaborate researches, the result of which showed that animals which were fed exclusively upon gelatin rapidly deteriorated in strength and weight, and finally succumbed to starvation. Subsequent experiments upon gelatin have been conducted by many physiologists with these conclusions: 1. Gelatin is innocuous, and its exclusive use will not support life. 2. Mixed with other foods, it promotes nutrition and is easily digested and absorbed. 3. To some extent it saves waste of albuminous tissues.

Since bones consist of nearly two thirds of their weight of gelatin, the latter may be advantageously used as an inexpensive means for furnishing variety in the diet by addition to meat broths and jellies, pea and bean soups, etc. M. Edwards says that the proper proportion for such mixtures should be at least one fourth of meat soup to three fourths of gelatin soup. The bones themselves may be broken and made to yield fat and gelatin for soup " stock." The amount of nourishment which they afford is extremely little, and they are mainly of service for economic reasons to save waste.

Edible birds' nests are not true gelatin, but a Chinese food product allied to mucin.

Gelatinous substance may be obtained from boiling for several consecutive hours such material as calves' feet, sheep's trotters, ox tails, etc., and after clarifying, straining, and concentrating, very palatable jellies may be made, to which chicken or mutton is added for invalid use.

Calf's-foot jelly and calf's-head jelly, if not made too rich by added ingredients, make suitable invalid dishes, especially when flavoured with sherry or Rhine wine. Ox-tail soup is too rich for the sick.

Pure white gelatin is insipid, and is almost impossible to eat in considerable quantity unless it is well seasoned. If free from all gluey taste and odour, and prepared with coffee or lemon juice, or other fruit flavours, it makes an easily digested invalid food. Or it may be combined with eggs or milk as blancmange, or with soup. The addition of meat extracts to it improves the taste, and the admixture of wine, like good sherry, alters the taste rather by the introduction of its aromatic principles than by the alcohol itself, which is largely evaporated from the jelly.

"Well-prepared jellies, not containing too much acid or pungent spices, are very useful foods for invalids, and may be administered with advantage in febrile states" (Bauer).

Dry gelatin contains 17.3 per cent of nitrogen, which is even a larger proportion than is contained in albumin; consequently urea excretion is decidedly increased by gelatin feeding. Diuresis is also produced, and the desire for liquid is intensified, so that a large proportion of gelatin in the diet causes decided physiological effects.

Fish

Fish vary both in digestibility and nutritive qualities. The chief differences are in regard to coarseness of fibre and the quantity of fat present. Fish meat is less stimulating, sustaining, and satisfying than that of birds or mammals.

Eels contain the largest proportion of fat, which amounts to 28 per cent. Herring have 7, salmon about 6.5, while sole has but 0.25 per cent (König). Mackerel, trout, and shad have considerable fat.

Fish which, like the salmon, are rich in flavour and in fat, while they may be very nutritious, are much less easy of digestion than are the simpler varieties, such as sole or flounders and codfish. Dried codfish can be eaten on long sea voyages day after day without the repulsion which is soon excited by the continuous diet of the more highly flavoured fatty fish.

The flesh of many fish contains a large percentage of water, besides gelatin.

The following fish, in the order named by Walker, have the largest percentage of albuminoids: Red snapper, whitefish, brook trout, salmon, bluefish, shad, eels, mackerel, halibut, haddock, lake trout, striped bass, cod, flounder.

All fish are best in their proper season, for out of season they deteriorate from change in food or other causes, and are less nutritious, besides possessing inferior flavour, and sometimes disagreeable odour. They should be eaten as fresh as possible, for there are few alimentary substances capable of exciting so violent gastro-intestinal disturbance as decomposing fish. The practice of preserving fish frozen or packed in ice is open to the objection that the cold prevents malodours from revealing commencing putrefaction. Vivid red gills and fulness and brightness of the eye are a good test of freshness.

It is a popular fallacy that fish constitute a good "brain food" on account of their containing a large percentage of phosphorus, a prominent ingredient of nerve tissue; but in reality many fish contain less of this element than meat, and neither Eskimos nor other aboriginal tribes who live largely upon fish are noted for intellectuality.

Some fish contain different species of tapeworm, but they are seldom if ever transmitted to man.

Fish having white meat constitute an excellent food for invalid diet, and when cooked by boiling or broiling (not frying) they may be given to convalescents and to those with feeble gastric powers.

The most digestible fish are fresh sole, whiting, bluefish, white-fish, bass, red snapper, fresh codfish, halibut, shad, and smelt. Pavy says: "Of all fish, the whiting may be regarded as the most delicate, tender, easy of digestion, and least likely to disagree with a weak stomach. The haddock is somewhat closely allied, but has a firmer texture and is inferior in flavour and digestibility."

Crimping is a process sometimes applied to fresh fish, like the cod, by which the firmness of the flesh, as well as its flavour, is increased. As soon as caught, the fish is incised transversely by numerous deep cuts. On being plunged into ice-cold water, the muscle fibres contract firmly and so remain.

As a rule, dried, smoked, or pickled fish should not be given to invalids, although thoroughly boned and desiccated or "shredded" codfish is quite tender. The latter process is now conducted by machinery, and thus prepared the fish requires less prolonged soaking and cooking.

Fish roe is not very nutritious, and it serves mainly as a relish. Shad roe, thoroughly cooked, is not objectionable, but sturgeon's roe or caviare, which is sometimes used as an "appetiser," is capable of arresting digestion, especially when old, black, or rancid. Caviare contains, according to analyses by König and Brimmer, water, 45.05; proteids, 31.90; fat, 14.14; salts, 8.91 per cent.

It must not be forgotten that some persons cannot digest fish of any kind, or at most can take but one or two varieties without provoking an attack of dyspepsia or biliousness. A few tropical fish are poisonous, and constitute an exception to the general edibility of vertebrate animals. (See Fish Poisoning.)

There are no diseases in which a fish diet possesses specific value, but often in chronic Bright's disease, lithæmia, gout, or other conditions in which it is undesirable to give much meat, it is very serviceable as a compromise.

Crustaceans

Lobsters, crabs, and shrimps, although they constitute a wholesome food, when absolutely fresh, for those in health, should never be admitted to an invalid dietary. They are all scavengers of the sea, and crabs not thoroughly cleaned or imperfectly cooked may be poisonous from contamination with putrid matter, although their own flesh is good. Soft-shell crabs are by no means always "soft" when eaten, and their shells furnish a large bulk of indigestible residue, which may prove irritating. I recall one fatal case of appendicitis caused by them.

Lobsters are highly poisonous to some persons even when fresh, and especially if eaten with other food they may excite nausea, vomiting, and even gastro-enteritis. In others they may cause urticaria or aggravate existing skin eruptions.

Persons who live at a distance from the seashore are apt, in making occasional visits to seaside resorts, to gratify a fondness for crustaceans, fish, and shellfish food by an excessive indulgence in "shore dinners," which result disastrously with stomachs unaccustomed to such diet; but the evil effects are fortunately temporary.

SHELLFISH

Oysters, clams, and mussels are very nutritious food, and the former at least, when fresh and when eaten raw or properly cooked, are an excellent invalid aliment. Oysters can often be digested earlier than meat in convalescence from fevers, and in many forms of gastric disorder.

The "soft part" of shellfish is formed chiefly by the bulkier liver, while the tough, harder portion is mainly the muscle which attaches the animal to its shell. This muscle is coagulated and rendered tougher by all forms of cooking; hence raw oysters are more tender and digestible than if stewed or broiled. In oysters the liver is relatively larger and more nutritious than in clams. In recommending oysters to invalids it is always best to allow only the soft parts to be eaten, and when this rule is observed they may be cooked in a variety of ways—by stewing, broiling, roasting, or "panning," and steaming—but they should never be fried for the sick.

Both oysters and clams have the advantage that they are very generally liked, and they make a pleasant variety of food to relieve restricted diets. They impart an agreeable flavour to milk and broths. It is customary to forbid their use by diabetics, on the ground that their livers contain glycogen. Clam juice or plain clam broth is almost specific for some forms of vomiting, especially seasickness. It may be tried in the vomiting of pregnancy, and may be retained when beef juice and milk are not. It is mildly stimulating to the gastric mucous membrane, and slightly nutritious and laxative. It is best obtained fresh, but very good canned or bottled preparations of it are made which keep pure indefinitely. It may be taken either hot or cold with a little Cayenne pepper half an hour before a meal. It seems to have an invigorating effect upon the stomach, and promotes the appetite.

Mussels are less commonly eaten in this country than in England and some parts of Europe. They belong in the same category with oysters and clams, and the remarks just made in regard to the latter apply to them as well. There is a form of poisoning by mussels which is exceedingly dangerous and sometimes fatal. (See Poisoning by Shellfish.)

In some persons shellfish, like crustaceans, produce skin eruptions, such as urticaria, or aggravate existing eczema.

IV. VEGETABLE FOODS

Sugars

Sugars are crystallisable carbohydrates in which oxygen and hydrogen exist in proportion to form water. There are many varieties, of which the commoner contained in food or used as an adjunct to diet are cane sugar, saccharose or sucrose, grape sugar, dextrose or glucose, levulose or fruit sugar, and sugar of milk or lactose. Inosite, mannite, dextrin, sugar of malt or maltose, honey, a sweet nitrogenous substance called saccharin, and fruit sugar or levulose (diabetin) are also used. Sugar may be derived from the stems of plants, as in the case of the sugar cane, or the palm, from tubers like the beet, from maple-tree sap, and from other vegetable growths.

The sugars present slight differences in their physical properties, such as specific gravity, solubility, and effect upon polarised light. They also differ in sweetness of taste and in digestibility.

As foods, sugars have essentially the same uses as starches (see Farinaceous Foods, p. 137), for all starch must be converted into dextrin or sugar before it can be assimilated. For this very reason, sugars, although they form an excellent class of food, producing force and heat and fattening the body, are not absolutely necessary for the maintenance of health if starches or fats are eaten. Recent experiments in the German, British, and other armies show that a liberal allowance of sugars in the diet tends, during manœuvres, to maintain strength, lessen hunger and thirst, and lessen the liability to heat exhaustion.

They possess additional properties, in that they have a more agreeable flavour than starches, are more satisfying to the palate, and they have antiseptic and preservative power. Hence sugars and sirups are extensively employed to preserve fruits either in solution or in dried form, like " candied " cherries, ginger, etc.

When taken for food, sugar is quickly soluble, and on this account taxes the digestive organs but little. Cane sugar, however, needs to be converted into grape sugar before it can be absorbed and assimilated, and grape sugar, which needs no change, is therefore sometimes spoken of as a predigested carbohydrate.

Between seven and eight million tons of sugar are consumed each year in the world at large. The English-speaking nations are the largest consumers. In 1895 the per capita consumption in England was 86 pounds as against 30 pounds in Germany, France, and Holland, and 7 pounds in Italy, Greece, and Turkey (Mary Hinman Abel). Cane sugar was originally used exclusively in preparation of medicines, not as a food.

Many persons acquire an inordinate fondness for sugar, and continued overindulgence in this food is very sure to give rise to flatulent dyspepsia, constipation, and disorders of assimilation and nutrition. It may even cause functional glycosuria. (See Diabetes.)

Sugar is very fattening. In the West Indies the negroes always grow fat in the sugar season, when they chew the cane in the fields.

Sugars are emphatically force producers. Chauveau and Kaufmann have demonstrated that during muscular activity the consumption of sugar in the body is increased fourfold. If one pound of sugar were burned so as to utilise all the heat, it would raise five gallons of water from the freezing to the boiling point (A. C. True).

Harley found experimentally that the muscle-energy producing effect of sugar is so great that two hundred grammes (seven ounces) added to a small meal increased the total amount of work done from 6 to 30 per cent, and that when sugar was added to a large meal it increased this total from 8 to 16 per cent.

Sugars and the Urine.—Grape sugar and fruit sugar or levulose, when eaten in large quantity in health, reappear unaltered in the urine, but the latter sugar in diabetes is said by Moritz to be consumed within the body. Sugar eaten in excess with other food increases the quantity of urine and feces and the urea elimination (W. G. Morgan).

Saccharose, eaten in excess, may reappear in the urine unaltered, or more commonly as glucose.

Lactose is converted into glucose, and it produces functional glycosuria more easily than the latter if eaten in bulk.

Alimentary glycosuria usually ceases in a few hours after discontinuance of eating the food which has caused it.

There are some diseases in which sugar in all forms should be strictly avoided, such as flatulent dyspepsia, acute and chronic gastritis, gastric dilatation, gout, rheumatism, obesity, and the uric-acid diathesis, and it should be absolutely forbidden in diabetes. Temporary disturbances of digestion from eating too much sweet food are very common, and can usually be rectified by simple remedies, and by withholding or diminishing the customary allowance of sugar. Sugar eaten constantly in excess spoils the teeth and destroys the appetite for other food. It lessens the hydrochloric acid of the gastric juice in cases of hyperchlorhydria, and is said to dissolve mucus.

Cane Sugar.—Cane sugar, saccharose, or sucrose, as used in the United States, is usually derived from the clarified and crystallised juices of the sugar cane (*saccharum officinarum*), but it is also made from beet root, as originally discovered by Marggraf, of Berlin, in 1747. The latter form is somewhat less sweet than are the better grades of cane sugar. The root contains 12 to 15 per cent of sugar. One third the world's commercial sugar is derived from sugar cane, and two thirds from beets. The annual per capita consumption of sugar in the United States is 66 pounds. About one quarter of a pound per diem may be eaten without harm. Much more than this in a short time is liable to disorder digestion, just as do the equally diffusible peptones eaten in excess.

Mary Hinman Abel, in an exhaustive study of the food value of sugar, says:

"There is no proof that sugar is harmful to the teeth, although doubtless sweet food, allowed to cling to the teeth after eating, rapidly ferments, and acids will be formed that, according to Professor Miller, of Berlin, may attack the teeth. This is equally true of starchy foods. It is said, however, that the negroes of the West Indies, who consume enormous quantities of sugar, have the finest teeth in the world. It is also unproved that sugar produces gout."

Sugar is better digested in proportion to the amount of exercise taken.

The maple tree yields from 2 to 10 per cent of sucrose. Maple sugar is eaten chiefly as a luxury, on account of its unique and agreeable flavour. It also makes an excellent sirup which is in great demand. About 7,500,000 pounds of maple sugar are made annually in the United States. Cane sugar can be obtained from the sugar pea, from the flower buds of the coca palm, and from other substances. It is soluble in half its weight of cold water and in less hot water.

The sap which is drawn from the sugar cane as well as the juice of compressed beet root is not a pure aqueous solution of sugar, but is mingled with other materials, chiefly of a mucilaginous character. An elaborate process of refining is applied in order to produce the commercial white sugars of various grades. The principal steps in this process are as follows: "1, Melting of the sugar; 2, straining through bag filters; 3, filtering through charcoal; 4, boiling or evaporating the decolourised liquid in vacuum pans; 5, separation of crystallised sugar by centrifugals" (Clark). The process is so cheap that cane sugar is practically never adulterated.

Cane sugar was formerly sold more extensively than at present in the form of coarse brown sugar. This variety is somewhat impure, and on this account has a slightly laxative action; but the great improvements made of late years in the processes of refining

STARCH GRANULES, MAGNIFIED.

(*From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau*).

DRAWN BY GEO. MARX.

sugar, and the extreme cheapness of this commodity, place the clarified forms of it within the reach of all, and even reduce to a minimum the temptation for sophistication which was originally much more extensively practised, especially in the adulteration of confectionery, with chalk, plaster of Paris, etc.

The most highly refined cane sugars contain about 0.25 per cent only of impurities and ash, but poorer grades hold 1 to 2.3 per cent, with as much water (König). Cane sugar is about two and a half times sweeter than glucose. Cane sugar is completely digested and absorbed, leaving no fecal residue.

"Grocer's itch" is a form of irritation of the skin of the hands sometimes acquired from contact with moist brown sugar, adulterated with dirt or sand and mites.

Caramel.—By the application of heat, at 400° F., refined cane sugar is melted, browned, and converted into a non-crystallisable fluid substance called caramel, having a slightly bitter but agreeable taste. Comparatively insipid farinaceous food, such as cornstarch and farina, may be flavoured with it for invalid diet. Burned flour may be used in the same manner, but its flavour is less agreeable. Caramel is also useful for flavouring milk, custards, etc.

At 320° F. sugar melts to an amber fluid, which, on cooling, is brittle and transparent. In this form it is called "barley sugar," and is much used in confectionery.

When sugar is cooked with acid fruits it is partly converted by the heat and acid to less sweet substances, hence to sweeten cooked fruits the sugar should be added when the cooking is completed.

Sugar differs from starch by containing another molecule of water. Starch, which forms fully three fourths by weight of the solid ingredients of wheat flour, is altered into sugar by heating with a little sulphuric acid, or even by prolonged heating alone or "torrification." The latter process converts it into dextrin, sometimes called "British gum," on account of its substitution in commerce for gum arabic. With prolonged heat there is a further change in the starch, which becomes of a brownish and finally black hue, passing through a stage analogous to the formation of caramel from sugar, and with extreme heat forming a residue of black carbon, all the water having been driven off. A hard, dried, thoroughly browned bread crust or toast is therefore similar to caramel, and every one is familiar with its gain in flavour.

Sugar candy is made by extremely slow crystallisation.

Sorghum is a variety of grass or cane from which sugar can be extracted, but in this country it is used more for the manufacture of molasses.

Candy and Confectionery.—Candy contains from 75 to 90 per cent of sugar, to which may be variously added butter or other fats, nuts, fruits, starch, glucose, flavouring extracts. Cheap varieties are coloured with aniline dyes, and are composed largely of glucose and starch. Children assimilate candy better than adults because they are less liable to dyspepsia, and because of their relatively active muscular energy and relatively large body surface for losing heat, in proportion to their size. They do not, as a rule, care for fat meat, and prefer sweets as a natural substitute.

An infant taking two quarts of milk per diem consumes nearly three ounces of sugar in the form of lactose. In later childhood the ability to digest starches replaces to some extent the need for sugar. It is, however, important that the taste for candy and sugar common to all children should not be permitted to interfere with a wholesome and natural appetite for other foods, especially fresh vegetables and fruits. The value of sweets in the adult dietary has of late years found recognition in armies. The British War Office shipped 1,500,000 pounds of jam to South Africa as a four months' supply for 116,000 troops, and one New York firm during the Spanish-American War shipped over fifty tons of confectionery to the troops in Cuba, Porto Rico, and the Philippines. The confectionery consisted of chocolate creams, cocoanut macaroons, lemon and other acid fruit drops.

Molasses, Treacle, and Sirup.—Molasses and treacle are products incidentally formed in the process of crystallising and purifying cane sugar. Treacle is the waste drained from moulds used in the refining process, and it contains, besides sugar, acids, extractives, salts, and more or less dirt. Like cane sugar, molasses constitutes a very desirable food, and is highly nutritious. Its use, both for cooking and to add to farinaceous food and enhance its flavour, is too well known to require description. Molasses, according to König, contains acetic and formic acids, which impart their reaction to it. It also contains cane sugar and 30 per cent each of invert sugar and of water.

Both treacle and molasses, owing to impurities, are more laxative than refined sirup, and the effect, as an aperient, of plain gingerbread made with good brown molasses is due to this property. For young children from six to ten years of age molasses sometimes operates very well in keeping the bowels open.

Plain molasses candy is a wholesome form in which to give sugar to growing children, if they are not allowed to eat too much and spoil their appetite for other foods. It is mildly laxative. Walker says that "good candy is good food." Candies are often made too rich with butter, chocolate, and other ingredients, when they disagree.

Molasses, like sirup, is a good preservative. It has been used to preserve potatoes in layers. An old-time custom among soldiers in the field is to fill a canteen with two parts vinegar and one part molasses as an emergency sustaining drink.

Glucose.—Grape sugar is present in almost all fruits, in the sweeter varieties of which it exists in large quantity. In peaches, pineapples, and strawberries it is found with cane sugar, and in grapes, cherries, and honey it occurs in connection with other varieties of sugars. In dried fruits, such as raisins or figs, glucose is present in a gummy form. It is commonly manufactured from starch.

Although prepared for immediate absorption from the stomach and intestine and assimilation, glucose is of little service for flavouring other articles of food, for when so used it is apt to produce flatulent dyspepsia with acid eructations. Moreover, it has less strength of sweetness than cane sugar, and, as it is more difficult to crystallise, it is much less convenient and desirable for general use.

Sucrose and maltose can only be absorbed by alteration into glucose. If glucose be eaten as a food, in form of candy or otherwise, it overloads the system by being too promptly absorbed. Malt extracts, sirups, and preserves adulterated with glucose easily ferment, for nothing ferments more promptly than such combinations with the bacteria present in the stomach.

Lactose.—Lactose, or sugar of milk, is taken as a food in some quantity with ordinary milk, and forms a very important ingredient of the diet of the growing infant, who is unable to digest much starch during the first year of life, and yet requires an easily assimilable form of carbohydrate. Cow's as compared with human milk is deficient in lactose, and the latter should therefore be added in proper proportion to the milk of bottle-fed infants. (See Milk Composition, p. 52.) It might be used for sweetening various articles of food, but it possesses no advantages over ordinary cane sugar, and is in fact more expensive and less sweet. It is mildly diuretic.

Mannite.—Mannite is obtained from the sweet juice of the stems of the ash tree. It is also contained in beet roots and some other vegetables. Like sucrose, it crystallises, and is white and free from odour. It does not ferment with yeast. It is laxative, and it may be used in diabetes, for it is not secreted in the urine as glucose.

Levulose.—Fruit sugar, or levulose, is now sold under the name of diabetin, in crystalline form, for use in diabetes, on the ground that it is not known to reappear in the urine. It can be taken freely and in considerable quantity without disordering digestion, as saccharin often does after continued use. Diabetin is sweeter than cane sugar, and has a somewhat fruity taste.

Honey.—Honey is a form of sugar prepared from the cane sugar of various flowering plants gathered by bees, which convert it by hydrolysis chiefly into dextrose. They then store it in cells. Thus it is really a vegetable product, although manufactured by an insect. In addition to sugar, it holds several other ingredients, principally wax, gum, pigment, and odorous materials. The sugar exists in two forms—crystallisable and non-crystallisable. The former is somewhat similar to glucose.

Honey contains, according to König: Water, 16.13; dextrose, 78.74; cane sugar, 2.69; nitrogenous matter, 1.29; ash, 0.12 per cent, besides traces of other ingredients.

Honey was more in demand for sweetening before the discovery of a method of making sugar from the sugar cane. It is a wholesome food, and is fattening when eaten with bread. In some countries—as, for example, in the Black Forest of Baden—the peasants consume it as a staple article of diet. Artificial honeycombs are now made from paraffin, stamped into cells to imitate the original, which enables the bees to devote more energy to the manufacture of honey and bestow less on the combs.

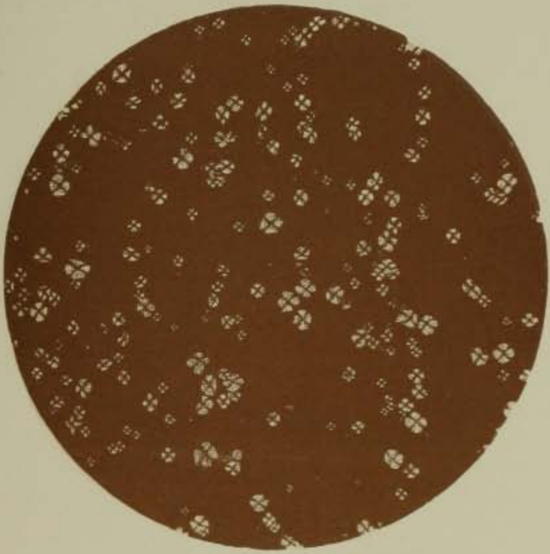
In a few instances, fortunately very rare, honey has proved poisonous owing to the bees having fed upon poisonous flowers. An epidemic of gelsemin poisoning occurred in Branchville, S. C., from this cause in which twenty persons were severely affected, three of them fatally.

Saccharin.—Saccharin is a crystallisable organic-acid substance, containing, in addition to the elements carbon, hydrogen, and oxygen, a little sulphur and nitrogen. It was introduced a few years ago as a substitute for sugar, and it is especially useful in cases of obesity, rheumatism, gout, and diabetes, when the withdrawal of sugar is followed by intense craving for it, or a refusal to eat those foods which are customarily flavoured with it. It is antiseptic, and has the property of acidifying the urine, being eliminated unaltered by the kidneys, hence it can be used medicinally in cases of pyelitis or cystitis. It may be given for months at a time without danger, if the quantity prescribed does not exceed more than one or two grains, three times a day. More than this dose may cause gastric derangement. It may be added to food in cooking, or a one-quarter grain tablet may be used to sweeten a cup of coffee.

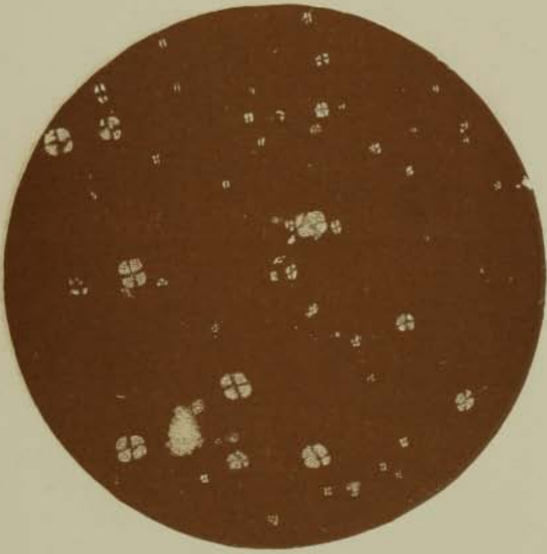
Cereals and other Starchy Foods

Starchy Foods in General.—The cereals in commonest use as food products are wheat, corn, rice, rye, barley, oats, buckwheat. From these are manufactured a variety of flours and meals.

About 30 per cent of all cereals produced in the world are grown in the United States, and at least one fourth of the total wheat production is from this country; on the other hand, 98 per cent of the rye and 75 per cent of the barley and oats are grown in Europe. The United States produces about 75 per cent of the corn of the



Maize Starch x 145



Wheat Starch x 145

(From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau).

PHOTO BY CLIFFORD RICHARDSON.

world. These estimates give a general idea of the relative use of these cereals, and illustrate the great preponderance of wheat bread and cornmeal and other preparations of corn eaten in the United States.

Besides the cereals and vegetables which, like the potato, are composed chiefly of starch, there is a large miscellaneous group of starchy foods used as flours, which are therefore conveniently considered with the cereals. Such are arrowroot, tapioca, cassava, sago, and peas. Peanuts, chestnuts, and plantains are also sometimes used to furnish flour.

Starch is the term applied to the fecula or granular material found in fruits, roots, and tubers and in the cellular tissue of plants. The structure and form of the starch granules vary, and those from different plants may be distinguished by microscopic examination.

Patients, as a rule, are ignorant as to the nature and limitations of "starchy foods," and their conception of them is based upon such foods as resemble powdered laundry starch in appearance, like arrowroot, cornstarch, etc. After being told to eat no starchy foods, they not infrequently will say they suppose that potatoes are not starchy. The expression at best is not an accurate one; for many starch-holding foods contain a large proportion of other ingredients, especially proteids, as will be seen from the following table furnished by Rübner:

	ONE HUNDRED PARTS OF DRY MEAL CONTAIN—	
	Albumin.	Starch.
Wheat	16.52	56 25
Rye	11.92	60.91
Barley	17.70	38.31
Maize	13.65	77.74
Rice	7.40	86.21
Buckwheat	6.8—10.5	65.05

Farinaceous foods are composed of flour of different kinds, and constitute a subdivision of starchy foods. The different starchy and farinaceous foods are derived from a variety of plant structures, including roots, tubers, bulbs, stems, pith, flowers, seeds, fleshy fruits, etc. Some, like the banana and certain vegetables, are eaten raw, but the majority require cooking, and the starches derived from grain-bearing plants of the grass tribe or cerealia usually must be prepared by grinding and milling before cooking. About one sixth of the protein of the various grain flours passes through the alimentary canal undigested.

The following table by Professor Atwater will be found useful in giving at a glance the average percentage of starch contained in the commonest vegetable foods:

Atwater's Table of the Percentage of Starch in Vegetable Foods

Wheat bread	55.5	Potatoes	21.3
Wheat flour	75.6	Sweet potatoes	21.1
Graham flour	71.8	Turnips	6.9
Rye flour	78.7	Carrots	10.1
Buckwheat flour	77.6	Cabbage	6.2
Beans	57.4	Melons	2.5
Oatmeal	68.1	Apples	14.3
Cornmeal	71.0	Pears	16.3
Rice	79.4	Bananas	23.3

In round numbers it may be stated that starch composes one fifth of potatoes, one half of peas, beans, wheat, rye, and oats (their flours contain more), and three fourths of rice and Indian corn.

In addition to the cooking which the cerealia require, they are often predigested by diastase for invalid use. Strong heat converts starch to dextrin; but diastase, like the natural digestive ferments, can convert it into maltose, and as such it is fitted for absorption.

Fortified gruels, as they are called by Roberts, are made of cereal flours or dried legumes, with addition of milk, beef tea, or eggs. The flours if used alone, in strength of 5 per cent, become pasty and taste insipid, but if one eighth of their weight of ground malt be added they remain fluid with 20 per cent of flour, and, as this starch is largely dextrinised, they are highly nutritious. Thus made, Roberts says they contain 2 per cent of proteid and 14 per cent of carbohydrates.

Bread-making.—It has been well said that the quality of the bread used by the inhabitants of any country is a fair measure of their civilisation. Flour is prepared from various grains by crushing and grinding processes. The grains consist of (1) an outer layer, the husk or skin, which is woody, fibrous, and indigestible, and which in the milling process is separated into "bran"; (2) the kernel within the husk, which is composed of gluten, fats, and salts; (3) the starch.

To appreciate the important details of bread-making, it will be necessary to first review the structure and composition of the grain from which the bread is derived.

Structure of the Wheat Kernel.—The wheat kernel is subdivided into four layers. The first or outermost layer (Fig. 1, *H*) consists of two or three strata of elongated cells the long diameters of which correspond with the long axis of the grain. From these cells slender filaments or tapering, hair-like processes project outward. The cell margins are irregular in outline, and appear somewhat beaded.

Immediately beneath the outer hairy layer lies the second layer (Fig. 1, *F*), consisting of more or less quadrangular cells, with rounded angles, which are more uniform in size than the others, and grow at right angles to them. The third layer (Fig. 1, *K*) consists of a delicate, transparent membrane-like structure. The fourth or internal layer (Fig. 1, *S*) is composed of large, almost rectangular cells arranged in one or two strata, and which contain a dark granular material which may be easily separated from the cell walls.

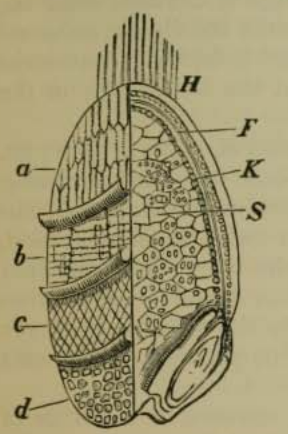


FIG. 1.—Section through wheat kernel (from Rupp). *H*, hair-like processes; *F*, *K*, second and third layers; *S*, fourth internal rectangular cell layer; *a*, *b*, *c*, *d*, successive layers represented as partially stripped off.

The grains of other cereals conform in a general way to the structure of the wheat grain, although they differ in the thickness of the several layers, the number of their strata, and the size of the individual cells.

Bran.—Bran (Fig. 2, *a*) contains carbohydrate material which is but little if at all digested in the human alimentary canal, although the lower animals derive abundant nutrition from it. The nutritive salts of wheat are chiefly contained in the bran; and for this reason, if bread constitutes the principal food for a time, it is best to eat that which contains some bran. But if too much is consumed it hastens peristalsis, and nutrition suffers because the food is hurried out of the alimentary canal before absorption is complete. When bread is eaten with other food containing nitrogen and salts, white bread is preferable.

Gluten.—Gluten is separated in the process of making starch from wheat and other grains. It is a valuable nitrogenous food product, consisting of (*a*) 60 to 70 per cent gliadin and (*b*) 30 to 40 per cent glutenin. The greater part of the gluten is held in the central four fifths of the grain. The gliadin adheres to the glutenin, retains the gas in dough, and in excess it makes the flour soft and sticky, hence soft wheat yields a flour with high percentage of gliadin, but hard wheat has a low percentage.

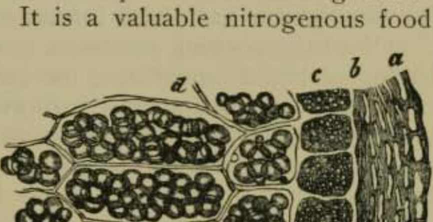


FIG. 2. — Microscopic characters of wheat (+ 200) (from Landois and Stirling). *a*, cells of the bran; *b*, cells of thin cuticle; *c*, gluten cells; *d*, starch cells.

Gluten is capable of considerable expansion independently of the development of CO_2, and, as this power varies with different flours, it affects the quality of lightness of the bread. Some glutens expand four or five times as much as others (H. Snyder and L. A. Voorhees).

Composition of Bread.—Bread is really a mixed food, in that it contains so many classes of ingredients—fat, protein, salts, sugar, and starch—and this is probably the explanation of the fact that its daily use never cloys the appetite. Although it contains some fat, it has not enough for a perfect food, and hence the almost universal custom of using butter with it. Moreover, it forms a convenient vehicle for taking fat in this manner, and the butter aids in the mastication and deglutition of the bread.

Good bread contains, on the average, protein, 9.57 per cent; fat, 1.5 to 2 per cent; and carbohydrates, 55 per cent, the remainder being largely water, with a trace of salts. In round numbers, bread contains about two thirds nutrient material, or twice as much as beef, although it is of different force value in the body. One hundred grammes furnish 216 calories. A pound of bread is made from about three quarters of a pound of flour by the addition of 25 per cent of water. Some flours will take up 10 per cent more water (Snyder and Voorhees).

Bread-baking.—Bread is made from a mixture of the flour of any cereal with water, which is added in definite proportion, constituting a dough which is made uniform by kneading either by hand or by machinery. A small quantity of the ferment yeast is also worked uniformly into the dough and the mass is left to stand for a number of hours, during which fermentation progresses, producing from the starch alcohol, carbonic acid, and water. The best temperature at which this leavening proceeds is from 100° to 110° F. After remaining for some hours at a uniform temperature, the bread is baked in a hot oven the temperature of which is sufficient to kill the yeast germs and check further fermentation.

Of all the cooking processes now in use by civilised man, the baking of bread is, perhaps, the most important. The object of cooking flour in this manner is to make it light and porous, so that the digestive fluids may be easily incorporated with it. Flour eaten alone forms a glutinous or sticky mass which is quite indigestible and difficult to swallow, besides being comparatively tasteless. There are many variations in the process of bread-making, but all are based upon the same principle—the development of carbonic-acid gas throughout the mass of dough, which bubbles up and causes it to "rise" or forces it apart. In general, the process involves a loss of about 1 per cent of CO_2 and 1 per cent of alcohol. The loss of volatile products represents a loss of but 1.58 per cent of starch. Of the remaining starch less than 8 per cent is converted into soluble form (dextrin), but many of the starch granules are ruptured or disintegrated. A very small percentage of fat also disappears in the process of baking.

Development of Carbonic-acid Gas.—Carbonic-acid gas may be generated or introduced in four ways: I. Indirectly by natural fermentation excited by the addition of the yeast fungus, *Torula* or *Saccharomycetes cerevisiæ*. II. By the use of "leaven," a name given to old dough in which fermentation has already occurred. III. By the addition of baking powders. IV. Directly by "aëration."

I and II. *Bread made by Yeast or Leaven.*—When bread is made by yeast or leaven the process, which may be divided into three stages, is as follows:

(1) The wheat or other flour, finely ground, is mixed into a thick paste with water, which may be either warm or cold, and to which the ferment, together with a little salt, is added; the mass is thickened with flour to form a dough, and the dough is well worked by hand or kneaded so that its several ingredients may become most thoroughly incorporated. If this is not done properly the bread is lumpy or of uneven porosity. The entire mass may be prepared at once, or a small part of the flour is first allowed to ferment for a short time, and then is kneaded into the remainder.

(2) The dough is next set aside for some hours in a warm place to rise. This process consists of a fermentation which is produced in the flour by the action of the yeast, resulting in the freeing of carbon dioxide and water. The accumulating carbonic-acid gas endeavours to escape in bubbles, which become entangled in the more or less tenacious gluten of the flour. Upon the size and number of these bubbles depends the porosity of the bread, and this in turn is modified somewhat by the kind of flour used, the quantity of the ferment, and the rapidity with which the development of carbonic acid is allowed to proceed.

(3) The final stage consists in the baking of the dough after it has risen. The heat of the oven, by expanding the carbonic-acid gas, makes the bread still more porous and "sets" the walls of the little cavities which have formed so that the loaf maintains its shape. The gas is finally driven off, together with a large quantity, but not all, of the water. The baked bread is therefore considerably lighter in weight than the dough, much drier, and porous.

The water added to make the dough escapes in part through evaporation, and the external portion of the bread becomes drier and browner than the interior or crumb, and constitutes the crust. The thickness of the crust will depend upon the character of the flour used, the temperature of the oven, and the duration of the process of baking. Bauer claims that the crust contains less nitrogenous material than the crumb, but this is contradicted by Dujardin-Beaumetz, and there is no definite reason why it should.

With the exception of these changes, bread has practically the same composition as its original flour.

Mixing meal or flour with fat tends to prevent the evaporation of water from the bread.

The chief art in baking bread consists in arresting the yeast fermentation of the dough by the heat of the oven (300° to 400° F.) at exactly the right period. If fermentation has not proceeded far enough the bread is tough, or sodden, or lumpy, whereas if it has gone too far it acquires a sour taste by the development from the carbohydrates or organic acids, such as acetic, butyric, and lactic, which are both unpalatable and unwholesome. Fermentation produced by the use of leaven instead of yeast is much more difficult to control, and these acids, therefore, are more likely to be formed. The bread made with fresh brewers' yeast is by many esteemed to have the best flavour. The process of bread-baking also causes the starch granules to burst, if this has not already occurred from absorption of water in the dough, and results in the conversion of some of the starch into dextrin, with the further formation of alcohol and sugar (glucose). About 6 to 8 per cent of the starch is thus made soluble. There are several minor chemical changes, and the entire action of yeast and heat upon the dough is thus summarised by H. Snyder and L. A. Voorhees (U. S. Department of Agriculture Bulletin No. 67, 1899):

"(1) The fermentation of the carbohydrates and the production of carbon dioxide and alcohol; (2) the production of soluble carbohydrates, as dextrin, from insoluble forms, as starch; (3) the production of lactic and other acids; (4) the formation of other volatile carbon compounds; (5) a change in the solubility of the proteid compounds; (6) the formation of amid and ammonium compounds from soluble proteids; and (7) the partial oxidation of the fat."

About 2 per cent of the weight of the flour used is lost in volatilising various organic products. With prolonged fermentation this loss may amount to 8 per cent.

The soluble dextrin has the physical properties of a gum. It is obtained by heating starch to 300° to 400°. In steam-cooked cereals also, the starch is partially dextrinised.

III. *Baking Powders.*—Carbonic-acid gas may be developed in bread by the action of baking powders. These powders are very extensively employed, and "a conservative estimate of the quantity of baking powder used in the United States each year places the figure considerably above 50,000,000 pounds" (Clark).

There has, however, been much argument in regard to their wholesomeness, and elaborate researches in chemistry and the physiology of digestion have been conducted to determine whether or not the continued use of these ingredients in bread is injurious. The so-called baking powders are manufactured by the combination of many different ingredients, such as sodium carbonate with tartaric acid, the acid phosphate of lime with sodium carbonate and potassium chloride (Liebig-Horsford), or a combination may be used of ammonium carbonate with hydrochloric acid. It is claimed by the advocates of the use of baking powders that they possess many advantages, such as the fact that the bread rises quicker, and that although fermentation does not occur, the bread is more porous, and hence more digestible, and that its taste is not impaired. On the other hand, it is argued that such bread is practically less wholesome, and that its continued use, from the introduction of so many chemicals, especially when ammonium carbonate is employed, proves irritating to the stomach and may excite dyspepsia and gastric catarrh. Even when not used for the making of bread these baking powders are often employed in the preparation of various forms of cake where lightness and quickness in making are important features.

Baking powder when pure should consist only of cream of tartar (acid tartrate of potash, obtained as a precipitate in the casks in which wine is made) and soda, with a little flour added, and should be free from alum, ammonia, etc. Mixed with water and dough, the soda is split by the acid tartrate, liberating carbonic-acid gas. Alum is sometimes used in baking powders with soda. Its action is less reliable, and in large quantities it is astringent and injurious to digestion.

IV. *Aërated Bread.*—The process of aërating bread consists in the forcing of carbonic-acid gas into the dough under pressure. The gas is generated by the action of sulphuric acid upon lime, and while there are several methods of its use, in general, about one cubic foot of gas is applied to fourteen pounds of flour, although not over one half of this quantity remains in the dough. It is claimed for this process that the bread is exceptionally light, dry, and porous, that there is no danger of malfermentation, with production of acidity, and that it sooner hardens when exposed to the air as compared with home-made bread prepared with yeast.

Aërated bread keeps fresh longer than other varieties. It has a peculiar taste which, however, is preferred by some people. It is claimed as a further advantage for its manufacture that the bread requires less kneading by the sometimes dirty hands of the baker. Some twenty or thirty varieties of germs are usually to be found beneath the finger nails of persons who are ordinarily cleanly. If special care is not taken by those who prepare bread it is possible for disease germs to be introduced from beneath the nails into the dough. It has been claimed that various infectious diseases might be transmitted in this manner. The danger, aside from any æsthetic consideration, is, however, grossly exaggerated, as the fermentative processes, together with the prolonged heat used in baking, are fatal to both germs and spores. In aërated bread salt is added as in the other processes, with the result of making the bread firmer and somewhat whiter.

There are many cereals, such, for example, as oatmeal and the coarser whole meals, which are exceedingly wholesome when cooked by some methods, but which cannot be baked into good bread because of the difficulty of making them porous, and their attempted use in this form usually results in dyspepsia, with heartburn and acid fermentation.

It is pointed out by Sir Henry Thompson that when coarse meal is necessarily used for bread-making, it, " being a bad conductor of heat, will have a hard, flinty crust if baked sufficiently to cook the interior; or it will have a soft, dough-like interior if the baking is checked when the crust is properly done." For this reason he advises baking the flour in the form of flat cakes, which can be uniformly heated throughout. Palatable cakes can be made in this manner by a mixture of wheat meal and Scotch oatmeal.

The addition of boiled rice flour in bread-making causes the bread to become more adhesive and to hold more water. Hence bakers sometimes resort to this means to make their bread heavier. By turning the fresh loaf over occasionally as it lies upon the shelf the water is prevented from gravitating to the bottom and making it sodden. While the primary object of bread manufacture is to render the starch more soluble, the gluten is also easier digested after fermentation. Freshly baked bread is much less digestible than dry bread for the reason that, being more moist, it tends to form a tenacious bolus in the mouth which is not readily mingled with the saliva or other digestive secretions. Dry bread, on the other hand, crumbles into smaller particles, which are easily acted upon by the saliva and pancreatic juice. For the same reason, the crust of bread is more digestible than the interior part of the loaf.

Spoiled Bread.—Bread may be unfit for use from being made of adulterated or too old flour, from turning sour from bad flour developing excess of lactic acid, from becoming bitter from yeast, from becoming sodden from insufficient fermentation or aëration, and it may grow mouldy from exposure to air when it is too moist.

" Most of the diseases of the War of 1812 were due to defective food, and in 90 per cent of the cases the flour was at fault. In the War of the Rebellion similar reports were often received " (Woodruff).

VARIETIES OF BREADSTUFFS

Bread of different kinds constitutes the staple starchy food for Americans, as the potato does for the Irish peasantry and macaroni for the Italians.

The quantity of bread consumed varies somewhat with the ability to obtain other articles of diet. For example, persons residing in large cities are wont to eat a larger percentage of animal food and less breadstuff than those in the country. The French labourer consumes daily eight hundred grammes of bread in the country against five hundred in the city. The most important bread used, both from the standpoint of its nutritive value and the quantity consumed, is derived solely from wheat flour; but, for economical or other reasons, this flour is sometimes advantageously mixed with potatoes or bean flour. The latter, added in the proportion of 1 part to 10 of wheat, gives a white bread rich in nitrogen and highly nutritious. Corn flour may be mixed in the same proportion.

Composition of Breads and Crackers of Various Kinds (Clark)

	Water.	Nutrients.	Protein.	Fats.	Carbo-hydrates.	Mineral waters.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Wheat bread	32.51	67.5	8.8	1.9	55.8	1.0
Graham bread (wheat)	34.2	65.8	9.5	1.4	53.3	1.6
Rye bread	30.0	70.0	8.4	0.5	59.7	1.4
Boston crackers	8.2	91.8	10.7	9.9	68.8	2.4
Soda crackers	8.0	92.0	10.3	9.4	70.5	1.8
Pilot crackers	7.9	92.1	12.4	4 4	74.2	1.1
Graham crackers	5.0	95.0	9.8	13.5	69.7	2.0
Oatmeal crackers	4.9	95.1	10.4	13.7	69.6	1.4
Oyster crackers	3.8	96.2	11.3	4.8	77.5	2.6

Wheaten Flour and Bread.—In the average composition of wheaten bread nitrogen exists in the proportion of 1 part to 21 of carbon (Yeo). Besides the deficiency in nitrogen, there is but a trace of fat in refined flour, a trace of acid, and little mineral matter.

The following table from the U. S. Department of Agriculture Bulletin No. 67, 1899, gives the percentage of

Proteids in Wheat Flour

Albumin	0.3	per cent.
Globulin	.9	"
Proteose body	.2	"
Gliadin	6.8	"
Glutenin	4.5	"
Total	12.7	"

The best wheaten flour for wholesome bread should be of a slight yellowish-white tinge, and not too fine. The colour fades as the flour becomes dry.

Yellow flour is sweeter and more nutritious than white pastry flour, although it makes a darker bread. The flour contains 10 to 11 per cent of gluten. Such flour when mixed with water should form a dough which is both coherent and ductile. These properties are due to the gluten which it contains.

Bread made from good flour should be porous, but not filled with large holes, and should have the proper consistence and firmness to cut well in thin slices. Wheaten flour contains much less crude gluten after thorough baking, for in the process of strongly heating flours containing nitrogenous material, the proteid as well as the starch becomes more soluble in water (Leeds).

Heavy, sodden bread has been insufficiently fermented.

Tough, moist, imperfectly baked, or hot bread is liable to excite further fermentation in the stomach, causing heartburn and other symptoms of dyspepsia. The digestibility of such bread is promoted by heating it to drive off the moisture, and by spreading it well with butter to prevent it from agglutinating in the stomach.

Water continues to evaporate from hot fresh bread, and such bread should not be covered tightly, or else it becomes sodden.

Stale bread and dry toast are both more digestible than fresh bread. In stale bread water is evaporated to a great extent, so that the bread becomes friable and is more readily masticated and mingled with digestive fluids. The fact that stale bread on being warmed over becomes softer is accounted for on the hypothesis that in drying the water has not all been evaporated, but that some of it has combined with the flour, forming a new compound, which is dissociated by the further application of heat (Yeo).

In toasting, the digestibility of bread is still further promoted by additional heat, and the superficial layers are browned and altered in flavour, acquiring a taste somewhat similar to caramel. Water is evaporated, and a slice, if sufficiently thin, bakes dry and crisp throughout, but if thick, the outer layers are scorched while the mass within may become even softer than before toasting.

Buttered dry toast is a digestible form of invalid food, for if the butter be spread thin while the toast is quite hot it penetrates to the interior, and both fat droplets and starch crumbs mutually protect each other from cohering in large masses. The butter, moreover, enables one to eat more bread in this form. The same is true of milk toast, and this furnishes in addition a means of giving considerable milk to patients who are unwilling to drink it.

Whole-meal Bread.—For some flours the whole of the wheat is used, the gluten nitrates and phosphates being all retained. They are more delicate than oatmeal, and more digestible.

Wheat yields soluble matter, such as albumin and dextrin, amounting together to about 10 per cent, besides various salts. The insoluble matter of the grain is chiefly starch and gluten, which constitute from 72 to 75 per cent. Wheaten bread contains about 25 per cent of carbon and 1.2 per cent of nitrogen (or about 8 per cent of protein material). The proportion which these elements bear to each other and which is needed for maintenance of life is carbon fifteen to nitrogen one; hence it appears that wheaten bread alone is not an economical food. If man is to live upon it alone for any length of time, brown bread or Graham bread is better than the varieties made from fine flour, from which latter the nitrogenous elements have been largely removed by milling. A "bread-and-water diet" is proverbially a reducing diet, and as such it is given to insubordinate prisoners (see Diet in Prisons), but they cannot subsist upon it for longer than two or three weeks at most.

Bread made of whole meal is usually not so light as that made with refined white flour. The explanation of this is said to be the fact that the silicious envelope of the grain contains a ferment resembling diastase, which is called cerealin. While the dough is rising, this ferment acts upon a good portion of the starch, forming viscid compounds of dextrin and sugar, which by agglutination prevent the carbonic-acid gas from puffing up the bread as much as it should. On the other hand, too much attrition in the mill ruptures the individual starch granules, and without the use of artificial baking powders the bread will not be light and wholesome. "Seconds" is a medium ground flour which makes a digestible bread.

The British Commissioners of Prisons recommended the use of whole-meal bread for convicts at hard labour on account of its greater cheapness and nutritive value, but advised a modification in the process of its manufacture. The dough is made of flour from which the sharps, etc., have been removed. The latter are then added and mixed thoroughly with the dough just before it is ready for baking, and it is claimed for this process that there is not time for the cerealin to act, and consequently the bread is much lighter.

Pumpernickel is a German black bread made with unbolted meal and sour dough. It is somewhat laxative.

Zwieback is a thoroughly dry form of bread, which is very wholesome for invalids.

Graham bread—so called after Sylvester Graham, who advocated its use—differs from white wheat bread by containing the outer coatings of the wheat kernel, called bran, which contain a larger percentage of albuminous material and of phosphate. The bran, however, while containing serviceable food products, is so difficult of digestion that it tends to irritate the mucous membrane of the intestine and increase peristaltic action. For this reason it is more laxative than white wheat bread, but also less nutritious.

It is a popular idea that coarse bread, black bread, whole-meal bread, etc., are more nutritious than the bread made from refined white wheaten flour or delicate French breads. This is not necessarily true, and much depends upon the digestive organs of the individual. In a report on the digestibility and nutritive value of bread (Bulletin No. 85, U. S. Department of Agriculture, 1900) by Charles D. Woods and L. H. Merrill, they show the coefficient of digestibility of white bread averages 93.37 per cent (in some samples it is as high as 97.06 per cent), whereas that of whole-wheat bread is 91.50 per cent, and that of Graham bread is but 86.94 per cent. They also found that bread was rendered more digestible when eaten with milk than if eaten alone, the increase in digestibility amounting to 15 per cent. There are peasants in Europe who can thrive upon the coarsest forms of sour, black bread, and there are others who can use different forms of fermenting foods and beverages which to those unaccustomed to them would prove most injurious. Thus generalisations cannot be made, for much depends upon the condition of life of the individual and the general habit of his digestive organs. Wheat bran contains about 15 per cent of nitrogenous material, 3.5 per cent of fatty matter, and 6 to 7 per cent of mineral substance, mainly phosphates (Yeo), all of which materials, from a purely theoretical standpoint, should be nutritious, but, practically, little bran is absorbed, and it is often irritating, especially where feebleness of the digestive organs exist. As proved by the researches of Professor Snyder, this is the reason why bread made from patent flours is so much more digestible than that made from Graham or whole wheat flour.

According to Bauer, " with wheaten bread, rice, macaroni, etc., the carbohydrates are utilised to within 0.8 or 1.6 per cent, whereas of black bread, potatoes, and the like, 8 to 18 per cent of the carbohydrates are passed with the feces."

Decorticated flour is prepared by special methods of grinding with the object of removing two or three of the outermost and toughest coverings of the grain, but not the inner envelope. Yeo says of bread made from such flour, that while it may be suitable " for young and growing persons with sound and active digestion," it may " prove very indigestible to adults leading sedentary lives. It makes a bread which is usually heavier, moister, and of closer texture than that made from the finest wheat flour."

When digestion is not vigorous, it is better to obtain the necessary nitrogenous material from animal sources. The special uses of coarse forms of bread will be pointed out under the treatment of constipation.

The portion of grain which is useless in the diet of man is wholesome for some of the lower animals, who can convert it into flesh, to be eventually eaten by man.

Gluten Bread.—Bread made from gluten flour is useful where there is a tendency to obesity, and is given to diabetics. It may be toasted like ordinary bread. The best bread of this kind is made in Paris, and contains from 40 to 50 per cent of gluten. Another good gluten biscuit is made by the Battle Creek (Mich.) Sanitarium Health Food Company, but there are many so-called gluten breads in market which do not contain above 16 per cent of gluten, the remainder being starch.

Poluboskos is a gluten food which is said by those interested in its manufacture to contain only 0.4 per cent of starch. The name indicates " much nourishment." It is given to diabetics in doses of one or two teaspoonfuls in milk.

Rye Bread.—Next to wheat, rye is the most important bread-making flour, although it is less digestible for invalids, and it may be mixed with wheat flour in the proportion of two parts of the former to one of the latter.

It has the advantage of keeping fresh longer than pure wheaten bread, and if well made it is wholesome and somewhat more laxative, but contains much less gluten than white bread from wheat. It should be baked in a hotter oven to insure its digestibility.

Biscuits, Pastry, Puddings, etc.—In addition to bread an almost innumerable variety of biscuits, cakes, pastry, tarts, pies, etc., are prepared by the addition, in various proportions, of flour, milk, cream, butter, or other fat, sugar, eggs, flavouring extracts, and fruit, such as raisins.

For making pastry, cake, and puddings of different kinds, the finer grades of wheat flour are usually employed, although corn and Indian meal are sometimes used.

The dough is raised in such preparations by the help of yeast, alcohol, fat, baking powders, or whipped white of egg. A hot fire is used in the cooking, and the puddings are either baked, boiled, or steamed, so that the flour is altered by the heat in much the same manner as in the manufacture of bread.

These foods vary so much in richness and digestibility that it is difficult to formulate any definite rules for their use. In general, they must be avoided by all persons having indigestion, dyspepsia, or, in fact, any severe illness; but farinaceous puddings, simply made and thoroughly cooked, with the addition of eggs and milk, play an important part in hospital dietaries, and are very good foods for convalescents.

Boiled or steamed puddings, being unfermented and surrounded with abundant water, are very likely to be sodden or stringy, and therefore wholly indigestible.

Pastry, even when light, is apt to be too rich, and if not well cooked it is sodden or tough and almost certain to disagree, mainly because of the changes which the high grade of heat produces in the butter or other fats used in its preparation.

PREPARED FARINACEOUS FOODS

(Often called "Infant Foods" or "Prepared Baby Foods")

Prepared farinaceous foods are made by the following methods: 1. Application of heat alone. 2. Digestion with malt or diastase combined with heat. 3. After dextrinisation, the food is evaporated with milk or cream.

The prepared farinaceous foods may be eaten alone or diluted with water, but they are usually given to invalids in a cup of broth or beef tea, which disguises their sweetness. The sweeter varieties are best combined with milk.

1. *Farinaceous Foods prepared by Heat alone.*—Flour ball, Ridge's Food, Blair's Wheat Food, Schumacher's Food, Imperial Granum, and Robinson's Patent Barley are examples of this class.

Wheat and oats are sometimes prepared by roasting (not steaming), a process which removes all moisture besides producing some chemical changes in the fats and starches. Cereals treated in this manner will keep from moulding in any climate, and are both digestible and nutritious.

Imperial Granum is a type of a large class of prepared foods, the basis of which is starch, modified, it is claimed, so as to render it easily digestible. Such foods are often fed to newborn infants to the exclusion of milk, but no greater mistake can be made, for their digestive apparatus is wholly unfit to deal with starch in any form. The human infant is designed to be nursed at the breast for the first year of life, and Nature has furnished ample food for it which is wholly devoid of starch. The saliva and pancreatic secretion upon which the digestion of starches depends are not fitted for this work at all during the first eight or nine months of life, and then only partially, hence starchy foods, " farinaceous baby foods," should never be given at all before that age as *foods*, and should only be used very sparingly, if at all, as mechanical diluents of milk. Moreover, in such simple starchy foods as arrowroot the proportion of tissue-building to heat-producing foods is one to twenty, whereas in human milk it is one to five (Starr). Even when the starch of infant foods is rendered soluble or dextrinised or converted into sugar, the absorption of too much of such material diverts energy which can be better employed in controlling metabolism in other ways or removing waste.

Granum is composed of over three fourths starch, made into a fine flour. One teaspoonful of it should go to each three ounces of water, in which it is boiled for ten minutes. An equal quantity of milk is then to be added, and the mixture must be again boiled for five minutes.

The mixture may sometimes be fed to infants after the eighth or ninth month, but only once or twice in twenty-four hours. It is a useful temporary food for adults with irritable stomachs.

Flour ball is prepared by boiling wheat flour tied in a bag, with the supposed purpose of converting it into dextrin, and it is a popular belief that this conversion is quite complete; but it requires a temperature of 250° F. to dextrinise starch, and this degree cannot be attained by the process. Leeds has shown by recent analyses that even after seventy-five hours of continuous boiling the percentage of soluble carbohydrates is increased by only 0.05 of 1 per cent, whereas some of the prepared foods contain from two to six times as much soluble carbohydrate as wheat flour. Flour ball tastes flat and insipid, owing to the long boiling dissolving out fat, soluble albuminoids, and salts (Leeds).

Starr gives the following rule for the making of flour ball:

Tie one pound of unbolted wheat flour firmly in a pudding bag and boil for ten hours. At the end of this time it will be found, on opening the bag, that the outer layer of the ball is doughy, while the interior is hard and dry, it having been baked by the long-continued heat. This hard mass may be used for infant feeding in the latter part of the first year, but it should not be given more than twice a day. The flour ball is grated fine, and it may then be prepared, according to Starr's rule, as follows: "Rub one teaspoonful of the powder with a tablespoonful of milk into a smooth paste, then add a second tablespoonful of milk, constantly rubbing until a cream-like mixture is obtained. Pour this into eight ounces of hot milk, stirring well, and it is then ready for use. The flour ball thus prepared is quite digestible, and it prevents the formation of large curds of milk.

As a diluent of milk it is much cheaper for the poor than the prepared amylaceous foods which are on sale.

2. *Farinaceous foods digested with malt or diastase with heat* are often called "Liebig's Foods."

Liebig's foods are made of equal quantities of wheat flour and barley malt, with bran, and 1 per cent of bicarbonate of potassium. These ingredients are mixed into a paste with water and digested for several hours at fixed temperatures, until the starch is transformed into soluble carbohydrates, maltose, and dextrin. The food is strained, pressed, and extracted with warm water, evaporated, dried, and pulverised, when it is ready for use.

Examples of Liebig's type of dextrinised foods are: Mellin's Food, Horlick's Food, Savory & Moore's Infant Food.

According to Leeds's analysis, the best samples of Mellin's and Horlick's foods contain no starch, but a large percentage (Mellin's 68.18 per cent, Horlick's 76.83) of soluble carbohydrates, and about 10 per cent each of albuminoids—if the process is complete. Savory & Moore's food he finds contains considerable starch.

Mellin's Food consists of brown sweetish granules, easily soluble in both hot and cold water, milk, etc. It is made of coarsely ground wheaten flour with the addition of malt and potash. It is then digested with water at a moderate temperature to form dextrin and sugar. Afterwards it is strained through sieves and evaporated in a vacuum pan.

Mellin's Food is often fed to infants, but it contains too much sugar without fat for a wholesome baby's food for continued use in quantity. It may be resorted to temporarily when good cow's milk cannot be obtained. The food may be prepared for use as follows:

For an Infant One Month Old

Mellin's Food	5 level teaspoonfuls.
Fresh milk	10 tablespoonfuls.
Hot water	22 "

For an Infant of Three Months and for Delicate Children

Mellin's Food.............. 8 level teaspoonfuls (equal to 1 heaping tablespoonful).
Fresh milk................. 16 tablespoonfuls (equal to $\frac{1}{2}$ pint).
Hot water.................. 16 tablespoonfuls (equal to $\frac{1}{2}$ pint).

For Infants of Six Months and Over

Mellin's Food................................ 2 heaping tablespoonfuls.
Fresh milk.... .... 24 tablespoonfuls (equal to $\frac{3}{4}$ pint).
Hot water.................................. 8 tablespoonfuls (equal to $\frac{1}{4}$ pint).

Mix the Mellin's Food with a little hot water into a smooth paste, add the remainder of the water and the milk, and mix thoroughly. Keep this mixture on the ice or in a cool place.

Benger's Food is a preparation of wheaten flour to which, after cooking, pancreatic extract is added. When mixed with warm milk both milk and flour are newly digested. A tablespoonful of the food is dissolved in two ounces of cold milk. Then half a pint of boiling milk or milk and water is slowly stirred in. Further pancreatinisation is then arrested by boiling for twenty to thirty minutes. The preparation has no bad taste and is a nutritious and digestible food in cases of gastric ulcer, phthisis, dyspepsia, etc.

3. *Foods which are Dextrinised and then Evaporated with Milk or Cream.*—These are sometimes called "milk foods." Such are Lactated Food, Malted Milk, Loeflund's Cream Emulsion, Nestlé's Food, Gerber's Food.

The general process by which foods of this class are made is as follows:

Wheaten or other flour is first made into dough, baked, ground, mixed with more or less condensed milk or cream, and then dried at a moderate temperature. By addition of malt or diastase the starch is partially converted into dextrin and maltose, and the albuminoids are rendered slightly more soluble, the casein is dried, and the lactalbumin is precipitated.

One form of "cereal milk" is made from a mixture of wheat and barley meal with milk.

It is claimed for some of the malted foods prepared for infant and invalid use that the artificial digestion is not wholly completed, and this is said to be an advantage in stimulating the digestive organs.

Malted milk is a powdered sterilised preparation of pure cow's milk and extracts of malted barley and wheat, the starch of which has been converted into dextrin. The mixture is dried *in vacuo*.

The casein of the milk is predigested by a vegetable ferment. The preparation keeps well while hermetically sealed, and when required for use for an infant, from one to four teaspoonfuls are dissolved in from eight tablespoonfuls to a half pint of water. For adults, two tablespoonfuls of the powder in a half pint of water make the strength of cow's milk. The idea of this preparation is to furnish a substitute for human milk which will keep well, be always ready for use, and in which dextrin takes the place of additional fat.

It resembles Mellin's Food, except that it contains some, though not enough fat. It is used in about the same proportion. It makes a better invalid food for adults than for infants, and patients with enteric fever and severe gastro-intestinal disorder take it with benefit.

Nestlé's Food is prepared in Switzerland, at Vevay, from sterilised fresh cow's milk to which wheaten bread crust is added after dextrinisation by additional heat. Cane sugar is mixed in, and the mass is dried, pulverised, and hermetically sealed in tins. For use it requires dilution with water.

Carnrick's Food is composed of evaporated or desiccated milk partly peptonised and thoroughly sterilised by heat, 45 parts; dextrin and soluble starch, 45 parts; milk sugar, 10 parts.

Eskay's albuminised food consists of the prepared cereals—oats, barley, maize, and wheat together with lactose and egg albumin. It contains 11.33 per cent of total solids.

Bread Jelly.—A bread jelly may be made to add to milk for invalids and for use while weaning infants who are old enough to digest a little starch—i. e., over one year of age. The crumb of stale bread is broken into small fragments and covered with boiling water, in which it is allowed to soak until well macerated. The water is then strained off, fresh water is added, and the mass is boiled until quite soft. On cooling, a jelly forms which may be mixed with milk in any desired proportion.

Farina is a general name meaning flour, and is defined by Webster as "the flour of any species of corn or starchy root"; but in England the term corn is used as a general name for any grain growing in ears. Farina as sold by grocers in this country is often made from wheat, but much of the gluten and bran has been separated, rendering it less nutritious than whole wheat. In cases of diarrhœa it is more bland and less irritating than whole wheat. The name farina is also applied to fine white potato starch, which forms a jelly when cooked, like arrowroot.

Wheatena is a nutritious food containing all the wheat berry excepting the husk, and thereby differing from finer preparations in which the layer of gluten cells is removed with the bran. The starch granules, moreover, have been ruptured by heat. It is commonly eaten as a thin mush or porridge.

Cracked or rolled wheat has similar advantages.

Shredded wheat and *pulled bread* are modified breadstuffs which have lately become deservedly popular for dyspeptics on account of their easy digestibility.

Shredded wheat biscuit is made of wheat which is thoroughly cleaned, washed, cooked, and treated by machinery which draws out the wheat kernels into long, continuous filaments, thus breaking down their structure without separation of the component parts. Eighty such filaments are obtained within a space four inches wide; they are porous and, unlike dough, are capable of absorbing the digestive fluids, thus no leavening or baking powder is required. The shreds are folded by mashing into oblong biscuits, which are recooked at successive temperatures until all moisture is driven off and they are ready for use. They may be eaten soaked in milk, cream, or broth, or moistened with hot water and buttered.

Crackers.—All kinds of crackers enter more into the dietary in America and England (where they are called "biscuits") than in any other country. The lighter forms of wafers and rusk are nutritious and very easily digested by invalids having mild gastric disorder, for the starch has been well torrefied.

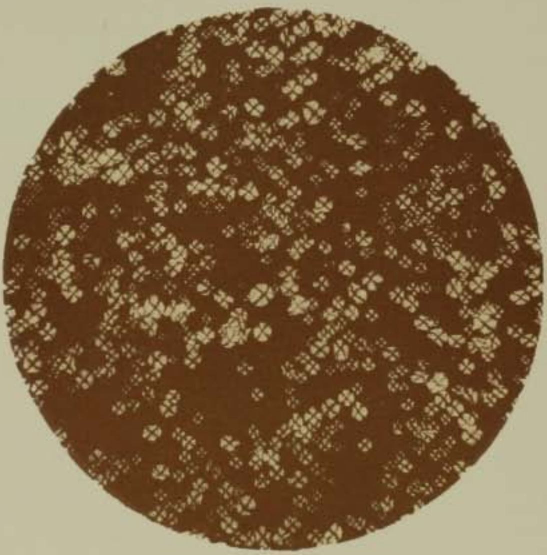
Crackers vary much in hardness and flavour, but, generally speaking, they are quite as digestible as good bread. The simplest forms, such as water crackers or milk crackers, are made with flour and water or milk, to which a little salt is added, after which they are baked in flat shapes so as to become hard and more or less brittle. Soda is sometimes added. If it is desirable to have them less friable, butter may be added in small quantity. The hard unleavened preparations known as "ship biscuits," "hard-tack," and "pilot biscuits," which form an important article of diet for sailors at sea, are manufactured upon these principles.

Ship biscuits are so dry and firm that they are much less bulky than bread, and it is estimated that three fourths of a pound of such biscuits is equivalent to one pound of bread in actual nutritive value.

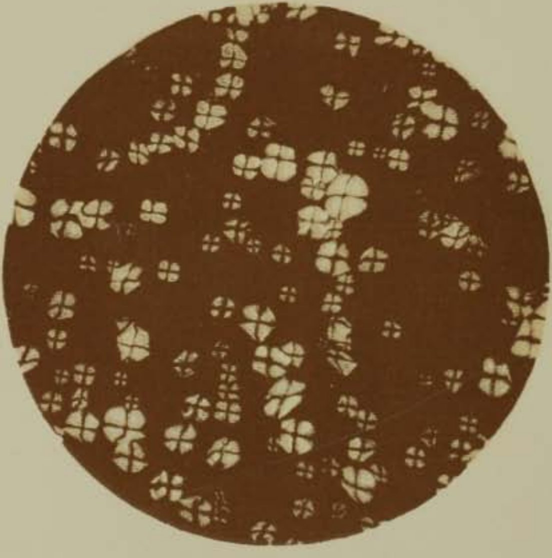
Most biscuits, if kept long exposed to the air, become exceedingly dry and tasteless, although they do not readily mould. Owing to their hardness and unpalatableness when long kept, it is found inexpedient to give them to soldiers or sailors to the exclusion of fresh bread whenever the latter can be obtained. The biscuits known as "hard-tack" are usually made five inches square and are perforated with small holes. They have the advantage of keeping well for a very long time and remaining edible, although they are not very palatable even when fresh. They are extremely tough, and require soaking in milk or water before they can be eaten.

Granose is a flaky form of entire wheat biscuit prepared by the Battle Creek (Mich.) Sanitarium Health Food Company. It may be eaten with cream or hot milk, and is palatable and nutritious. Granola is a similar preparation.

Semolino is a name having two applications. In France it denotes the hard central substance of the wheat grains which are retained in the bolting machine after separation of the finer portion which has passed through; but in Italy the word is used to denote the finer portion itself, consisting of fine hard granules rounded by grinding. The larger sizes contain much gluten, and



RICE STARCH X 150



RICE STARCH X 450

(*From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau*).

PHOTO BY CLIFFORD RICHARDSON.

may be used to thicken soups. The granules swell in water. When the grinding and sifting process is carried still further the starch granules are obtained in the fine powder which constitutes flour.

Semolino is used extensively in the manufacture of what are called "alimentary pastes," such as macaroni.

Macaroni is made by mixing semolino made from hard flinty wheat into a paste which is kneaded and put into a cylinder, the bottom of which is pierced with holes. A piston descends in the cylinder, and the paste issues from the perforations in the form of long thin tubes, which are cooled by a current of air, cut in lengths, and dried on screens. As much as twenty million pounds of macaroni are manufactured annually in Lyons alone. It contains 16 to 18 per cent of gluten, whereas bread holds 10 to 11 per cent.

Sir Henry Thompson says, in speaking of macaroni, that, "weight for weight, it may be regarded as not less valuable for flesh-making purposes in the animal economy than beef or mutton. Most people can digest it more easily and rapidly than meat; it offers, therefore, an admirable substitute for meat, particularly for lunch or midday meals."

After thorough soaking and when well cooked by boiling or stewing in milk or stock it is very nutritious, and it is often agreeably combined with cheese, although this is not advised for persons with feeble digestive power. Cooked alone with boiling water, macaroni is by many regarded as tasteless; and as the art of cooking it properly is less understood in this country than in Italy, it is not so favourite an article of diet as it might be.

The use of Italian pastes, such as spaghetti and vermicelli, in this country is extensive, but by no means as much so as their intrinsic value deserves. They are manufactured from flour from which the starch has been in part removed, and hence contain a relatively large proportion of nitrogenous matter. Although very wholesome they are tough, and require prolonged cooking. The vermicelli which is sold in the form of letters, to use in soups, cannot be boiled sufficiently to be thoroughly digestible unless the letters lose their shape.

Buckwheat.—*Buckwheat*, or blackwheat as it is sometimes called, is indigenous to temperate climates, and in some parts of the world, notably in Russia, Siberia, and Brittany, it constitutes a staple of diet, but in the United States it is the least imporant of the cereals, and is used rather as a luxury for making griddle cakes. The buckwheat produced in the United States is mainly raised in New York, Pennsylvania, and some of the New England States. Buckwheat bread is nutritious, but it crumbles and does not keep well.

Soya bread is made from an oily pea which grows in China and Japan, and is used sometimes by diabetics, for it contains over one third part of gluten and but 1.17 per cent of glucose.

Millet and sorghum are grown in the warmest parts of Asia and Africa, and to some extent in southern Europe. In Russia millet is sold as a white meal. White sorghum, which is a grass or cane, is converted into flour called *doura*, and in Africa, mingled with barley, it is distilled into beer. A fine quality of alcohol may be made from it. In the United States it is mainly grown for molasses and sirup; sugar is also made from it. Bread made from either millet or sorghum meal is fairly palatable and nutritious when warm, but when it becomes cold it grows dark and crumbles. The grains are hulled like barley and are ground into flour, which is either eaten pure or mixed with bread. Millet is a grass raised largely in India, China, Egypt, along the west coast of Africa, in Italy, Spain, and Portugal. There are many sub-varieties. It contains, on an average, over 7 per cent of fat, nearly 10 per cent each of proteid and dextrin, 60 per cent of starch, and 2 of sugar (Parkes).

Rye.—Rye may be said to stand very close to wheat in importance as a food. In Europe it is more in use for bread-making than in this country, where it is mainly eaten by the Germans. In Germany the rye production is double that of wheat, and in Russia it is three times greater. Former generations lived almost entirely upon rye in France, as they did upon oats in Scotland and parts of England, wheat being an almost unobtainable luxury.

Rye yields a coarser, darker bread than wheat, but is about equally nutritious, although not always so digestible, and it is somewhat laxative. In general, the statements made in the preceding pages (pp. 140–144) in regard to bread-making, etc., with wheaten flour, may be applied to rye flour.

Rye bread contains less gluten than wheaten bread, and it takes less time to raise and bake it, provided the oven is very hot. If properly made it is easily assimilated, and many like its taste.

Rye is often combined with wheat in France, under the name of *méteil*, and in Spain and Greece a mixture of the same name is made with barley instead of wheat.

Corn.—Maize, or Indian corn, is very extensively grown in temperate and warm climates all over the world. It may be dried, parched, and roasted whole, or ground into meal of various degrees of fineness.

There are some 300 varieties of corn, but the common kinds are known simply as white, yellow, and red.

The chief preparations of corn are hominy, samp, cornmeal, cracked corn, cerealine, and maizena (a South American cornmeal, used in the manufacture of a drink called "*chicca*").

Aside from its use as a food, corn furnishes alcohol and liquor, as well as glucose and laundry starch.

Chittenden and Osborn have made an elaborate research into the chemical composition of the "proteids of the corn or maize kernel"

(American Chemical Journal, vol. xiii, Nos. 7 and 8, and vol. xiv, No. 1). These consist of "three globulins, one or more albumins, and an alcohol-soluble proteid" called maize fibrin or zein.

Corn is a wholesome cereal, for it contains considerable fat and proteid as well as starch, and it furnishes abundant energy, producing heat. It is very fattening for both the lower animals and man. In the Southern States and in France it is largely fed to horses.

As a vegetable, corn is less used in Europe than in America, perhaps on account of the prevalent idea that it is a hog's food, although cornmeal is employed for baking into cakes and to mix with flour in bread-making. Eaten as a vegetable, unless very young and tender, corn is one of the least digestible foods, and canned corn is notoriously so. This is chiefly on account of the toughness of the husk of the kernel, which often is found in the feces practically unaltered by its transit through the body. Hence it may cause flatulency, indigestion, and diarrhœa.

Cornmeal, on the other hand, is quite digestible, and, like oatmeal, is somewhat laxative. As compared with wheaten flour, it contains more fat, having about 9 per cent, but it is deficient in salts. It makes a dry, friable bread.

Samp is a very digestible form of corn when well boiled.

When maize becomes mouldy it causes the disease known as pellagra. (See Diet in Pellagra.)

Polenta is a maize meal extensively used in Italy.

Cornstarch is very white and soft. It contains 53 per cent of starch. The best grades are used as a substitute for arrowroot, and make a wholesome invalid food, being very white and soft.

Indian meal is yellow, granular, and coarser than cornstarch.

Mush is made of well-ground cornmeal or Indian meal. The cereal is boiled in salted water, and when cooked is not pasty, but mixes well with cream, and is very digestible and nutritious.

Rice.—Although less eaten in this country than wheat, corn, and rye, except in the Southern States, rice constitutes the staple food of a majority of the world's inhabitants. Asia produces most of the rice consumed, but a little is grown in Spain, Italy, and Portugal. According to Clark, "in Asia a large part of the population consume 275 pounds per head a year," and nearly two billion pounds are used per year in Europe. In the United States, where rice was first introduced in 1694, it is chiefly grown in South Carolina. There are several hundred varieties of rice, the two principal classes being the dry or mountain rice, and the wet rice, which grows in flat marshland, periodically inundated. Both the Chinese and Japanese make a wine from rice, and a vinegar can also be obtained.

The native Oriental method of treating rice is to beat the kernels of grain out of their husks in wooden mortars, and for European markets they are glazed by shaking in a sheepskin-lined drum

(Clark). They are also bleached, and may be broken after decortication and ground into a flour.

Rice contains more starch than any other cereal—from 75 to 85 per cent—and is an exceedingly digestible form of starch for invalids when properly cooked, so that the individual grains are swollen or softened. This object is best attained by the process of steaming. The digestibility of plain boiled rice is improved by eating it with a little fresh butter, which coats the kernels and prevents their agglutination into a pasty mass. If the rice tastes insipid it may be spiced or flavoured with raisins. Rice pudding, milk and rice, and rice with beefsteak juice constitute excellent foods for young, growing children, and for use in convalescence from typhoid fever, diarrhœas, and many other diseases. It is also advantageous to eat rice with fruit, such as apples or prunes.

Rice should not be depended upon without some form of animal food, for it contains too little nitrogen to satisfy the needs of the system.

Bread cannot be made economically from rice, on account of the small amount of nitrogen which this cereal contains, and the consequent lack of stability in the shape of the loaf, and unless wheat be added in large proportions, such bread is indigestible and watery.

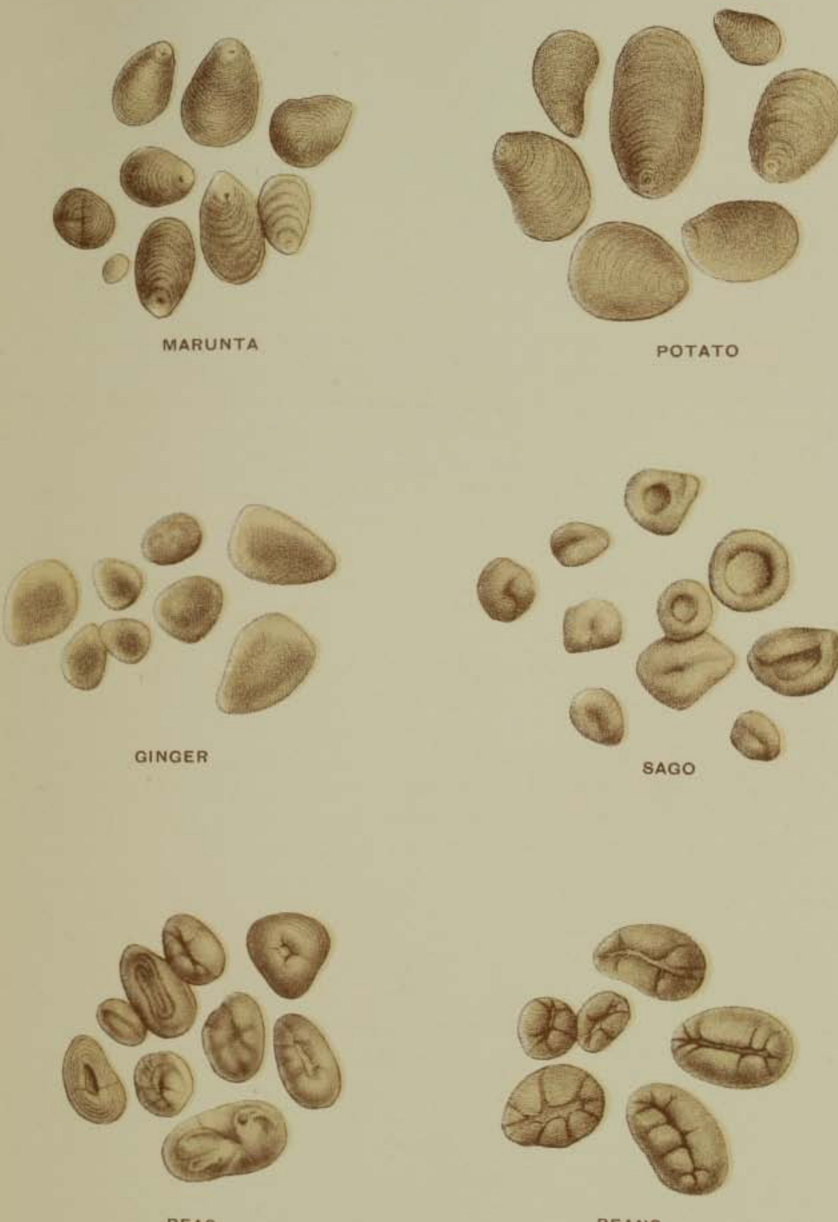
Barley.—Barley ranks very close to wheat in nutritive power, and cooked barley meal, like wheaten flour, contains gum, albuminoids, starch, and dextrin. As compared with wheat, barley contains more fat, salts, and indigestible cellulose, less protein, and less digestible carbohydrate.

The employment of barley bread for food is of very ancient date, reaching back to the early days of the Greeks and Hebrews, but with the spread of the use of potatoes and the cheapening of wheaten flour, it has fallen into comparative disuse, and in the United States barley is mainly used to thicken soups and in the manufacture of beer. In some of the Pacific States it is fed to horses. Pearl barley is made by depriving barley corns of their outer shells or covering, and then subjecting them to rubbing between a single millstone and a sheet of rasped iron or wire cloth, a process which polishes the kernels and rounds them off.

Barley water makes an excellent diluent of milk and a demulcent drink for infants and invalids. For the latter it may be flavoured with lemon juice. It may be made as follows: Grind half an ounce of pearl barley in a coffee mill, add six ounces of water, boil twenty minutes, add salt, and strain. It should be made fresh daily and kept in a cool place. It is better than oatmeal water whenever the bowels are loose. The latter, made in a similar manner, is to be preferred when constipation exists.

Oatmeal.—Oats contain considerable fat, protein, salts, and indigestible cellulose, in addition to a large percentage of starch. They

PLATE VI.



STARCH GRANULES, MAGNIFIED.

(*From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau*).

DRAWN BY GEO. MARX.

have been eaten in Germany for over a thousand years, and constituted the original grain food for all Europe.

Oatmeal is much less used than other cereals for bread because it lacks gluten, although it is still so employed to a limited extent among the poorer classes in France. It makes a dark, bitter bread, but forms a better porridge than can be obtained from rice or barley. The use of oatmeal porridge by all classes is very extensive throughout the United States. This is largely attributable to the improved methods of its preparation by high milling, rolling, etc. Scotch groats are prepared by removing the outer husk, leaving the grain almost whole. The grain is then reground between closer set millstones. It forms two grades of meal, the coarser of which is used for porridge and the finer to make bannocks or oatmeal cakes. A good deal of the oatmeal sold in America is identical with Scotch groats. True Scotch groats are heated by the miller over perforated iron plates and slightly parched for three or four hours before being ground. For those who can digest oatmeal well, it ranks among the cheapest and most satisfying of foods.

The nutritious value of oatmeal is great, but it depends very largely upon the skill with which it is cooked. It is not infrequently cooked in such a manner that the individual grains are left whole, but in this form the flavour is less well developed than it is by prolonged cooking; the oatmeal granules are much more difficult of digestion, and are capable of exciting gastro-intestinal irritation in feeble persons. But for many people oatmeal thus cooked possesses a decided advantage from the fact that it is less completely absorbed, leaving a considerable residue which adds to the bulk of fecal matter, excites peristaltic action, and reduces the liability to constipation. For most persons, however, and especially for all those with limited digestive power, oatmeal should be so thoroughly cooked as to acquire the consistence which enables it to be easily poured, and on cooling it should form a tender, gelatinous mass.

Oatmeal is a very hearty food, and those who eat much of it should live a vigorous outdoor life. If ill-cooked and if given to very young children, it occasions colic, flatulence, and rashes.

It is best when of recent crop and freshly ground. If it is kept long it absorbs moisture, and, losing its delicate flavour, becomes mouldy and sour.

The following analysis of oatmeal is given by Letheby:

Nitrogenous matter	12.6	per cent.
Carbohydrates, starch, etc.	63.8	"
Fatty matter	5.6	"
Mineral matter	3.0	"
Water	15.0	"
Total	100.0	"

Oatmeal, like cornmeal, has more protein and fat than the flours and meals derived from other cerealia, and hence, like bread, it may be eaten daily without impairing the appetite.

Revalenta, or *revalenta Arabica*, is a farinaceous food much eaten in some parts of Europe, which is a mixture of several meals, principally ground peas, beans, corn, and lentils, but barley and oatmeal may be included.

Arrowroot.—Arrowroot is derived from the rhizomata or root stocks of several kinds of tropical plants grown in both the East and West Indies. The roots are washed, reduced to a pulp, strained, dried, and pulverised into a very fine starchy flour. The best flour is made from the *Maranta arundinacea*. It is obtainable in market in the form of a fine white powder, and consists of exceptionally pure starch, the granules of which are small and friable. It has a very bland, insipid taste, and it is as digestible or more so when cooked than any other starch which is used in making gruel or jellies for invalids. In the form of a jelly it keeps longer without souring than do many other forms of starchy food, such as the potato; and in bad cases of dyspepsia, when much gastric irritation exists, it often constitutes a serviceable article of diet. Arrowroot is sometimes fed to young infants, but it is unwholesome for them, and ferments in the stomach.

Tous-les-mois.—Tous-les-mois is a starch derived from a West Indian tuber by maceration, straining, washing, and drying. It is used for the same purpose as arrowroot. Its granules are the largest of any of the food starches, but they are quite digestible and nutritious for invalids.

Salep.—Salep is a starchy food which is obtained from the tubercles of certain Oriental orchids. It is a mixture of starch and mucilage which makes a useful demulcent drink.

Tapioca, Cassava.—Tapioca and cassava are made from the rhizomata of the *Manioc utilissima* or Manihot, a common plant in temperate and tropical regions. It is extensively grown in South and Central America, Africa, and the West Indies. Manioc flour forms the basis of food of the natives, and when made into bread and cakes it replaces the wheaten bread of Europe and North America. Cassava contains a poisonous juice that must be first drained off.

Tapioca, which is purified cassava, is made, like sago, by drying on hot plates, the clarified starch being first heated into a paste in large metal pans. It is an almost pure starch. The granules are not tough, and are very easily digested, so that they form one of the most useful of the amylaceous foods for persons with feeble digestion. Tapioca may be eaten alone in the form of puddings with cream or flavoured with lemon juice, wine, nutmeg, or other spice or aromatic, or may be used to thicken broths or soups. "Pearl tapioca" is a spurious article made from potato starch.

Air-dry tapioca contains 11.97 per cent of water. Water-free tapioca consists of: protein 0.79, carbohydrates 98.90, and ash 0.31 (C. D. Woods and L. H. Merrill).

Sago.—Sago is an easily digestible form of starch derived from the pith found in the stem of different varieties of palm from Sumatra, Java, and Borneo. It is commonly sold in market in a granular form, and is known as "pearl sago." This is prepared by adding water to sago flour so as to form a paste which is run through sieves to granulate it. The spherical form of the granules is acquired by allowing them to fall into a shallow iron pan held over a fire. Sago is made with milk, cream, and eggs into nutritious puddings, and it may be used to thicken broths and soups of various kinds. It has an agreeable flavour, somewhat more delicate than tapioca, and is an invaluable adjunct to the invalid dietary.

Iceland Moss (*Cetraria Islandica*) is a lichen sometimes employed as food after purifying it by washing. It contains at first various bitter principles, which must be eliminated. It can be made into bread or used as an ingredient of blancmange, etc. It has been recommended by Senator and others for use by diabetics to replace ordinary bread, and it makes a convenient vehicle for the administration of fats, such as bone marrow (Walker). It also forms a good demulcent decoction.

Several forms of seaweeds are used as food by the Japanese, Siamese, and Polynesians.

Starchy Foods for Children

The best cereals and other starches for children are rice, hominy, Indian meal, barley, oatmeal, cracked wheat or wheaten grits, farina, cornstarch, and sago.

When the cereal grains are used instead of flour, they should be soaked in cold water for five or six hours and then cooked for two or three hours in a double boiler. If fed to infants less than two years of age or to children with any gastro-intestinal disorder, they must be thoroughly strained. They should be salted and served with cream, but without much sugar. The steamed preparations of oats, wheat, etc., which are sold in market, may be boiled one hour, and otherwise treated as the grains.

Bread and crackers may be allowed to infants after the first year, but only with their meals. The bread should always be porous, well baked, and stale. It may be toasted, or given dry in milk, or moderately buttered. Zwieback and plain rusk are also good foods for young children.

Crackers are made in great variety for children who have passed the second year. They should not be too dry or hard. They may be eaten in milk or with beef juice, or separately, with meals only.

The best are those made of wheaten or Graham flour, oatmeal, or gluten. The latter are the least palatable.

A large variety of prepared cereal foods are sold and recommended especially for children's use. These foods have been converted by heat or malt to dextrin and glucose or maltose, but they often contain a deficiency of flesh formers, and should never be long relied upon for feeding young infants to the exclusion of more natural food. (See Prepared Farinaceous Foods, p. 149.)

Diastase, Malt Extracts, etc.

Diastase is a vegetable ferment which has the property of converting starchy foods into a soluble material called maltose. It is soluble in water and weak alcohol, insoluble in stronger alcohol. Its advantage, as compared with similar ferments in the saliva and pancreatic juice, is considerable, and its strength enables it to dissolve starches when present in the proportion of only 1 to 2,000. Like the above-named ferments, it acts in alkaline solution, but, unlike them, it continues to operate in acid media; hence its action is not disturbed by the gastric juice. Diastase is the peculiar substance which causes the ripening during germination of fruits and vegetables by converting their starches into dextrins and sugars. Hence fruit becomes more and more digestible as it ripens.

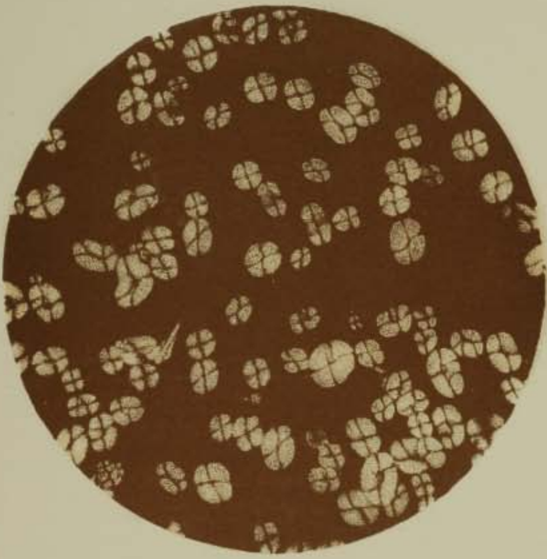
In prescribing diastase or malt extract it should be remembered that the ferment is precipitated and destroyed by alcohol of even moderate strength, and also by salicylic acid, which is antagonistic to it.

When malt is added to a pease pudding or other mashed vegetable, it separates the mass into a paste of cellulose and vegetable casein, with a supernatant solution of dextrin.

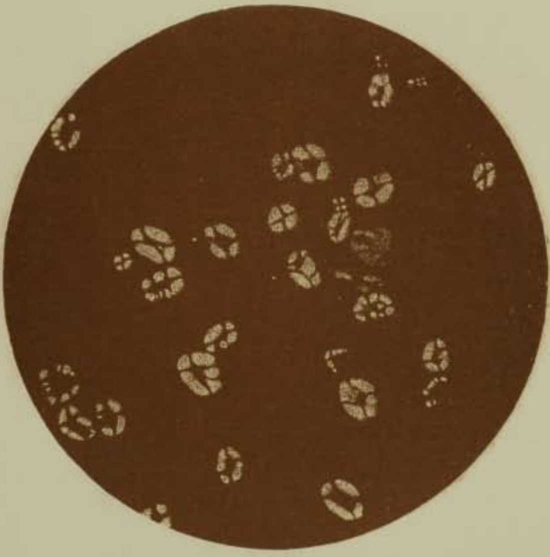
Williams recommends the use of malt flour with cereal foods to render them more digestible. Malt flour alone is too sweet, but, added in the proportion of one part to four or eight of oatmeal, it makes an excellent light, thin porridge for invalids.

A variety of malt extracts and malted foods are prepared for invalids, and many of them possess intrinsic value for nutrition and tonic action. They are especially useful in chronic and subacute ailments and convalescence from protracted fevers. They are beneficial in tuberculosis, caries, chronic abscess, neurasthenia, the scrofulous diathesis, typhoid fever, and to some extent they can be used as beverages to replace the stronger malt liquors, ale, beer, etc., for, according to Leeds, they always contain above 3 per cent of alcohol.

All malted foods are deficient in fats and protein. Farinaceous meal of any kind mixed with one eighth of its weight of ground malt forms a highly digestible combination. Even 20 per cent of meal can be used, and the preparation still keeps fluid (Roberts).



Bean Starch x 145



Pea Starch x 145

(*From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau*).

PHOTO BY CLIFFORD RICHARDSON.

Kepler's Extract of Malt is given in the dose of a teaspoonful after meals in milk or soda water, or it may be spread upon any form of starchy food.

Loeflund's Malt Extract is given in doses of a dessertspoonful after meals in a gobletful of milk.

Maltine is made from three cereals—barley, wheat, and oats. It is rich in diastase. It may be added in equal part to wheat or barley flour which has been previously boiled in water, and the mixture may be used as a diluent of milk. Maltine may be taken after meals, either plain or added to cod-liver oil, coca wine, pancreatin, hypophosphites, etc., for use in tuberculosis and other diseases.

Hoff's Malt Extract is given in doses of a wineglassful or more with meals for adults, and one or two tablespoonfuls for children. It contains considerable diastase, a minimum of alcohol (about 2 per cent), and is said to be free from noxious ingredients. It may be drunk warmed, with a lump of sugar added, as a soothing draught to allay cough. If desirable for feeble stomachs, it may be diluted with water or soda water.

Trommer's Diastatic Extract of Malt is composed of the soluble ingredients of Canada barley malt. It is of a sirupy consistence and has a sweetish taste, which some patients object to, while many prefer it. The sweetness may be lessened or disguised by dilution with water, hot milk, brandy, whisky, or rum. It is advisable, if the stomach is feeble, to give teaspoonful doses at first, to be increased to a tablespoonful three times a day after meals.

Pancreatic extract or three to five grains of pancreatin with five grains of sodium bicarbonate may be added to a cupful of thick, well-boiled farinaceous gruel of any sort—oatmeal, cornstarch, etc.—and if kept at 100° F. for a few minutes, the mass is soon liquefied and made digestible. The hydrated starch has been converted into dextrin and sugar. There is little or no alteration produced in taste, and if starch is to be given to an infant under a year old for any purpose, it may be prepared in this manner.

Vegetable Food

Nearly all the great divisions of the vegetable kingdom afford wholesome food for man.

Vegetable food eaten in large quantity increases the elimination of carbon dioxide from the lungs. It also makes the urine alkaline and intensifies the alkalinity of other secretions. The urine of herbivorous animals is normally alkaline when they are well fed, but during prolonged fasting it becomes acid. The nursing calf when taking only animal food from the mother passes acid urine, but after weaning, when the animal changes to a vegetable diet, the reaction becomes alkaline.

The chief vegetable proteids are vegetable albumin, vegetable casein or legumin, and gluten. The latter predominates in the cerealia, and the legumin is principally found in pulses. These proteids are less rich in nitrogen than the corresponding animal albuminates.

Many vegetables contain tough cellulose, and at best not over 50 per cent of this material is digested and assimilated in man, although the lower animals derive much more nutriment from it.

A purely vegetable diet is not economical for a labouring man, for the reason that to derive sufficient nitrogenous substance from it he must either obtain the very best and most expensive cereals or legumes, or he must eat a very large quantity of vegetables. (See Vegetarianism, p. 35.) By the addition of albuminous food or fat to his diet he saves both expense and wear and tear of his digestive organs. If unable to obtain fresh meat, he may employ for this purpose milk, bacon, lard, dried fish, such as herring or cod. Among vegetable foods oatmeal and beans will furnish him with the largest available proportion of nitrogenous material. Vegetables, except those which are really seeds, such as those of the leguminosæ or pulse tribe, contain but little fat.

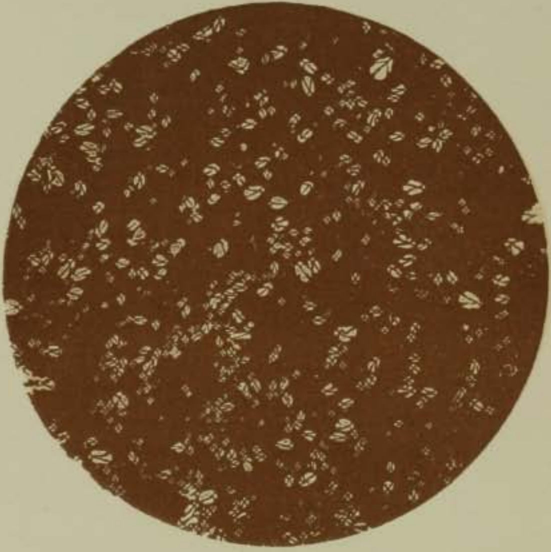
A strict classification of vegetables is impossible in these pages. Green corn is certainly a vegetable, but it is more conveniently described in connection with cornmeal, samp, etc., among the cereals. (See Maize, p. 156.)

Certain vegetables are classed as "green vegetables," meaning the lighter kinds of vegetables which contain considerable earthy salts and comparatively little starch, like spinach and lettuce, in distinction from heavy vegetables which contain much starch, like potatoes, beans, etc. The former term is used to describe fresh garden vegetables of all kinds in distinction from those which, like potatoes or onions, may be kept for some days or weeks without spoiling. The name is, however, too vague for accurate description.

"Greens" is the common name given to such vegetables as spinach, lettuce, beet tops, etc., which contain much chlorophyll and little starch or sugar, and which are eaten soon after being taken from the garden.

A simple division of vegetables for patients is (*a*) those the edible portions of which grow above ground and (*b*) those which grow below ground. With few exceptions, like the legumes, corn, and cabbage, the heavier vegetables—i. e., those which require more digestive power, and which contain abundant starch or sugar—grow below ground, or are tubers. Those which grow above ground are more digestible when fresh and young.

Celery, however, is not a tuber, is not especially "starchy," and yet grows, in part, at least, beneath the earth; so it is best in all important cases to specify by name the individual vegetables which can be partaken of rather than to describe them in general classes.



POTATO STARCH X 43

POTATO STARCH

(*From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau*).

PHOTO BY CLIFFORD RICHARDSON.

Many vegetables, in themselves difficult of digestion, may be made less so by conversion into well-cooked *purées*, or their extracts can be used for flavouring broths and soups for invalid use. Generally speaking, dried vegetables are much less digestible than when fresh. They become hard, stringy, and tasteless.

The following-named vegetables are those in common use which contain the largest percentage of both starches and sugars: Potatoes (both white and sweet), yams, beans, lentils, corn, peas, carrots, parsnips, beets, turnips.

Vegetable foods which are somewhat stimulant or pungent in their action are leeks, onions, garlic, herbs in general, mustard, cresses, mints, asparagus, and radishes. They increase the secretion of the saliva and gastric juice, and several are somewhat diuretic.

Some vegetables are laxative on account of their special chemical composition. Such, for example, are spinach, tomatoes, and most green vegetables when fresh and well cooked. Some, like cucumbers, are laxative from the seeds, or, like old corn, from the indigestible residue which they contain. The heavier vegetables, such as peas, beans, turnips, potatoes, etc., are liable to be constipating, although they aid normal peristalsis in that class of cases in which the diet has been previously mainly nitrogenous. (See Dietetic Treatment of Constipation.)

Vegetables which have a special antiscorbutic reputation are cabbage, tomatoes, and all those used for fresh salads. These also furnish calcium oxalate in the urine.

All vegetables which are eaten raw should be thoroughly washed beforehand; otherwise they may be contaminated with manure and other impurities, or the excrement of domestic animals which have been roaming in the garden. The larvæ of both tapeworms and roundworms have been transmitted to man in this manner. Water from foul wells is sometimes used for sprinkling gardens, and it is possible for typhoid, cholera, or other noxious germs to be spread by this means when the vegetables are eaten raw.

Legumes

Peas, Beans, Lentils, Peanuts.—Legumes rank next to cereals in importance as vegetable food. In middle and northern Europe among legumes peas are preferred, but in Mediterranean countries the use of beans and lentils predominates. In this country both peas and beans are extensively eaten, the lentil very little. Owing to the exceedingly leathery external envelope which they possess when old, legumes are very indigestible unless cooked for a long time, and if dried they require previous prolonged soaking in cold water, for drying diminishes their size and makes them extremely tough. Fresh legumes contain much water, and in percentage composition resemble the cabbage. They also contain much protein, carbohydrates, and a little fat. The proteid substance v. Liebig called "plant casein," from its resemblance to milk casein. It differs from the proteid gluten of grains and pea and bean flour and will not form dough or make bread. The percentage of protein in legumes exceeds that of the best beef (M. H. Abel). Although the legumes contain so large a percentage of protein, it is by no means all assimilated. Hoffman found that nearly one half of the protein of lentils passed off in the feces, being unabsorbed. Strümpell found that 40 per cent of the protein of whole beans—i. e., with the skins intact—is undigested; but when made into flour only 8.2 per cent of protein was unabsorbed, the latter corresponding with the digestibility of meat protein.

Legumes are liable to induce intestinal fermentation, with excessive and often annoying production of gas (methan), hence they are not available as the sole article of diet. If eaten as an exclusive food, eighteen ounces of dried peas or beans, making six pints of thick soup, would have to be consumed daily (M. H. Abel).

Dried or " split " peas have had the external envelope removed, and they may be made into nutritious *purées*. The tough external coats of old peas may often be found wholly unaltered in the feces.

According to Parkes, a pound of peas contains 168 grains of starch, and about 6.5 per cent of this food is wasted in the alimentary canal.

Fresh very young green peas, *petit pois*, are easily digested, and may occasionally be allowed in a convalescent dietary, but old and tough legumes require more mastication even than meat.

The legumes are often cooked with pork, which raises the percentage of fat in this form of food and adds to their nutritive value. Baked beans are cooked in this way, and also pea soup; the swelling starch granules mingle with the melting fat of the pork and make the dish more palatable as well as much more digestible than when this fat is added to meat in the form of croquettes or mince, when it merely smears the outside of the larger particles of food.

Erbswurst, or pea sausage, was introduced some years ago in the German army. It was invented in 1870 by a cook named Grünberg, and the German Government bought the secret of its preparation. It is a cooked food composed of pea meal mixed with fat pork and salt, so treated as to prevent the decay of legumin. It is highly nutritious, for the peas contain a large proportion of nitrogenous as well as starchy material, and the fat furnishes energy, but as a diet it soon becomes monotonous, and not infrequently produces flatulence and diarrhœa, for which the legumes are noted. The flatulence is caused by liberation of sulphuretted hydrogen from a substance called legumin.

Erbswurst may be quickly made into soups. It figured largely in the Franco-Prussian War, and was known as the "iron ration." A powdered "pea soup" may now be obtained which is composed of powdered peas and extracts of beef with salts and herb extracts for flavouring. A three-and-a-half-ounce package contains in grammes: proteids, 21; fats, 17.25; carbohydrates, 46.5. It is excellent for army service in the field.

Composition of some Prepared Military Pea Foods (Woodruff)

	Water.	Protein.	Fats.	Carbo-hydrates.	Wood fibre.	Ash.	Authority.
Erbswurst	12.09	31.18	3.08	47.50	....	6.15	Blythe.
" as first used	.....	16.00	35.00	27.00	....	.....	Parkes.
" 1887	.....	15.70	23.00	.....	....	.....	"
Dried pea soup (1)	7.58	16.93	8.98	53.44	1.34	11.73	König.
" " " (2)	8.08	15.81	24.41	36.78	1.69	13.53	"
Kopf's " " (used by the English army)	4.78	21.09	17.25	46.45	4.40	6.03	S. P. Sharpless.

Penzoldt has succeeded in obtaining predigested vegetable albumin by the following receipt:

Finest pea meal	250.0 grammes.
Pepsin	0.5 gramme.
Salicylic acid	1.0 "

Mix and let stand at 100° F. for twenty-four hours; strain.

The fluid retains the taste of pea soup, and is quite free from starch. It may be added to meat extracts or eggs, and may be flavoured with salt, pepper, and spices.

Haricots or *kidney beans* constitute a very serviceable article of diet, being one of the cheapest and best of all the pulses. These beans must be thoroughly soaked until swollen and soft before boiling, and should be only eaten when wholly tender. Their flavour is heightened by the addition of a little onion, parsley, or other aromatic vegetable, and their nutritive value is increased by cooking them with pork.

Fresh, young, and tender string beans are very digestible.

Young, fresh Lima beans are wholesome and very nutritious, but if old they are indigestible.

The *red bean* of the tropics, which is largely used in the Mexican army ration, is less prone to cause diarrhœa than the dry domestic white bean; but it has a more tender skin, is therefore less easily transported, and it absorbs moisture so rapidly that it is liable to ferment.

The *frijole* is a small, flat, reddish-brown bean much eaten in Mexico and neighbouring portions of the United States.

The *soya bean* is the chief legume of China and Japan, where it furnishes the necessary protein to add to a rice diet. From its vegetable casein several varieties of bean cheese are made.

13

Lentils.—Lentils are much cultivated in the south of France, and also near Paris. They are usually dried and split, in which condition they make a nutritious soup. They are used more on the Continent of Europe than in this country, and they are eaten in England, usually in the form of *purée*. Lentil flour contains twice as much protein as that of oats or wheat, and nearly twice as much lime (Roberts). The Hindoos rely upon the lentil for its staying power when undertaking arduous journeys.

Lentils are sold under the name of "*revalenta Arabica*" of which they form an ingredient (p. 160). Their taste is somewhat bitter, and on that account, unless disguised by some vegetable flavour, they may be disliked. Like the other legumes, they contain protein and fat, and are nutritious.

Peanuts.—The peanut is not a nut at all, but a legume growing under ground. It resembles nuts, however, in its large content of fat—50 per cent.

Peanuts are nutritious, but indigestible when roasted whole. Peanut flour is made from the ground and bolted nuts, and it is claimed that a pound of it contains as much nutritive material as three pounds of beef or two of peas. The peanut grits may be boiled like oatmeal or made into biscuits. Experiments have been made with the view of possible introduction of this food into the German army to be used like the Erbswurst of fame in the Franco-Prussian War. Peanuts contain considerable oil, which is extracted and sold largely as spurious olive oil. It is also sometimes used in the preparation of oleomargarine, and the roasted nuts themselves make a sort of imitation coffee. A form of peanut meal is prepared for diabetics which is said to contain little or no carbohydrate. Pancakes may be made from it. The meal contains 52 per cent of protein, 27 per cent of carbohydrates, and 8 per cent of fat. Four million bushels of peanuts are raised annually in the Southern States of this country.

Roots and Tubers

Roots and tubers constitute a very important class of vegetable foods. They contain both starch and sugar as well as a little pectin and potash salts. They have much less albuminous material than is to be found in any other forms of starchy food, and they also hold a large percentage of water. Many of them are very nutritious and even fattening, but in proportion to their bulk they afford less actual nutriment than either the legumes or cereals.

Potatoes.—The potato ranks first in importance among the class of tubers which serve man for food, both on account of its easy cultivation in a great variety of soils and on account of its digestibility when properly cooked. As an exclusive article of diet the potato is too largely composed of starch to be of much nutritive value, and enormous quantities have to be eaten (several pounds a day) in order to supply enough nitrogen for the energy of the body. The potato, however, has less starch than rice, peas, or lentils. It also has less woody fibre than most underground vegetables. In Ireland this vegetable constitutes a greater proportion of the daily food than in almost any other country, and in periods of famine has been known to form four fifths of the entire food for a time, but of late years it has been largely supplemented by the cultivation of Indian corn and other products. The flavour and quality of the potato is influenced very much by the soil and climate in which it grows, a sandy soil being best.

König gives the percentage composition of the potato as water, 75.77; nitrogenous materials, 1.79 (others give 2.10); fat, 1.60; starch, 20.56; cellulose, 0.75; ash, 0.97. It is thus seen to contain about one fourth solid matter.

The potato becomes a much more strengthening food when eaten, as it usually is, with meat gravy, fat, or butter and salt.

Potato juice has a faintly acid reaction, and its vegetable acids are mainly combined with salts of potassium, but also with sodium and calcium. It also contains traces of iron, phosphoric and sulphuric acids, chlorine, silica, and magnesia. Owing to the large proportion—from 12 to 24 per cent—of nearly pure starch which is found in the potato, it is very extensively used in this country and elsewhere for the manufacture of laundry starch. Old potatoes, and those which have been long kept, show some alteration in the quantity of their starch, and a part is converted into sugar and gum.

Potato starch, as compared with other starches, is thoroughly digestible, but much depends upon the cooking. The starchy granules are tough and absorb water from the acid juices which surround them and from water added in cooking, and when properly prepared the potato becomes soft and mealy. When this is not the case, however, it remains hard and soggy, and is thoroughly indigestible.

The following statement in regard to the potato is made in a recent report of the British Commissioners of Prisons:

" Within and surrounding the cells is a fluid or juice the albuminous constituents of which are coagulated during the process of cooking. The watery part of this juice is absorbed by the starch granules, which swell up and distend the cells in which they are contained, so that they no longer adhere together, and the result is the loose flocculent mass which is described as a floury or mealy potato. Unless the potato be properly cooked, the fluid referred to is only partially absorbed, the cells do not become sufficiently distended and separated, and the potato is then described as ' waxy ' and ' dense.' In this condition it is not digested, and consequently does not furnish to the system the antiscorbutic principle in which resides its chief value as an article of diet."

When potatoes are cooked in water, it is desirable not to remove their skins, for the latter prevent to a great extent the passage of the salts out into the fluid. The fact that potatoes will not decay if kept dry for a length of time makes them very useful vegetables upon sea voyages, when their antiscorbutic properties are especially serviceable.

Potatoes are more digestible when cooked by baking in their skins than by any other process. They then become mealy and their starch is digested with comparative ease by invalids. They are also quite digestible if steamed, or if boiled and mashed through a colander.

Potatoes must be avoided in all cases of feeble digestion unless they are perfectly mealy and crumble readily, and this quality depends not alone upon the method of cooking, but upon the nature of the potato itself, which varies according to the soil or the season of the year in which it has been grown. Very young potatoes are not mealy. They require more cooking and are less digestible than those of medium age. If too old, on the other hand, potatoes become waxy and equally undesirable. If they have been exposed to frost or have been cultivated in a damp, boggy soil, their digestibility is much impaired.

Sweet Potatoes.—The variety known as the sweet potato contains somewhat less starch than the white potato, having but 16 per cent, but it has more water, and a larger proportion of sugar—10 per cent. It forms a valuable and decidedly nutritious food which is eaten extensively throughout the United States, but it is not so digestible as the white potato, for it cannot always be obtained in a mealy form, and is sometimes stringy and sodden. A flour or meal can be prepared from it by drying. Its use in Europe antedates that of the white potato, which has to a great extent superseded it. These potatoes vary much more in flavour than do the white. In general, they should not be given to invalids.

The *yam*, another form of tuber, is eaten in the tropics and in some parts of Europe. It is mealy, but not very sweet, and it constitutes a wholesome and thoroughly digestible food.

The *Jerusalem artichoke*, or ground pear, is a tuber belonging to the sunflower family, which was originally introduced from Brazil. It is used more commonly in England than elsewhere, but is also sometimes cultivated in the United States. It is sweet and watery, for it contains little starch, and it is not "mealy" when cooked. It contains more sugar than the sweet potato, having 14 per cent of sugar, 3 per cent of nitrogenous material, and 2 per cent of inulin (Yeo). Its nutritive value is comparatively slight, but it is easily digested.

The Beet contains among its solid ingredients between 85 and 90 per cent of starches and sugars, a trace of salts, and somewhat over 1 per cent of proteid matter. It is a common source of sugar, which when refined is sometimes less sweet than cane sugar, but is otherwise as good. On account of the sugar which they contain, beets have the reputation of contributing to the formation of fat in the body. Young, tender beets are very nourishing, and they are often eaten in the form of salads or with vinegar and oil, and thus contribute a useful variety to the diet.

Succulent Tubers.—There is a group of succulent roots which contain considerable watery juice, and on this account are usually eaten fresh, for if kept long they become dry and less palatable, or are apt to decay; with care, however, they may be preserved in their natural state for a considerable period. They are very digestible, and when thoroughly boiled are nutritious. They are carrots, parsnips, turnips, salsify, and radishes.

Carrots consist of upward of 85 per cent of water, with a small proportion of salts, 8 per cent of carbohydrates with some sugar, and about 1 per cent of protein. The outer layers of the carrot contain a material called pectin that can be obtained as a jelly and mixed with fruit or meat jelly for flavouring invalid diet.

Young carrots, when soft and friable, if boiled are very tender and highly flavoured, and constitute a nutritious food. In France and Germany they are more popular than in this country and are cooked with other vegetables, although somewhat at the expense of the flavour of the latter. At the baths of Vichy they form a part of the daily breakfast.

Parsnips contain the sugar of starch with a large percentage of water, and they are sometimes fermented into an alcoholic beverage. They are a wholesome although less used food than carrots. The parsnip contains over 90 per cent of water and only 6 per cent of starch and sugar, with 1 per cent of protein, besides other materials. It is a rather strongly flavoured vegetable, and bulky in proportion to its nutritive value. It is extensively used for feeding cattle, and when young and properly cooked by prolonged boiling and seasoning it is a good food. It should be particularly avoided by those persons in whom there is any tendency to flatulency, which, like the legumes, it is apt to produce.

Turnips are less nutritive than either carrots or parsnips. They should never be eaten by the sick.

Kohl rabi, or turnip-root cabbage, yields an overground turnip, which is somewhat astringent.

Salsify, or oyster plant, is a root which has a mild sweet flavour somewhat similar to the parsnip, and is an excellent food of easy digestibility.

Radishes, which are not unlike turnips in composition, contain a large percentage of water and a comparatively small amount of starch. This vegetable is of no special value for nutrition, and serves chiefly as a relish. Being usually eaten raw, it is difficult of digestion, and is apt to produce eructations. It is rendered more digestible by cooking. It has some reputation as an antiscorbutic.

Green Vegetables

Composition.—Green vegetables do not contain much nutriment in comparison with the cereals and tubers, and they are mainly useful for furnishing a pleasing variation in diet and for supplying a large proportion of salts and some acids which are believed to be serviceable in the prevention of scurvy. The various uses of the salts have been elsewhere described (see p. 45). These vegetables often contain 90 per cent or more of water, which in itself is useful to the system in many ways. They furnish only a small quantity of nitrogenous material, which varies from 1.5 up to 4 per cent. In addition, they contain cellulose, chlorophyll, sugars, gum, pectin, and sometimes a little fat. Their variety of taste depends upon the presence of flavouring materials, chiefly essential oils. As a rule, they have a better flavour, and are more digestible when young than old, when they become tough and "stringy" from a relatively large percentage of cellulose or woody fibre. Since the green vegetables afford so little nutriment in proportion to their bulk, they are not of much service for persons with feeble digestion, and, unless they are young and tender, they are positively harmful by overtaxing the digestive system and irritating the alimentary canal. On the other hand, they are very useful in overcoming constipation by their bulky waste matter, which acts as a mechanical stimulus to peristaltic action and promotes movement of the bowels.

The digestibility of these vegetables is rendered much greater by careful cultivation in suitable soils. Owing to the large quantity of water which they hold (which readily evaporates), they soon wilt or become dry in market. For the most part they should be eaten when quite fresh, although celery and winter cabbage form an exception to this, as they may be kept for weeks.

Fresh green vegetables as well as roots or tubers are always made more digestible by cooking, which softens them. Their most digestible form for invalids is that of *purées*.

Cabbages.—The cabbage family, which belongs to the natural order *Cruciferæ*, furnishes many examples of green vegetables, some of which are of value for their leaves, and others for their modified flowers. There are about seventy varieties of cabbages. They contain considerable sulphur, which, if malfermentation exists in the alimentary canal, produces sulphuretted hydrogen, causing flatulence and unpleasant odour. They may also give rise to calcium oxalate in the urine, by causing indigestion, and they should be avoided by the rheumatic or gouty, and, in fact, by all classes of invalids. Cabbages and other vegetables of this order impart a strong taste and odour to the water used for boiling them. When soft and crisp, cabbage is a wholesome food for those with strong digestion, and it has decided antiscorbutic properties when fresh, which are lessened by fermentation.

The principal edible representatives and preparations of the cabbage family are the following:

1. *Sauerkraut* is made by placing salt between layers of cabbage leaves and subjecting them to pressure, which bruises them and squeezes out their juices. The mass then ferments with the formation of organic acids.

2. *Cauliflower* and *broccoli* are the flowers of plants which are grown large and tender by cultivation. When boiled and served with a milk sauce they are much esteemed for their flavour and easy digestibility in healthy stomachs, but they cause flatulence if eaten by dyspeptics. These vegetables may be dressed with olive oil and eaten as a salad.

3. *Cole* is a plant of the cabbage family which does not "head."

4. *Seakale* is grown in the dark, so that it has no chlorophyll. It is equally digestible with cauliflower if well bleached. It is more often cultivated in England than in this country.

Spinach, beet tops or "greens," dandelion tops, and turnip tops are all useful green vegetables, and of these spinach, which is slightly acid, is the most common and desirable. These substances afford almost no nutriment, and are valuable chiefly for their laxative action. The mineral salts which they contain, especially those of spinach, have been shown by Luff, of London, to be of positive value in gout in increasing the solubility of sodium biurate and retarding the conversion of quadriurates into biurates. (See Gout.) If the leaves are young and tender, and if they are cooked until they become quite soft and are then chopped into a fine pulp, they are very wholesome articles of food for the relief of chronic constipation. The dandelion leaves have a less delicate flavour than spinach, and are said to possess a slight diuretic action. Unless bleached they are bitter. The dandelion root is laxative, like the leaves, and it forms an ingredient of root-beer.

Lettuce, etc.—There is a group of vegetables of which lettuce is the chief type, the leaves of which are eaten raw. They are useful for their flavour and for the variety which they furnish in the course of a meal. They cannot be said to possess any nutrient value, but they are usually taken with vinegar and oil, and the latter is very nourishing. Since they contain little starch and practically no sugar, they may be allowed in the diabetic regimen.

Sorrel and cress, or peppergrass, are used in the making of salads, but less in this country than in Europe. Sorrel has a somewhat pungent or acid flavour, which is due to acid oxalates, and this fact renders it unfit for use by patients who are subject to attacks of gout and rheumatism or who have the uric-acid diathesis. A fatal case of sorrel-poisoning in a boy five years of age has been reported. To quench thirst, excited by eating a quantity of sorrel, he swallowed some soapy water, the alkali of which produced a soluble oxalate. A quantity of oxalic acid was found in the stomach.

Many other substances are mentioned in works on dietetics which are used in the making of salads or pickles and as relishes. They are antiscorbutic and serve to stimulate the digestive secretions and give a fillip to the appetite. Such are green peppers, capers, mint, tarragon (an aromatic Siberian plant), parsley, chervil, endive, chicory, okra.

Celery is a wholesome vegetable when cooked in milk until it is quite soft; but eaten raw it is stringy, and, as it has but little nutritive value, its use in that form should be discarded by invalids. Its aromatic flavour makes it very popular, and it furnishes a useful addition to a light luncheon with bread and cheese. It has acquired an undeserved reputation for use in rheumatism. "Celery salt" is an agreeable flavouring substance for soups and salads. Various preparations are made from the plant, which are sold by druggists as hypnotics. They are of no value.

Artichokes are a variety of thistle. They contain tannin and mucilaginous materials, but nothing of true nutrient power, although, according to Moleschott, they hold 17.75 per cent of organic matter.

Green artichokes when tender and thoroughly cooked are easily digested, but their cost in this country prevents them from being consumed except as an article of luxury. They may be given to some diabetic patients among the few vegetables which they can eat with impunity. Eaten raw, as they sometimes are in France, they are very indigestible.

Tomatoes.—The tomato is a vegetable which was introduced into this country about sixty years ago, the value of which is becoming more and more appreciated. In Germany it is still sold as a fruit of luxury rather than as a common vegetable. It is wholesome when eaten raw as a salad with vinegar and oil, and it forms a popular ingredient of strong condiments, such as tomato catsup. It is refreshing, slightly acid, and easily digested. The oxalic acid which it contains makes it injurious in cases of gout or the uric-acid diathesis. The tomato is much prized as a canned vegetable on account of the fact that it retains more of its original flavour than do most vegetables preserved by this process.

The *eggplant* is related to the tomato, and like it contains many seeds when full grown, but it is much less digestible, especially when fried, and is not a suitable food for invalids.

Cucumbers are mainly eaten raw, and they should be young. Like celery, they contain too much woody fibre to be consumed in bulk. They are valuable for pickling in vinegar or in the making of chow-

chow, but they are always indigestible; this is due in great part to the large size of the seeds which the vegetable contains, and it should never be eaten by any one excepting those having vigorous stomachs. Eaten raw, even in small quantities, it may produce violent colic and diarrhœa.

Asparagus is a vegetable possessing a very delicate flavour, and from the fact that it is among the first of the fresh vegetables to appear in the early spring it is highly esteemed. When young and tender it is very digestible, even for invalids. The green asparagus contains more bitter and resinous principles than the white. It has been claimed that it possesses some influence as a cardiac sedative as well as aphrodisiac action, but these properties are imaginary. It is, however, slightly diuretic, and it owes this influence to a substance called asparagin, which may be obtained in crystalline form. Asparagus imparts a very strong and disagreeable odour to the urine which I have known to appear within an hour after it has been eaten, and which persists from twelve to twenty hours. It is caused by a volatile sulphur product, a methyl mercaptan, which has been proved to originate in the intestine during digestion, from whence it is absorbed.

Rhubarb, or "pieplant," the stems of the leaves of which are eaten stewed, is an excellent vegetable. The flavour is quite tart, and the fibre is stringy, but thorough cooking renders it soft and digestible. It is laxative, and is therefore useful in cases of chronic constipation. This wholesome vegetable has not received the attention it deserves. In Germany, for instance, it is still grown merely as an ornamental garden plant on account of its large showy leaves. It produces calcium oxalate in the urine if eaten in excess, and must therefore be avoided in oxaluria, gout, and rheumatism.

Pumpkins and *squash* contain much water and a good deal of coarse fibre. Tender and young summer squash is fairly digestible, but presents no special dietetic advantages. The pumpkin is one of the oldest vegetables on this continent, for it was grown extensively together with maize by the early Indian tribes.

Onions, *garlic*, *shallots*, and *leeks*, which are edible both as fresh vegetables, and after long keeping, are useful as condiments for flavouring salads, meat stews, and other foods. They are also eaten independently for their nutritive properties, which are somewhat greater than those of the four or five vegetables last considered. Tender young leeks and white onions boiled and served with milk or cream are very wholesome and of delicate flavour. They possess, in common with the other green vegetables, a moderate laxative action, and are antiscorbutic. They impart a strong typical odour to the breath, which appears within two or three hours, and if constipation exists, persists for twenty-four hours or more. This is due to volatile substances which are absorbed by the blood from the alimentary canal and carried to the lungs, where they are liberated.

Vegetable marrow is a highly succulent vegetable, somewhat resembling the pumpkin. It possesses an agreeable flavour, but consists so largely of water that it is of scarcely any use as food.

Cranberries are really more of a fruit than a vegetable, but they are usually eaten with meat as a vegetable. They are serviceable for their agreeable acidity and flavour, but unless very thoroughly cooked and made into a jelly with much sugar, they are indigestible, for their outer coatings are extremely tough. They should never be given to invalids.

The composition of some common vegetables is thus tabulated by Moss:

Composition of Vegetables

CONSTITUENTS.	Potato (Payen).	Potato (Letheby).	Sweet potato (Payen).	Jerusalem artichoke.	Carrots (Letheby).	Parsnips (Letheby).	Turnips (Letheby).	Cabbage.
Nitrogenous matter......	2.50	2.1	1.50	3.1	1.3	1.1	1.2	2.0
Starch, etc.............	20.00	18.8	16.05	...	8.4	9.6	5.1	
Cellulose...............	1.04	....	0.45	1.5	...	...	...	5.8
Sugar and gummy matter	1.09	3.2	10.20	14.7	...	5.8	2.1	
Fatty matter............	0.11	0.2	0.30	0.2	0.2	0.5	...	0.5
Saline matter...........	1.26	0.7	2.60	1.3	1.0	1.0	0.6	0.7
Other organic matter....	......	....	1.10	...	...	...	...	...
Pectic acid.............	......	....	.....	0.9	...	...	...	...
Pectin..................	......	....	.....	0.4	...	...	...	...
Inulin..................	......	....	.....	1.9	...	...	...	...
Water...................	74.00	75.0	67.50	76.0	83.0	82.0	91.0	91.0
Total.............	100.00	100.0	100.00	100.0	100.0	100.0	100.0	100.0

The following analyses of common vegetables have been made by König:

	Carrots.	Turnips.	Beet root.	Celery.	Onions.	Cabbage.
Water..................	88.32	91.24	87.07	84.09	85.99	89.97
Nitrogenous matters.......	1.04	0.96	1.37	1.48	1.86	1.89
Fat.....................	0.21	0.16	0.03	0.39	0.10	0.20
Sugar	1.90	4.08	0.54	0.77	2.78	2.29
Other non-nitrogenous extractives	7.17	1.90	9.02	11.03	8.04	2.58
Cellulose...............	0.95	0.91	1.05	1.40	0.71	1.84
Ash	0.71	0.75	0.92	0.84	0.70	1.23

	Cauliflower.	Brussels sprouts.	Spinach.	Lettuce.	Asparagus.	French beans.
Water..................	90.39	85.63	90.26	94.33	93.32	88.36
Nitrogenous matters.......	2.53	4.83	3.15	1.41	1.98	2.77
Fat	0.38	0.46	0.54	0.31	0.28	0.14
Sugar	1.27	....	0.08	....	0.40	1.20
Other non-nitrogenous extractives...............	3.74	6.22	3.26	2.19	2.34	6.82
Cellulose...............	0.87	1.57	0.77	0.73	1.14	1.14
Ash.....................	0.82	1.29	1.94	1.03	0.54	0.57

The two preceding tables differ slightly in detail, but no more than the average variation in percentage composition of the vegetables when not grown under identical conditions. They agree as nearly as can be expected.

FRUITS

Composition.—The varieties of fruits which are consumed in all countries are innumerable, and their uses are various. Sweet fruits no doubt largely composed the diet of primordial man, as they do of every savage tribe to-day living outside of the Arctic Zone.

Speaking generally, fruits are composed largely of water with starches, sugars, a vegetable jelly called pectin, cellulose, and organic acids.

Pectin is a carbohydrate substance found in ripe pulpy fruits. It enables fruit to gelatinise when boiled. Its properties and composition are not thoroughly understood.

The *organic acids* exist mainly in union with alkalies, forming compounds which are readily split up in the system, leaving the alkalies free to combine as carbonates or phosphates.

The most important acids are citric, malic, and tartaric, which exist in various quantities and combinations.

Citric acid predominates in lemons, limes, and oranges; tartaric acid in grapes; malic acid in apples, pears, peaches, apricots, gooseberries, and currants.

Among the least acid of the common fruits are peaches, sweet pears, sweet apples, bananas, and prunes; moderately acid are strawberries. The most acid of all are currants and lemons.

Fruits contain a smaller proportion of earthy salts than other foods.

Certain fruits also hold a little nitrogenous material, chiefly as albumins, but, as a rule, the starches and sugars predominate, and the nutritive value of any fruit depends upon them chiefly. Most fruits contain too much water to constitute an economic diet if eaten alone. Some also contain a small quantity of fat and waxy matter, and most of them have more or less pigment.

Fruits which are especially rich in flavour, and which exhale a pleasant aroma, owe these conditions to the various essential oils and compound ethers which they possess in considerable amount.

Many fruits are only partially edible owing to the fact that they are composed of a pulp contained within an indigestible structure of cellulose or woody fibre.

Fruits are commonly classified into stone-bearing fruits, pomes, berries, capsules, and pepos. Some, such as the date, the plantain and its variety, the banana, afford sufficient nutriment to amply support life for a long time; others, like the apple, are wholesome, but slightly nutritious; while others again are of little value for nutritive purposes, and are mainly serviceable for their agreeable flavour to furnish variety in the diet.

Composition of Fruits (Bauer)

	Apple.	Pear.	Peach.	Grape.	Strawberry.	Currant.	Orange, pulp only.
Water	83.58	83.03	83.03	78.18	87.66	84.77	89.01
Nitrogenous matters	0.39	0.36	0.65	0.59	1.07	0.51	0.73
Free acids	0.84	0.20	0.92	0.79	0.93	2.15	2.44
Sugar	7.73	8.26	4.48	24.36	6.28	6.38	4.59
Other non-nitrogenous matters	5.17	3.54	7.17	1.96	0.48	0.90	0.95
Cellulose and kernel	1.98	4.30	6.06	3.60	2.32	4.57	1.79
Ash	0.31	0.31	0.69	0.53	0.81	0.72	0.49

Composition of Fruits (Yeo)

	Apple.	Cherry.	Raisin.	Fig.
Water	27.95	49.88	32.02	31.20
Nitrogenous matters	1.28	2.07	2.42	4.01
Fat	0.82	0.30	0.49	1.44
Free acid	3.60	.....	.....	1.21
Sugar	42.83	32.22	54.26	49.79
Other non-nitrogenous matters	17.00	14.29	7.48	4.51
Cellulose and seeds	4.95	0.61	1.72	4.98
Ash	1.57	1.63	1.21	2.86

Fruits arranged According to the Proportions between Acid, Sugar, Pectin, Gum, etc. (Average). (Fresenius)

Fruits.	Acid.	Sugar.	Pectin, gum, etc.
Plums	1	1.6	3.1
Apricots	1	1.7	6.4
Peaches	1	2.3	11.9
Raspberries	1	2.7	1.0
Currants	1	3.0	0.1
Blackberries	1	3.7	1.2
Whortleberries	1	4.3	0.4
Strawberries	1	4.4	0.1
Gooseberries	1	4.9	0.8
Prunes	1	7.0	4.4
Apples	1	11.2	5.6
Sweet cherries	1	17.3	2.8
Grapes	1	20.2	2.0
Red pears	1	94.6	44.4

Fruits arranged in the Order of their Content of Sugar (Average). (Moss)

Peaches	1.6 per cent.
Apricots	1.8 " "
Plums	2.1 " "
Reineclaudes	3.1 " "

Mirabelles	3.6 per cent.
Raspberries	4.0 " "
Blackberries	4.4 " "
Strawberries	5.7 " "
Whortleberries	5.8 " "
Currants	6.1 " "
Prunes	6.3 " "
Gooseberries	7.2 " "
Red pears	7.5 " "
Apples	8.4 " "
Sour cherries	8.8 " "
Mulberries	9.2 " "
Sweet cherries	10.8 " "
Grapes	14.9 " "

Uses and Properties.—The uses of the different fruits may be summed up as follows:

1. To furnish nutriment.
2. To convey water to the system and relieve thirst.
3. To introduce various salts and organic acids which improve the quality of the blood and react favourably upon the secretions.
4. As antiscorbutics.
5. As diuretics, and to lessen the acidity of the urine.
6. As laxatives and cathartics.
7. To stimulate the appetite, improve digestion, and give variety in the diet.
8. As special "cures" for certain diseases, like the grape cure, although their specific action is very doubtful.

In a study of the diet of women students at Lake Erie College in Ohio, made in 1900 by Isabel Bevier and Elizabeth C. Sprague, it was found that an increase in fresh fruit consumption, especially at breakfast, showed that more breakfast was eaten and it materially lessened the craving for sweets.

Fruits which afford the most nutriment are the banana, date, fig, prune, and grape. This is due to the large proportion of sugar which they contain.

Fruits which contain the most water are muskmelons, watermelons, oranges, lemons, limes, shaddocks, and grapes.

The antiscorbutic value of fruits is illustrated particularly by certain varieties which furnish abundant potash salts, as well as lime and magnesia. Among these are to be mentioned apples, lemons, limes, and oranges.

The diuretic influence of fruits is in part due to their water, but chiefly to their organic acids and salts, which stimulate the circulation and probably also the activity of the renal epithelium.

Fruit-eating lessens the acid of the urine or even makes it alkaline owing to decomposition of various alkaline salts in the blood or tissues, which are reformed into alkaline carbonate and, as such, are excreted. For this reason fruit is sometimes beneficial in lithæmia and allied conditions to prevent accumulation of acid urates.

The laxative action of fruits is partially derived from indigestible substances, cellulose, seeds, etc., and also, no doubt, from the special influence of their organic ingredients, which in some instances is very striking.

The best fruits to offset constipation are fresh apples, figs, prunes, peaches, and berries. Dyspeptics must be careful to avoid eating all hard skins, seeds, or coarse-fibred fruits.

Fruit Ripening.—As fruit ripens it absorbs more and more oxygen, and the tannin and vegetable acids which it originally contained are altered, so that it becomes less astringent and acid. The starch is more or less completely turned into levulose or glucose, and soluble pectin is formed. The aroma and taste of ripe fruits depend upon the relative quantity of these different substances, together with various volatile ethers and oils. The sour fruits have either more acid or less sugar, and in the sweet fruits there is a preponderance of sugar which masks the acid taste. The more luscious the fruit, the more soluble sugars and special flavouring substances does it contain.

The employment of fruits as a common article of daily diet is highly beneficial, and the improvements which have been made of late years in methods of culture and means of rapid transportation make some varieties of fresh ripe fruits, such as the orange and the banana, available in almost every climate in all seasons, while their increasing cheapness places them within reach of the poor.

Fruit Poisoning.—While fruits eaten daily and in proper moderation are very wholesome, if they are eaten too freely, or if they are either insufficiently ripe or overripe, soft, and decomposing, they undergo malfermentation in the alimentary canal, and are almost certain to cause diarrhœa with colicky pains, cramps, and sometimes nausea and vomiting. Severe attacks of gastritis may, especially in children, be produced by indulgence in unripe apples, pears, cherries, berries, etc., and even fatal choleraic diarrhœa has been occasioned by the indiscriminate consumption of fruits which have strongly laxative action. After such fruit poisoning, emesis should be excited if the patient is seen in time, and otherwise, if free purgation has not occurred, it is advisable to give a dose of castor oil or other cathartic, to remove the irritating substances as soon as possible from the alimentary canal. In bad cases, prolonged gastric fever may ensue. Some tropical fruits possess specific poisonous properties.

When to Eat Fruit.—*Cooked fruits* may be eaten with any meal, but usually when fruit is eaten for special dietetic purposes its effect is always more pronounced if taken alone, either at the commencement of meals or, better, between them. One often observes patients who can obtain no laxative effect from apples, figs and other fruit eaten as dessert, but which taken at night into an empty stomach or an hour before breakfast, with a glass or two of cold water, has a very pronounced favourable influence upon the bowels.

The poorest time for eating fruit is at the conclusion of a very hearty dinner at which considerable variety of food has already been consumed. Fruit in general is less wholesome when eaten out of its natural season. All fruits, such as berries, the seeds of which are eaten, are much less liable to produce intestinal irritation if taken with bread or other bulky starchy food. Raw fruit unless eaten at once after picking should be well washed. The skin and seeds of the larger fruits and of grapes are quite indigestible.

Fruit Soups.—In Germany fruit soups are more in vogue for general use than in this country, and they are often prescribed in fevers when diarrhœa does not exist. Uffelmann directs that for making a fruit soup one part of fruit to four or five of water may be used, and Bauer recommends soups "made by boiling fresh or dried fruits with water, with or without the addition of sugar, lemon peel, etc., and freed from the solid residue by pressure."

Dried Fruits can be eaten less abundantly than fresh fruits. Some of the dried fruits are wholly indigestible; such are currants and citrons. Others, like figs or prunes, are wholesome, and raisins, sultanas, dates, etc., contain considerable nourishment. All these dried fruits are preserved in their own sugar (glucose), which forms a sticky, gummy, non-crystallised mass. Dried apples, peaches, prunelles, etc., are preserved simply by the evaporation of the excess of water which they contain.

Dried "currants" are the berries of a vine cultivated in the Ionian Islands. The word currant is a corruption of Corinth. The fruit in its dried state is wholly indigestible.

When dried fruits, such as figs or dates, have become too hard they may be softened and made more palatable by pouring boiling water over them and allowing them to soak for a few hours, or the fruit may be put into cold milk and brought to the boiling point over the fire. This method will soften them in a quarter of an hour.

A simple fruit diet which has been advocated for the cure of obesity and other ailments is the following: Three meals a day are eaten, consisting of half a pint to a pint of milk, with from two to six ounces of whole-meal bread and a similar quantity of figs or dates, prepared in milk as above described. Obviously this diet is not sufficiently sustaining to be long endured.

Digestibility.—Among the commoner fruits of easy digestion are grapes, oranges, grape fruit, lemons, cooked apples, figs, peaches, strawberries, and raspberries.

Somewhat less digestible are melons, prunes, raw apples, pears, apricots, bananas, and fresh currants.

Of course the digestibility depends very much upon ripeness and freshness of the fruit as well as personal idiosyncrasy, and any classification can only be approximate.

Fruits most Useful for Invalids.—The most useful fruits for the sick are lemons, oranges, baked apples, stewed prunes, grapes, banana meal (not the fruit pulp).

Varieties of Fruits.—*Lemons, limes,* and *shaddocks* may be considered together as possessing the same general properties. Owing to the potash and other salts and abundant vegetable acids which they contain, they are the most serviceable of the antiscorbutic fruits, and also afford an agreeable acid and pungent flavour to articles of diet which might become monotonous in taste. For many persons the addition of a little lemon juice to some articles of food, such as cooked cereals and porridge or broiled fish, renders them more immediately digestible, and it can be regarded as having almost a specific action in promoting gastric digestion, although it is difficult to say in just what manner this comes about. Lemons are therefore a most desirable addition to the diet kitchen.

Lemon juice is a well-known mild remedy for seasickness, and holding a thin slice of freshly cut lemon in the mouth often removes the disagreeable taste from a coated tongue, cleanses the mouth, and may even counteract nausea. Sour lemonade taken in moderation, and made quite strong by squeezing the juice of one or two lemons in a small tumblerful of water, with the addition of only one or two lumps of sugar, is a cooling and refreshing drink in fevers, and does more to diminish the craving of thirst than almost any other form of beverage.

For those who fancy effervescing drinks, the lemonade may be improved by using one of the aërated waters—such as Apollinaris, Vichy, or carbonic-acid water—instead of plain water, or effervescence may be produced by the addition of five or ten grains of sodium bicarbonate. In many cases this mild remedy is beneficial to the stomach.

Henry claims that pure lemon juice poured into the nose will often control epistaxis. Fresh lemon juice has a popular reputation for warding off rheumatism, but it has been shown to have very little influence over nitrogen elimination, although it increases the phosphates of the urine (K. Dauber).

Limes.—The lime is a thin-skinned acid fruit, but there is also a sweet variety. Although less extensively eaten throughout this country than the lemon, which it resembles in effect, it is equally serviceable, and nearly ten thousand gallons of condensed lime juice are imported annually into this country from Jamaica. To make this juice the fresh limes are pressed by machinery, and the seeds and pulp are removed by straining and filtering. The juice is then boiled down to a high degree of concentration. It is carried on sailing vessels to prevent scurvy, and used in almshouses and prisons, where the diet is monotonous.

The *shaddock, pomelo,* or *Citrus pomelanus,* is a very large, globular pulpy fruit, which may attain to a weight of fifteen pounds. The rind is thick and acid, and the very juicy pulp is bitter. The fruit keeps fresh for a long time. A smaller variety, known as the grape fruit, has come into general use of late, although it is still a relatively expensive fruit in most parts of the country. It grows in pendant clusters. Many persons find that half a grape fruit taken at the commencement of breakfast has both a laxative and diuretic action, and it is always cooling and agreeable to those who do not dislike a bitter taste. The objection to its use is that it requires a large quantity of sugar to make it really palatable and diminish its astringency. This is disadvantageous in cases of flatulent dyspepsia, but for invalids who are convalescing from prolonged fevers, suppurating disease, etc., an excellent tonic may be given by cutting a grape fruit in two and pouring half an ounce or more of good rum into the fruit, with the addition of a little sugar. The bitterness is entirely disguised and the combination is agreeable and appetising.

Oranges.—Oranges are an exceedingly useful article of invalid diet. The juice of ripe oranges allays thirst, and it is well borne in cases where there is considerable gastric irritation and tendency to vomiting. It is only in the worst forms of gastric disorders that orange juice disagrees, and there is no fruit which is so generally available in the sick-room, for it is agreeable to almost every one, and is refreshing in fevers. I often give it in typhoid fever. Orange juice is laxative, particularly for infants, and is the best remedy for infantile scurvy. It may be given undiluted or made into orangeade with one of the effervescing waters. In renal and other diseases in which it is desirable for the patient to drink large quantities of fluid for its diluent and diuretic effect, the addition of orange juice to beverages will encourage their consumption.

Orange marmalade is a wholesome relish, having an appetising, bitter flavour.

Orange water ice, as well as lemon ice, well frozen, if not made too sweet, may be allowed in the milder forms of fever, inflammations of the throat, etc., especially in children. It is soothing, refreshing, and cooling, and is less likely to disagree than the richer ice cream.

Apples, when ripe and properly selected, are extremely wholesome and very digestible. They contain abundant potassium and sodium salts, as well as those of lime, magnesium, and a trace of iron. Their nutritive value is not high, depending mainly upon a little sugar, for they are largely composed of water, having over 83.5 per cent (Bauer). In dried apples the percentage of water is reduced to one third, while that of sugar is proportionately increased.

Apples contain free organic acids (malic and gallic) as well as salts, such as malates, citrates, and tartrates. They also contain lime, phosphates, plant albumin, gum, and chlorophyll. They are good antiscorbutic remedies, and are laxative, especially when taken into an empty stomach. There are many dyspeptics who thrive upon apples, even if eaten raw, and who can regulate the action of the bowels with them effectually. They should be given to most invalids only when cooked. They are most digestible when baked and eaten with cream, or they may be beaten with white of egg to add to their nutritive power. They are both palatable and very digestible for convalescents if stewed as apple sauce, when there is no objection to the addition of the greater quantity of sugar which is required in this method of cooking. They should be avoided in all cases of diarrhœa, gastro-intestinal irritation, and diabetes.

Pears are similar to apples in their effect, but are less laxative. If fully ripe and soft they are even more digestible raw than apples. They have the advantage of keeping their flavour when well preserved in sirups, but they possess no special food value, and are mainly used for their choice flavour, aroma, and appearance, which stimulate the appetite.

Quinces are indigestible unless very thoroughly cooked.

Peaches, *nectarines*, and *apricots* are of comparatively little nutrient value, but their flavour and appearance make them tempting articles for the table. They do not contain as much sugar as apples and other fruits. When thoroughly ripe they are wholesome if not eaten in excess. They agree well with some gouty persons, and are even allowed to diabetics in cases of moderate severity. Peach and apricot juices are laxative.

Pineapples (*Ananassa sativa*), as usually obtained in this country, have been picked green in Cuba, and if eaten raw are indigestible. Their ripe juice is, however, very wholesome, and they contain a ferment capable of digesting proteid material, which is used to some extent in the preparation of predigested invalid foods, such as Mosquera's beef meal. Prof. R. H. Chittenden has isolated this ferment, which has a rapid softening, disintegrating, and digesting effect upon such proteids as blood fibrin and muscle tissue. It is an acid fluid which acts best in a neutral medium, but, like trypsin, it also digests in both acid and alkaline solution. Three ounces of the juice will dissolve ten to fifteen grains of dried albumin in four hours. He also found a milk-curdling ferment in the juice.

Tamarinds are cooling and laxative. When added to milk they cause curdling, and form a whey which may be used as a beverage in fevers when constipation is to be overcome.

The *mango* is a sweet and somewhat acid fruit, with moderately laxative action.

The *pomegranate* is a pulpy fruit, wholesome when fresh, but it is expensive and little used in this country. It has a thick, tough rind, which is astringent, with a bitter-sweetish taste. A tæniacide for the tapeworm is made from an infusion of the rind, but it is so nauseous and disgusting to the taste that patients can seldom retain it unless it is put into the stomach with a tube.

Bananas.—The banana is really a variety of the plantain, or *Plantago musa*, but the fruit is not so large or so hard as that commonly called plantain, and the flavour is far more delicate. The botanical name of the banana, *Musa sapientum*, was given because it constituted the principal food of the Brahmin caste of India. There are many score of varieties of the banana, ranging from the most delicate examples of the *Musa sapientum* family to the heaviest of the plantains, and they vary in digestibility as they do in flavour. Casati (Equatorial Province, 1891) names some fourteen varieties, having different characteristics and existing in the Equatorial Province of Africa alone. He noted that, curiously, only the women and children ate the natural fruit, the warriors feeding on the fruits dried and prepared in oil—probably from an intuition that they were more highly nourished by the concentrated food.

In the West Indies, in the islands of the Pacific, along the Congo, and throughout Central Africa many natives eat bananas as their staple article of food, and maintain good physical development. The fact that a diet consisting solely of this fruit will sustain life for long periods is owing to the relatively high percentage of nitrogen which it contains compared with sago, arrowroot, and similar carbohydrates. This percentage amounts to nearly five parts per hundred of the entire fruit, or one fifth of the total solids (Corenwinder).

Grown on a given acreage, bananas will support a larger number of persons than wheat.

The banana has of late years assumed a very important position among fruits sold in this country. Improvements in cultivation and means of transportation, and the length of time through which the fruit will keep without spoiling, are accountable for this, and upwards of one hundred thousand bunches of bananas are sold per month for distribution in New York city and vicinity alone. It ranks equally with the orange in extent of consumption, and during the winter months it is often the only fresh fruit which is universally obtainable in remote country districts, while its cheapness places it within the reach of almost every one.

In British Guiana the banana is employed especially as a nourishing food for young children and invalids.

Many persons find that they cannot easily digest bananas as we obtain them in this country; but this no doubt depends upon the fact that the fruit shipped to the United States is picked very green, and is often quite immature and irregularly ripened when eaten. Imperfectly ripened bananas are composed chiefly of starch, but, as the natural ripening proceeds, the saccharine material is converted into a mucilaginous substance, which in turn forms dextrin and glucose.

The flour, which is made by drying carefully selected and well-ripened bananas, is, however, remarkably easy to digest, and highly nutritious.

Surgeon Parke ("My Personal Experience in Equatorial Africa," (p. 416), in an instructive and interesting account of his experience with the sick of the Emin Pasha Relief Expedition, refers to Mr. Stanley, who was in the midst of a severe attack of acute gastritis, as follows: " He eats porridge made with banana flour and milk. It is very light and digestible, and has more flavour than arrowroot; it is also very nutritious. We whites have very good reason to know this fact now, as we have mostly lived on banana flour for the past two years."

During most of this period, it should be observed, the members of the expedition were taking very long marches and were suffering from frequent attacks of malarial fever, which were a severe test of the nutritive qualities of any dietary.

Farinaceous food is so prone to undergo malfermentation in the stomach when the normal digestion is disordered that it becomes very important to seek some variety of starchy food which can be easily assimilated without the production of acid eructations, flatulence, or heartburn. The starchy foods which have heretofore been obtainable in this country for this purpose have been all derived from tubers or cereals which have been rendered more assimilable by predigestion or " malting."

It is difficult to make a good fruit flour, for many fruits, when dried, form a mucilaginous mass like the fig, or a sticky material like the raisin, or shrivel to a stringy substance like the apple and the apricot. But the banana, in some varieties and conditions, constitutes an important exception, and when carefully selected and thoroughly dried it can be ground into a meal or even into a flour, making as fine a powder as arrowroot, having a white or pale greyish or yellowish colour, and an agreeable faintly aromatic odour and taste.

This meal possesses decided intrinsic advantages as an invalid food. I have tested these preparations, both experimentally in the laboratory and clinically, and found that an unboiled, saturated aqueous solution of banana flour contains a very large percentage of sugar—from one half to three fourths as much as certain of the best known prepared saccharine foods for infants to which sugar had been artificially added. The finest banana flour, called " bananose," at the end of one and a half hour of pancreatic digestion was capable of developing twice as much sugar as the same quantity of oatmeal or farina, and approximately one and a half time as much sugar as cornstarch. Saliva, when substituted for pancreatic extract, produces a similar effect.

The banana flour, when prepared from the best quality of bananas, is made into a thin gruel or porridge by the addition of either water or milk, and eaten with cream it constitutes a delicious and highly nutritious article of diet suitable in cases of gastric irritability and acute gastritis, etc. It is particularly serviceable for children between five and ten years of age. For those craving an acid flavour, lemon juice with powdered sugar upon the banana porridge is found to be very acceptable. The records of some fifty patients in the New York and Presbyterian Hospitals to whom I gave gruel or porridge made with banana flour show that it was exceptionally well borne by irritable stomachs, almost never vomited, having no tendency to produce acidity from flatulence, nor did it cause diarrhœa or any apparent laxative effect. It proved very useful in several cases of simple gastritis and acute gastritis complicating chronic indigestion and in the early convalescent stage of typhoid fever. It was used with advantage even during the fever itself whenever a change from an exclusive milk diet seemed indicated either by the patient's dislike for milk or by its causing dyspepsia.

The taste of banana flour is peculiar, and is not always agreeable at first; but it may be so modified by different processes of cooking that the majority of patients find it much more palatable than the conventional arrowroot, cornstarch, or farina. It is a decided gain to be able to enlarge the list of starchy foods adapted to feeble digestions by a fruit flour which presents the following advantages: An agreeable variety of taste; a high percentage of nitrogen, dextrin, and glucose; ready digestibility; high nutritive value; the property of keeping definitely in a concentrated dry state, ready for immediate use.

Grapes.—Grapes are universally grown and enjoyed on account of their delicious flavour and aroma as well as their general wholesomeness, and they constitute an important article of diet. Perfectly ripe and seedless grapes, such as the Black Hamburg and other varieties, have long been recognised as an excellent food for invalids. Grapes contain so large a proportion of water that they possess but little nutrient property, although they hold considerable sugar, but the salts which they furnish to the system are useful. These salts are the sulphates, phosphates, and chlorides of sodium, potassium, calcium, magnesium, and iron.

The habit which some people have of swallowing the pulp whole with the seeds, however small the latter may be, cannot be too strongly condemned. The seeds under no circumstances are digested, being too hard and tough to be affected by any of the juices of the digestive tract, and they therefore act as irritants or foreign bodies. It was originally believed that inflammation of the appendix vermiformis was often caused by the entrance of one or two sharp-pointed grape seeds into this small division of the alimentary canal, but this has been proved to be an exceedingly rare occurrence. The main disadvantage of swallowing seeds consists in their interference with normal digestive processes, while they are liable at any time to cause more serious disturbance of the nature of diarrhœa, enteritis, or intestinal obstruction. Swallowing the skins of grapes is equally harmful.

Grapes, on account of their sugar, must be excluded in cases of diabetes and gout. A special " grape cure " has been established for some diseases. It is discussed under that heading. Unfermented California grape juice constitutes an agreeable, wholesome, and slightly laxative, non-alcoholic beverage, which may be prescribed during mild fevers and in convalescence. Prof. Albert R. Leeds has recently sent me the analysis of a new grape food which he says " is entirely different from the grape juice, inasmuch as it contains, both in amount and condition, the constituents of the grape to a point of practical completeness which the manufactured juices have failed to attain. I have verified by most exhaustive tests the absence of all germs of fermentation, and this sirup will certainly keep indefinitely, even in the absence of alcohol or antiseptic." This " liquid grape food " contains protein and 64 per cent of grape sugar, with no alcohol and no starch.

Raisins, prepared by sun-drying from certain species of grapes which are particularly rich in sugar, form a useful food, chiefly on account of the agreeable flavour which they impart to more insipid substances. (See also Raisin Wine.)

Raisins are usually made from white grapes, but they turn dark purple or brown from oxidation of the tannic acid of their skins (Leöser). Muscatel raisins are dried on the vine by incising the stems to cause withering of the grapes.

Raisins cannot be eaten very abundantly without disordering digestion unless they have been cooked. Added to some forms of farinaceous food—such as rice pudding, sweetened breads, buns, cakes, pemmican, and the like—they increase the appetite. If given to children, as they too often are, they should be stoned carefully beforehand, and the tough skins must not be swallowed. The latter contain a whitish waxy material which keeps the grapes waterproof.

Plums.—Plums and greengages are wholesome fruits when they are wholly ripe; but they remain fresh for only a short time, and are often on that account picked and sent to market in an unripe condition, in which they are very indigestible, and are prone to excite diarrhœa and intestinal colic.

Prunes.—Prunes or dried plums are obtainable in various forms and sold in large masses like dates, or preserved individually in jars, in which form they have the advantage of keeping well for a long period. They contain a large percentage of sugar. They have a distinctly laxative effect, eaten raw or, preferably, stewed, and they are very wholesome and useful in cases of chronic constipation. They are comparatively inexpensive, and by some patients may be taken two or three times a day. They have a good effect in regulating the bowels in children, and three or four prunes given once or twice a day between meals will sometimes prove quite sufficient for this purpose.

Prunelles are sold in masses dried like dates. They have a pleasant acid flavour, but are not very digestible.

Olives are eaten for their agreeable flavour and their nutrient value, which is due to the oil they contain. (See Olive Oil.) They are much eaten as a relish, either plain or stuffed with peppers, and are used for garnishing salads, sauces, etc. About seventy varieties are now grown in California. They may be eaten fresh with bread in the warm countries where they grow, but they are too bitter for most palates, and are usually preserved by soaking respectively in (*a*) strong lye, (*b*) fresh water, and (*c*) salt solution, and are left in the latter for preservation. The lye neutralises their bitter taste. In Greece dried olives are much eaten. The composition of the ash of California olives presents, among other ingredients, 60 per cent of potash, 16 per cent of lime, and 8.3 per cent of phosphoric acid.

Composition of Pickled Ripe and Green Olives
(C. B. Smith and F. Langworthy)

	Water.	Fats (oil).	Carbohydrates.	Protein, ash, etc.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Pickled ripe olives	65.08	25.52	3.75	5.65
Pickled green olives	78.41	12.90	1.78	6.91

Berries.—The *strawberry*, on account of its exceptionally agreeable flavour, and also from the fact that it is one of the first fruits of the spring season in the eastern part of this country, is enjoyed by almost very one. There are, however, a few persons who have a striking idiosyncrasy against it, and in whom urticaria or more or less violent gastro-enteritis with sore throat (Osler) is promptly developed by taking even a few berries. The reason for this is not fully explained, for analysis of the strawberry fails to show any product which is peculiar to itself. There must consequently be some combination of organic acids or other materials existing in this berry which is exceptionally irritating to some persons.

The strawberry is usually a very wholesome food. It contains abundant salts of potash, lime, and soda, which give it a moderate diuretic action; it is also slightly laxative, partly from the seeds which it contains. There are many modes of eating, cooking, and preserving the strawberry which are too familiar to require comment here. Some persons learn that eating the berry with pepper or lemon juice enables them to digest it better, and those who suffer from flatulent dyspepsia, if they can digest the berry at all, do well to take it without sugar.

Currants, bilberries, mulberries, blueberries, huckleberries, raspberries, blackberries, and *gooseberries* all contain considerable free acid, and are moderately laxative, partly on account of their seeds, but their expressed juices sometimes have the same effect. Not all berries are laxative, however. Huckleberries and blueberries may be laxative when eaten with their seeds and skins, but Winternitz has recently shown that a decoction made from these berries is a good astringent for use in chronic diarrhœa. Blackberries have a similar action.

The expressed juice of red currants, raspberries, or blackberries makes a cooling and refreshing beverage or " shrub " when added to some effervescing water, such as Apollinaris or carbonic-acid water, and may sometimes be used in fevers, although lemon juice is usually preferable.

Currants are preserved in various ways, the chief one being in the form of jelly. Prepared in this manner, they constitute an appetising and wholesome flavouring material, which may be taken with meats and other foods to excite the appetite of invalids and convalescents whose chief difficulty is lack of desire for sufficient food.

Currants, raspberries, blackberries, etc., are frequently made into jams. These, on account of the large quantity of sugar which is added in their preparation, are quite nutritious, and their numerous seeds have a laxative action. For this purpose they are sometimes beneficially given to children to be eaten with bread and butter. They aid in satisfying the natural craving of children for sweets, and, if taken in moderation, they are very wholesome, and their flavour may encourage the eating of more nutritious but less agreeably flavoured food, such as rice, cornstarch, or farina.

The *gooseberry* is much more popular in England than in the United States. It contains citric and malic acids as well as sugar. It is rendered more wholesome by cooking, and is sometimes made into wine.

The *elderberry* furnishes an astringent wine, which is also somewhat diuretic and sudorific.

Melons.—Melons are of little service for nutrition, but they are so agreeable to the palate that they are in very general use. The varieties commonly obtainable in this country are the cantaloupe, or muskmelon, and watermelon, and of these, the former is less likely to produce gastro-intestinal disorder when not eaten too freely.

These fruits contain so large a proportion of water—upward of 95 per cent—that they are not satisfying to the appetite; and since in hot weather they are cool and refreshing, overindulgence in them is a common fault, and most of the ill repute of watermelons has arisen in this way rather than from any specific injurious effect which they produce. If eaten with other food, they dilute the gastric juice. Well-ripened muskmelons may often be eaten by invalids in moderation to promote the appetite, served at the commencement of a meal, at which time it is best that most fruit should be eaten when taken with other food.

Citrons are very indigestible.

Figs and Dates.—Figs and dates are chiefly eaten in the United States in the dry form, although in California and elsewhere they may be obtained fresh. These fruits hold large quantities of sugar, especially in their dry state, in which this ingredient is not only concentrated, but changed in the drying process. They also contain a little nitrogenous material, so that they have more nutritive value than many fruits; in fact, in some Eastern countries they constitute a staple article of diet, as illustrated by the use of the date in Arabia.

Figs have a decided aperient action, which is chiefly, but not solely, owing to their seeds. Three or four dried figs taken with a glassful of water at night before retiring, and again half an hour before breakfast, will sometimes cure mild constipation. The dried figs, like prunes, may be stewed if preferred. They contain a large percentage of glucose. The best figs, called Turkey figs, are raised in Smyrna, and when dried will keep for a long time.

Fungi

There are many species of fungi, some of which are available for food, while others are irritating, and still others produce violent gastro-intestinal disorder, and by their absorption give rise to symptoms of collapse, and may cause death.

König gives the following percentage composition:

	Fresh mushroom.	Fresh truffle.	Fresh common morel.
Water	91.11	72.08	90.00
Non-nitrogenous substances	2.57	8.91	3.48
Fat	0.13	0.62	0.24
Grape sugar, mannite	1.05	....	0.72
Other non-nitrogenous substances	3.71	7.54	3.95
Woody fibre	0.67	7.92	0.67
Ash	0.76	2.21	0.94

Mushrooms.—Mushrooms, on account of their nitrogenous matter, are some slight use as food; but if eaten in sufficient quantity to yield much nutriment, they always disagree. Bauer says: "Judging from their chemical composition, they ought to have no small value as foods, but it is doubtful how far they are really utilised in the alimentary canal."

Mushrooms have a tempting flavour, which is developed on cooking, and while they agree with most persons in health and form an acceptable article of diet, there are some persons who can never eat even the simplest varieties without suffering more or less from acute gastro-intestinal irritation. They should never be eaten raw. They are usually served alone, broiled upon toast or as a dressing for beef, fillet, steak, etc., or they may be preserved in olive oil or by drying. Their digestion requires fully three hours. The common mushroom consists of 91 per cent water, besides 3½ per cent of carbohydrates, and 4 per cent of proteid, with salts and other substances.

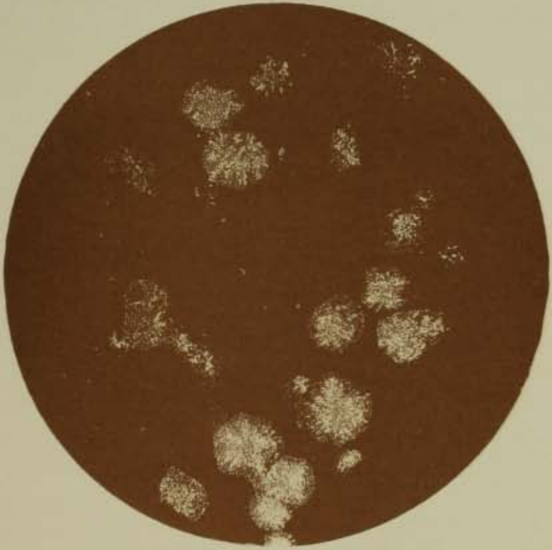
Truffles.—The truffle is a subterranean vegetable of the order of *Thecaphore.* It is an expensive luxury, and is used to add flavour in cooking and as an ingredient of rich meat sauces, *pâtés*, etc. It contains no sugar. Eaten in quantity by itself it is a highly indigestible substance. It easily decomposes with a very offensive nauseous odour. There are several varieties, of which the black is the chief, and it is obtained from beneath the trees of oak forests of Perigord in Southern France, where it is hunted by trained Spanish poodles or sows, whose sense of smell enables them to detect the fungus beneath the ground. There is a special hereditary race of truffling swine, broken for the purpose.

The *morel* is a friable, greyish-black, cone-shaped mushroom, which grows extensively in a variety of dry soils, but, like the *cèpe*, is obtained principally in France. It may be cultivated artificially. It is used for flavouring, like the truffle.

Cèpe is a name given to several mushrooms belonging to the *Boletus* family, which are globular in shape, and coloured orange or white.

Poisonous Fungi.—Most poisonous fungi are distinguished from the non-poisonous by a warty cap. They are often viscid and have other peculiarities of structure, colour, etc. They are acrid or astringent, and have a pungent, disagreeable odour (Christison). Poisonous mushrooms may either produce violent gastro-intestinal symptoms, which are seldom fatal, owing to the prompt evacuation of the poison from the system, or these symptoms are followed by a condition of narcosis ending in fatal collapse. The pupils are contracted, the urine is suppressed, the face is livid, and there is general vasomotor paralysis. The conjunctivæ are congested.

Muscarin is a substance isolated from poisonous fungi, which is a violent cardiac poison and constrictor of the pulmonary blood vessels, producing dyspnœa, prostration, and death. Its effects are antagonised by belladonna.



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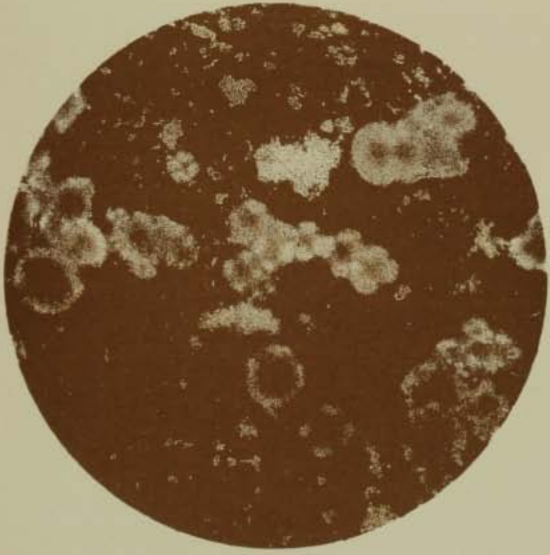

OLEOMARGARINE X 40

ANIMAL FATS, MAGNIFIED.

(*From Bulletin No. 13, Division of Chemistry, United States Agricultural Bureau*).

PHOTO BY CLIFFORD RICHARDSON.

Lichen

Iceland moss is used extensively as a food by dwellers in the arctic regions.

König gives the percentage composition of the dried moss as follows: Water, 15.96; nitrogenous matter, 2.19; fat, 1.41; non-nitrogenous matter, 76.12.

A bread is made from it after carefully washing out two bitter organic acids which it contains. Senator has recommended this bread for use by diabetics.

Nuts

Nuts contain protein, with some starch and more or less fat, and very little water. From 50 to 65 per cent of the common nuts is shell. With the exception of the cocoanut, chestnut, almond, and English walnut, the varieties eaten in this country furnish but little nutriment. Their chief value is to stimulate the appetite and afford variety in the diet. Excepting chestnuts and cocoanuts, they are usually eaten raw, as dessert, but they are much used in confectionery. A few nuts are used in salads and as dressing for fowl. As a rule, they are to be proscribed from invalid dietaries, but, with the exception of chestnuts and peanuts, they may be allowed to diabetics. A preparation of malted nuts which may be obtained in market is both nutritious and digestible. It contains emulsified nut fat, maltose, and vegetable protein.

Almonds contain a ferment called emulsin and much fat, and sweet almonds have 3 to 5 per cent of sugar, but no starch (Bauer). This low percentage of sugar makes them of service in the treatment of diabetes, in which disease they are sometimes used as a substitute for bread after being ground into meal. (See Diabetic Breads.)

Macaroons are a digestible form of cake for convalescents and children composed chiefly of almonds and sugar.

Almonds are wholesome and nutritious. They should not be eaten in cases of gastric irritability, but occasionally dyspeptics in whom gastric digestion is slow derive benefit from eating a few salted almonds with meals. They should be soaked and peeled or "blanched," otherwise their skins may set up gastric irritation.

The bitter almond contains hydrocyanic acid, sugar, and oil, and is not used except for flavouring cough mixtures. Almonds are imported chiefly from Italy, France, and Spain, but of recent years they have been extensively grown in California.

English walnuts eaten liberally between meals may assist in overcoming constipation through the bulk of insoluble residue which they leave, and possibly also from the oil which they contain.

Cocoanuts are very indigestible even when thoroughly desiccated and grated. The cocoanut contains a proteolytic ferment which converts meat into albumoses with considerable activity. The cocoanut has been successfully grown in Florida.

Brazil nuts, pecan nuts, beechnuts, butternuts, filberts, etc., all hold much oil, and are difficult of digestion. Butternuts easily become rancid after being shelled.

Chestnuts contain 15 per cent of sugar with so much starch that they are very nutritious, and in some parts of Italy they are made into cakes and eaten by the peasants as a substitute for potatoes. Raw chestnuts are wholly indigestible, but if thoroughly roasted or, better still, if long boiled, they become much less so. They should, however, not be given to invalids.

The *pistachio*, a native nut of Syria, has a greenish, almond-like kernel. It is chiefly used in confectionery and ices for both its colour and delicate flavour.

Peanuts are described under Legumes, p. 168.

Composition of Nuts and some Other Food Materials (C. F. Langworthy)

	Refuse.	Edible portion.	Composition and fuel value of the edible portion					
			Water.	Protein.	Fats.	Carbohydrates.	Ash.	Fuel value per pound.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Cal.
Almonds	64.8	35.2	4.8	21.0	54.9	17.3	2.0	3,030
Brazil nuts	49.6	50.4	5.3	17.0	66.8	7.0	3.9	3,329
Filberts	52.1	47.9	3.7	15.6	65 3	13.0	2.4	3,432
Hickory nuts	62.2	37.8	3.7	15.4	67.4	11.4	2.1	3,495
Pecan nuts	53.2	46.8	3.0	11.0	71.2	13.3	1.5	3,633
English walnuts	58.0	42.0	2.8	16.7	64.4	14.8	1.3	3,305
Chestnuts, fresh	16.0	84.0	45.0	6.2	5.4	42.1	1.3	1,125
Chestnuts, dried	24.0	76.0	5.9	10.7	7.0	74.2	2.2	1,875
Acorns	35.6	64.4	4.1	8.1	37.4	48.0	2.4	2,718
Beechnuts	40.8	59.2	4.0	21.9	57.4	13.2	3.5	3,263
Butternuts	86.4	13.6	4.5	27.9	61.2	3.4	3.0	3,371
Walnuts	74.1	25.9	2.5	27.6	56.3	11.7	1.9	3,105
Cocoanuts	48.8	51.2	14.1	5.7	50.6	27.9	1.7	2,986
Cocoanuts, shredded	....	100.0	3.5	6.3	57.3	31.6	1.3	3,125
Pistachios, kernels	....	100.0	4.2	22.6	54.5	15.6	3.1	3,010
Pine nuts or piñons (*Pinus edulis*)	40.6	59.4	3.4	14.6	61.9	17.3	2.8	3,364
Peanuts, raw	24.5	75 5	9.2	25.8	38.6	24.4	2.0	2,560
Peanuts, roasted	32.6	67.4	1.6	30.5	49.2	16.2	2.5	3,177
Litchi nuts	41.6	58.4	17 9	2.9	.2	77.5	1.5	1,453
Beefsteak	12 8	87.2	61.9	18.9	18.5	....	1.0	1,130
Wheat flour	....	100.0	12.8	10.8	1.1	74.8	.5	1,640
Potatoes	20.0	80.0	78.3	2.2	.1	18.4	1.0	385

"The meat of nuts, excepting chestnuts and cocoanuts, contains nearly 50 times as much fat and less than one fifth as much carbohydrates as wheat flour, and has about double the fuel value—i. e., energy-producing power. A pound of unshelled nuts will furnish about half as much protein and the same amount of energy as a pound of flour. Owing to their high fuel value and low protein contents, nuts would not make a well-balanced food when eaten by themselves" (C. F. Langworthy). Eaten with fruit, however, they are an excellent form of food, and if carefully selected and thoroughly masticated their coefficient of digestibility is high for persons in health, and they furnish very little residue of waste. The relatively high price of nuts as a food is offset by the fact that they demand no expense for cooking. A number of savage tribes live almost exclusively upon fruits and nuts, and M. E. Jaffa has shown at the California Agricultural Experiment Station (1901–1902) that such a diet is not incompatible in civilised man with maintenance of vigour and body weight.

V. FATS AND OILS

Fats and oils contain but three elements—namely, carbon, oxygen, and hydrogen. In the starches and sugars the proportion of oxygen and hydrogen is such as to form water, H_2O, when their molecules are split up; but in the group of fats oxygen is not present in sufficient quantity to form water with all the hydrogen atoms, and in their combustion with oxygen considerable heat is evolved. In some fats, like butter, very little oxygen is present, and carbon and hydrogen compose the bulk of the substance. The amount of fat which from time to time is stored in the body is regulated to a greater degree than any other substance by muscular exercise, which, if active, always tends to prevent its accumulation. The storage of fat is favoured by sleep as well as inactivity. (See Obesity and Leanness.)

About one fifth of the entire body weight is composed of fat, but only about a quarter of an ounce is contained in the blood. Before death results from starvation 90 per cent of the body fat is consumed. The chief sources of this fat in the human body are undoubtedly starches and sugars, but it is probable that under certain conditions it may also be derived from fatty food.

Fat is required to promote the earlier stages of growth and development of the organism, and there are also many forms of disease and degenerative changes which are accompanied by increased accumulation or production of fat in and between the tissues and cells. It is as impossible to live in perfect health without fatty food, as it is to live long upon fat alone, for it soon disorders digestion.

Uses of Fats.—The chief uses of fatty food are:

1. To furnish energy for the development of heat.
2. To supply force.
3. To serve as covering and protection in the body.
4. To make more plastic various structures of the body and give rotundity to the form.

5. To spare the tissues from disintegration, for, although their combustion in the body results largely in the production of heat, they also take part to some extent in tissue formation.

6. To serve for storage of energy.

The various forms of energy manifested in the different nitrogenous tissues—as muscular action, secretion, nerve force, etc.—are more or less intimately dependent upon fat combustion. It was originally believed that the force of the body was supplied by the oxidation of nitrogenous materials. Fat eaten with the food was supposed to be deposited again as fat in the tissues of the body without material change, but of recent years this theory has been very largely recast, and the primary value of fatty food consists undoubtedly in its contribution to force production and its power of saving other tissues, especially the albuminous, from destruction by oxidation, whereas its secondary use is in connection with tissue formation. Fats do, however, enter into the composition of many different tissues, even those of the nervous system.

The fats and oils which are employed as food all serve essentially the same purpose, and may therefore be grouped together as a distinct class. There is a general resemblance in their physical properties, although they differ considerably in the melting point. The several food fats and oils are of various chemical composition, but after being absorbed they are recognised mainly in one or two simple forms, chiefly as stearin and olein.

The use of animal oils, such as lanolin, and of the petroleum products, like purified vaseline, has very largely superseded the external application of other fatty substances—lard, etc.—to the skin for the purpose of lubrication.

It is not possible to get very much nourishment into the body by osmosis through the integument, but some improvement seems to follow the rubbing of fats and oils, such as cacao butter, olive oil, or cod-liver oil through the skin of marasmic children and other patients. (See Marasmus.) One or two teaspoonfuls of the oil may be rubbed in twice a day on the thighs, abdomen, and chest. The statement that the application of fats to the surface of the body by inunction reduces the body temperature is not substantiated by experience.

The treatment of biliary calculi by the administration of large doses of olive oil—two or three ounces at a time—given upon an empty stomach, has been suggested, apparently with the idea that it might have some local lubricating action. Cases have been reported in which gallstones have been said to appear in the feces as a result of this treatment, but it has been shown that the oil itself may become mixed with inspissated intestinal mucus and form small, hardened masses, which have been mistaken for gallstones. There is no foundation for the belief that oil is of any value for cholelithiasis, nor is it possible that it should enter the bile ducts to " lubricate " them.

Fats and oils are useful preservatives of many foods by preventing access of air, drying, and decomposition. A layer of oil floating on top of a flask of wine is capable of preserving its delicacy of flavour for a long time (Chambers). Oil preserves fish, like sardines, and layers of lard are used to protect jars of potted meats, *pâté-de-fois-gras*, etc. Oils and butter protect eggs from decomposition.

Digestibility of Fats.—There is some difference of opinion as to what extent fat may aid or retard the process of digestion, but it is a matter of very common experience that those persons whose digestive organs are feeble do not tolerate fats or oils well when eaten with other forms of food. This is no doubt owing to the fact that fats are practically unaltered in the mouth and stomach, and in the latter, when melted, they coat the mucous membrane and surround the particles of food with a thin film which materially interferes with the normal action of the gastric juice. For this reason fats are to be avoided by dyspeptics, and the fats selected for special nutritive processes should be in the form of good butter, cream, or cod-liver oil. On the other hand, fats may sometimes aid the digestibility of starchy foods by preventing them from forming lumpy masses in the mouth and stomach. For example, a well-roasted mealy potato may be made all the more digestible for an invalid by being mashed with a little butter or cream. The digestibility of fats may be much enhanced by the process of emulsification —i. e., of securing an extremely fine subdivision of the oil globules. More than fifty years ago Horace Dobell, of London, emulsified beef fat and lard by means of pancreatic juice, and recently John F. Russell, of New York, has modified and extended the principle so as to emulsify all fats, fluid or solid, deriving products of permanent fine emulsion, capable of dilution with hot water, and possessing high nutritive value. These emulsions consist of one half fat, which is predigested and easily assimilated.

It is stated by Ringer that fats taken fasting lessen the secretion of bile, whereas if taken with or after food they increase it, but, as many kinds of food promote the secretion independently of fat, it is doubtful whether the latter possesses any very decided action in relation to bile formation.

Most of the fat used as food melts at the temperature of the body, which facilitates its digestion.

Children often eat butter more readily than any other form of fat.

As a rule, the stomach is less disturbed by animal than by vegetable fats taken in excess, and the former may be tolerated for a longer time. The limit of digestibility of increasing quantities of food is much sooner reached with fats than with other articles of diet, and they produce satiety early in a meal, but, as in the case of many foods, toleration may be acquired for the ingestion of fat, which is exemplified in the fact that many persons who cannot digest cod-liver oil completely at first may do so after two or three weeks' trial. This is, in part, due also to the general improvement in health which follows in some cases the administration of easily digested fat. Overdoses of fat at any time are apt to give rise to the formation of irritating acids which cause nausea and vomiting, with possibly abdominal cramps and loose evacuations. Fat taken too liberally with other food ceases to be economical for the system and becomes positively harmful.

Since fat is exclusively digested in the small intestine, diseases of any part of the alimentary canal are contraindications for its use.

Liquefied fats and oils are usually administered as a matter of routine when corrosive poisons have been swallowed, with the idea that they coat over the mucous membrane of the stomach and œsophagus and protect them from the action of the irritant. This protective action is overestimated, for it is difficult to coat to a sufficient degree a mucous membrane which is already moistened with watery mucus.

The digestibility of all fat depends somewhat upon its cooked state. Many persons are nauseated or made dyspeptic by eating hot mutton fat who can eat the same with impunity when it is cold. In the latter condition it becomes more friable, and, if thoroughly mixed in chewing with starchy food, or used as suet in the form of a farinaceous pudding, it becomes very much more digestible. Children usually dislike fat meat, but they are quite willing to take suet puddings, which, if light and well cooked, are wholesome.

While the various fats and oils, in general, have the same beneficial effect upon nutrition, there is considerable difference in their force value and in the facility with which one variety or another may be assimilated in individual cases. The animal fats have a higher nutritive power than those derived from vegetables, and liver fat, butter and cream, are the most serviceable of all.

Animal Fats

The principal animal fats and fatty foods are butter, cream, suet, lard, oleomargarine, the fat of beef, mutton, pork and bacon, bone marrow, pemmican, fish, and cod-liver oil. Fat is also a constituent of the yolk of eggs.

Butter and cream have been discussed under the heading Milk Derivatives (pp. 95–99).

Lard is hog fat separated by melting from the areolar connective tissue. Considerably over half a billion pounds are annually produced in the United States. Crude lard contains glycerides of oleic, stearic, and palmitic acids, besides a little gelatin and other substances.

"*Cuisine*" is a preparation of cotton-seed oil designed to replace lard and cheap cooking butter.

"*Cottolene*" is another substitute for cooking purposes.

Stearins are the solid residue of animal fats remaining after pressure has separated the fluid fats. They are used in making compound lard, butterine, and similar foods.

Suet is the fat which surrounds the kidneys of the ox, sheep, and other animals.

Oleomargarine.—Oleomargarine was invented in 1870 by a French chemist, Mège-Mourier, who discovered that beef fat from particular portions of the bullock would melt at the same temperature with butter, and would keep longer without becoming rancid. The fresh fat is mashed in a grinding machine to free it from membrane. "The fragments fall into a tank heated with steam, which for every thousand parts of fat contains three hundred parts of water and one part of carbonate of potash and two stomachs of sheep or pigs. The temperature of the mixture is raised to 45° C." (Clark). After two hours the fat is withdrawn from the membranes, which have been digested away, and is heated still more with the addition of 2 per cent of salt. It is then cooled, pressed, and packed for market.

Much discussion has arisen in regard to the wholesomeness of oleomargarine, and its sale has been regulated by act of Congress since 1886 and by many State laws. It has been declared perfectly innocuous, and the object of the legal control of its sale is mainly intended to prevent it from being fraudulently offered as butter. It certainly tastes better than poor butter.

Butterine, which has now largely replaced oleomargarine in this country, is made in a similar manner, but with a somewhat different proportion of ingredients, and some of the leaf fat of the hog is added during the manufacture.

Beef Fat, Pork, etc.—Beef, mutton, and pork fat consist principally of the glycerides of such common fatty acids as stearic, palmitic, and oleic.

The fat of good roast beef is nutritious, and a very digestible variety of fat is good bacon thinly sliced and thoroughly cooked. This form of fat is crisp and dry, and it is often digested by invalids who cannot tolerate other kinds. Ham fat and pork fat, on the other hand, are usually very indigestible—the more so when hot.

Bone Marrow.—Bone marrow is an easily digestible and wholesome fat which has long been used as a food. The long bones of the ox are cut crosswise in pieces about two inches in length and cooked with the marrow within them. Red marrow is a useful food in cases of tuberculosis, secondary and pernicious anæmia, and chlorosis. But it is doubtful whether the marrow acts otherwise than

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in furnishing an assimilable fat to patients who are much in need of such food, and also a very digestible form of iron, which exists in it in considerable quantity. The marrow of young animals, such as the calf or lamb, is preferred for this purpose, because their tissue-building power is so active. Fraser reported the first case of anæmia treated by means of marrow, and he prefers a glycerin extract.

J. S. Billings, Jr., recommends a similar preparation made with sheep's ribs, chopped, rubbed in a mortar with glycerin, macerated and strained.

Henry F. Walker, of New York, uses a sort of emulsion made by mixing thoroughly the red marrow of the long bones of the ox with *Cetraria* (Iceland moss). This makes an exceedingly agreeable preparation, a whitish paste pleasant to the eye, and tasting not unlike good butter. It may be spread upon bread and eaten three or four times a day.

Pemmican is made of meat cut into slices and thoroughly dried in the sun; to this are added fat, sugar, and dried fruit, such as raisins and currants. It is used on long voyages, especially to the Arctic circle, where a fatty diet is essential to furnish heat and force to enable the body to withstand the rigour of the climate. It is easily masticated, and the sweet fruit promotes the flow of saliva.

Calves' brains and liver contain considerable fat.

The common fish which contain most fat are eels, salmon, herring, and mackerel. Sardines contain some fat, but derive most of it from the oil in which they are immersed for preservation.

Many fish oils have special uses. The Eskimos eat whale and seal oil and blubber, and dugong oil is eaten to some extent in Australia. The oil of the sturgeon is employed for preserving caviare. Turtle oil and butter is made extensively in Brazil from both the eggs and fat of the animal (Clark).

Cod-liver oil will be separately considered.

Eggs contain considerable fat in their yolks. Some eggs, like the plover's, are very rich in this ingredient. They are elsewhere described in detail. (See Eggs, p. 103.)

Lecithin is a form of fat contained in a variety of animal cells, but predominating in eggs and brains. Various preparations of it have been placed on the market as food, but it is best to administer it through modification of the dietary by increased use of such foods as eggs and calves' brains.

Vegetable Fats and Oils

The principal vegetable fats or oils and fatty foods are derived from seeds. Such foods are olives, olive oil, cotton-seed oil, and nuts. Traces of fat are found in the legumes.

Olive Oil.—Olives and olive oil constitute a very digestible form of fatty food, and may sometimes be eaten by consumptives in lieu of cod-liver oil. French olives gathered while young and tender are very wholesome.

Olive oil is made by crushing the fruit with stones, after which the pulp is pressed in bags. The first oil thus obtained is the best. A second oil is got by adding boiling water to the pulp residue, and pressing it again. This oil is more likely to become rancid than the first (Clark). The best oil generally obtainable is from France and Italy, but an excellent quality is manufactured in Southern California. The paler variety is preferable, but, unfortunately, it is constantly adulterated or imitated. (See also Olives.) Olive oil is eaten with salads, and is also useful for frying.

Cotton-seed oil, and to some extent poppy-seed oil, are now frequently substituted for olive oil in the preparation of various foods, and the sardines which were formerly preserved in pure olive oil are, for the most part, immersed in cotton-seed oil. This oil is not rancid, but its flavour and odour, which resemble linseed oil, are not agreeable when it is eaten raw with salads or fish, and, unless extremely pure, it leaves an unpleasant after-taste in the mouth. It is composed principally of palmitin and olein. It is a harmless food.

Linseed oil is sometimes substituted for olive oil, but it is not very digestible.

Cacao butter, oil of theobroma, is a firm oil obtained from cacao seeds during the manufacture of chocolate. It easily melts at the body temperature. It is used for inunctions and for making suppositories, and sometimes as an ingredient of infant foods, such as Lacto-preparata.

Nuts, especially English walnuts, cocoanuts, hickory, pecan, and Brazil nuts, all contain a good deal of vegetable oil. (See Nuts, p. 193.)

The oil of nuts which have been too long kept sometimes becomes rancid and unwholesome.

Cocoanut oil is principally used in Oriental countries.

Peanut oil is used to some extent in this country, like cotton-seed oil, mainly to adulterate or imitate olive oil, which is much more expensive.

Java almond oil may also be used for cooking.

Dietetic Uses of Fats and Oils.—Since fats are essential for growth and nutrition as well as force production, fatty food is indicated for convalescence from severe acute diseases, and for patients suffering from chronic wasting diseases, in both of which classes there has been considerable waste of the tissues. Persons whose general health has been impaired by bad hygienic surroundings, children who have been wrongly fed by ignorant or poor parents who could not obtain proper food for them, and aged persons in whom the nutritive processes are becoming less and less vigorous, may all be benefited by supplying a sufficient amount of fatty food in the dietary.

For scrofulous and tuberculous patients fats are especially indicated. There is therefore a very large variety of diatheses and diseases, both local and general, which may be benefited by improving the nutrition of the body and increasing force production through the agency of easily digestible forms of fatty foods. (See Appendix.)

Diseases in which Fats are Particularly Beneficial.—Tuberculosis, pulmonary as well as other forms; anæmia; chronic wasting diseases with secretion of pus, as empyema, chronic abscesses, etc.; marasmus; rickets; chronic bronchitis; many chronic diseases of the skin and nervous system.

Diseases in which the use of Fats should be forbidden or restricted.—All forms of acute gastro-intestinal disease; chronic gastritis; dilatation of the stomach; chronic diarrhœa; obesity; fatty and waxy liver; gallstones; acne; urticaria.

Generally speaking, fats are laxative, and oils should not be given in severe intestinal disorder.

By most persons fat cannot be eaten continuously in large quantity without producing indigestion. The stools become offensive and diarrhœal, there is nausea and gastric indigestion, and disgust for such a diet very soon arises. There are those who are unable to digest fats in any amount, however small, and they must derive all their energy from carbohydrates.

Glycerin.—Glycerin plays an inconspicuous rôle as a food. It is mainly useful for its sweetish taste as a substitute for sugar in the diet of diabetics, but to many persons the taste of glycerin itself is nauseous. It is now largely superseded by saccharin. It is highly hygroscopic, and if taken in the mouth undiluted makes the mucous membrane sticky and unpleasant, but it is used as a mouth wash in a diluted form in the proportion of a drachm to the ounce of water. The mouth may be rinsed or swabbed with it in cases of acute fever, such as typhoid, where the mucous surface has become dried or the tongue is glazed or fissured. It acts by protecting the mucous membrane from evaporation, making the mouth more comfortable. In such cases it sometimes diminishes thirst, although its effect in this respect is very uncertain. Glycerin is also laxative, and it may be given either *per os* or in the form of the well-known glycerin suppositories for the purpose of increasing peristaltic action and evacuating the bowels. It is also used as an enema.

Cod-liver Oil

The best cod-liver oil is known as "cold-drawn oil," and is prepared from the raw fresh livers of the codfish by subjecting them to heavy pressure, by which the oil is squeezed out.

Chemical and Physical Properties.—Cod-liver oil, according to analyses made by De Jongh, contains glycerin, olein (70 per cent), myristic, butyric, acetic, margaric, and other acids, biliary elements such as cholesterin, also iodine, bromine, chlorine, and phosphorus in small amount, and a peculiar material which is called "gaduin." Gautier and Mourges obtained besides a half dozen substances resembling alkaloids and other materials, a basic substance which they call morrhuine, about one half milligramme of which occurs in each gramme of the oil, and has, it is claimed, all of its active medicinal properties.

The refined oil may contain no iodine, and it is seldom present in greater amount than 0.5 per cent; hence the value of the oil does not depend upon this substance, as at one time suggested.

When pure, its odour resembles shoe leather. On adding strong acid, the biliary odour is intensified if the oil is unadulterated. If the odour is absent, the oil is spurious.

Cod-liver oil is one of the most easily absorbed of all the oils, owing to the quantity of its fatty acids. It is quickly oxidised in the body. It is highly nutritious and alterative, and is slightly laxative, especially for infants.

Some of the oil supplied in market is derived from the livers of other fishes than the cod, but the cod-liver oil is undoubtedly the best. Pains should be taken to secure a pure preparation thoroughly clarified from the impurities which oil may contain, such as traces of iodine, phosphorus, and sometimes bile salts. None of these substances add to its food value, and, if present in excess, the oil is much more likely to disagree.

The crude "straits" oil contains products of decomposition, is strong, malodorous, and of a dark-brown or even black colour. It is so disagreeable and indigestible that it possesses no advantage over the "shore" oil. The clarified Norwegian oil is the best variety to prescribe.

Cod-liver oil is sometimes adulterated with the cheaper cottonseed oil, to which a fishy flavour is artificially given, and it should therefore only be purchased from a well-known and responsible firm.

An advantage of cod-liver oil is that when pure it can be taken longer than any other fat excepting butter and cream, and in larger quantities than those substances without disordering the stomach. This is no doubt owing to the fact that the oil is already in a condition in which it has once served in the animal body for nutrition or at least for storing up energy. This form of oil is readily emulsified and saponified, and is absorbed by the intestinal villi with probably greater facility than any other fat.

Dosage.—Many patients who dislike the taste of the oil at first soon acquire tolerance for it if given in small and gradually increasing dosage, commencing sometimes with not over 10 to 30 drops twice a day, and children not rarely become so fond of it as to object to its discontinuance. Infants may be given from 5 to 20 drops two or three times a day. It is so valuable a food that where its use is clearly indicated every effort should be made to secure its toleration, and even though it may at first disagree, exciting nausea and vomiting, perseverance and care in its administration may enable it to be very well borne. If it is not digested at first, but one dose of two or three teaspoonfuls a day need be given, and this should be at night.

Those who like it can sometimes take as much as an ounce three times a day with advantage, although half an ounce is all that can usually be tolerated without disturbing digestion.

The oil must be given under proper supervision if its successful use is to be continued; otherwise it defeats its own object by upsetting digestion. Patients who dose themselves with it often use too much, and almost invariably take it at the wrong time in relation to meals.

It is best to prescribe it about two hours after dinner. If given earlier, it remains in the stomach, interfering with the digestion of other food, whereas if digestion is already well under way, it passes with the chyme into the intestine, where it is absorbed. While the oil is being taken the stools should be occasionally examined, as the absence of fat globules in them is a proof of its complete absorption.

Methods of Administration.—Many patients can take perfectly pure, well-clarified cod-liver oil better than the emulsions and preparations in which it is offered in the market, while others prefer it in the form of the so-called emulsions with hypophosphites of lime, soda, or iron, or with other substances. Some of these emulsions are rendered almost tasteless, while others are flavoured with wintergreen, ginger, or some other aromatic.

Emulsions are seldom as good as the pure oil, and are only to be preferred when the latter is not digested or when the taste proves too nauseous. They usually do not contain above 50 per cent of the oil, and often only 33 per cent; hence the dose is unnecessarily bulky. Moreover, they rapidly deteriorate with age, so that if emulsions are to be used they should be freshly made with yolk of egg and glycerin or mucilage of tragacanth.

Dr. James Stewart, of Montreal, gives excellent formulæ for this purpose as follows:

Cod-liver oil	6 ounces.
Oil of wintergreen	1 drachm.
Chloroform	2 drachms.
Glycerin, yolk of egg, each	5 "
Orange-flower water, sufficient to make	12 ounces.

M. Dose, one tablespoonful.

This is not too thick.

Cod-liver oil	6 ounces.
Oil of wintergreen (or any essential oil)	1 drachm.
Mucilage of tragacanth	2 ounces.
Orange water, sufficient to make	12 "

M. Dose, one tablespoonful.

This emulsion is somewhat thicker than the preceding one.

Oil of bitter almonds may be used in the proportion of three drops to the ounce, instead of the wintergreen oil.

Lefaki recommends an emulsion made with an equal part of lime water flavoured with lemon sirup or vanilla. This can be prescribed when diarrhœa exists. Another method is to add two ounces of finely chopped and strained fresh pancreas to the gallon of oil to produce an emulsion.

Stewart suggests rinsing the mouth before taking the oil with undiluted brandy or whisky and two or three drops of oil of peppermint. Children may be given a peppermint lozenge. If preferred, the dose of pure oil may be poured upon the surface of some fluid, such as orange or ginger bitters, strong black coffee, lemon juice, weak brandy and water, or even ale or beer. Pains should be taken to float the oil in the centre of the surface of the fluid, so that it is to some extent coated by it and does not come in contact with the glass or cup and produce a lingering, disagreeable taste in the mouth. Ringer suggests adding a few drops of catsup to disguise the taste, or the use of a mixture of equal parts of the oil and fresh aqueous solution of gum acacia with two minims of oil of lemons added to each ounce. A little salt taken in the mouth before and after each dose may neutralise the taste. He also refers to the use of a cod-liver-oil jelly containing 70 per cent of the oil. This disguises the flavour. The oil is sometimes given with different preparations of meat juice.

In this country cod-liver oil is extensively used in the form of capsules of gelatin which are shaped like an olive, and which some patients can swallow with ease, although they are rather bulky and not always reliable. A child of ten years came under my observation who for some time previously had been given four or five of these capsules daily, each containing a teaspoonful of cod-liver oil. She had developed an exceedingly irritative stomach cough, for which a variety of sedatives had been administered without any effect. To my astonishment, she at one time vomited seventeen of the undissolved capsules, which represented four or five days' dosage.

The oil is sometimes administered in the form of "oleochyle," in which it is claimed it has been predigested and rendered easier of absorption.

Claude Bernard, to whom we are indebted for much valuable research upon the physiology of digestion, first showed that ether given by the mouth acts as a stimulant to the secretion of the pancreas and the glands of Brunner which aid the digestion of fat, and that it increases the absorption of fats. Acting upon this suggestion, Dr. Balthazer Foster found that pure ether added to fats and oils in the proportion of five or six minims to a drachm of the oil would often insure its digestion, whereas previously it had excited nausea and vomiting, and this method has proved of service in the hands of others. The ether itself disguises somewhat the taste of the oil, but I have sometimes found it to produce disagreeable eructations. In fact, in some hospitals a "malingerer's mixture" has been employed composed of a disagreeable combination of ether, oil, and asafœtida, which has the result of causing eructations and maintaining an exceedingly disagreeable taste in the mouth. Lime water is sometimes added to cod-liver oil to produce a temporary emulsion, and it may prevent nausea.

Cod-liver oil is advantageously combined with malt, and when not so sweet as to be disliked by the patient it proves a very serviceable food. Cod-liver oil is added in the proportion of 30 per cent to maltine, or 50 per cent to malt extract.

In very hot weather it is usually best to suspend the administration of oil, as it is liable to disagree, even if it does not become rancid.

Substitutes.—Many substitutes for cod-liver oil have been proposed, but it is doubtful whether any of them can be made to yield all the benefits to be derived from the genuine substance.

Efforts have long been made to determine whether the alkaloidal or other substances obtainable from cod-liver oil do not possess all the nutritive and stimulating properties of the oil itself in equal or even greater degree. Some of them are doubtless capable of producing active symptoms, but if the oil itself is a true food, there can be no advantage in attempting to concentrate it beyond the minor consideration of avoiding its nauseous, fishy taste. M. Chapoteau describes a crystalline substance which he terms morrhuol, and which exists in the oil in the proportion of 1.5 to 6 per cent, the lesser quantity being found in the purest oil. It is claimed that three to five drops of this substance possess all the properties of a drachm of cod-liver oil. It may be given in capsules or disguised with olive oil, fat, or cream. Much interest is at present manifested in testing the clinical worth of preparations of this class, but although their use has been favourably reported by some observers within the past year or two, further evidence is required before their general substitution for the oil itself can be indorsed.

Von Mehring and Hauser recommend "lipanin," made by adding to olive oil 6 per cent of oleic acid. This is devoid of disagreeable taste and odour, and may be given in doses of from one to four teaspoonfuls three times a day.

Uses.—Cod-liver oil is not a specific for any disease, and there are many clinicians who prefer to prescribe other forms of fat when possible. Fothergill wrote that " out of five persons taking cod-liver oil probably only two require fat in that particular form, while three take it because it is the only fat put up in such a form as can be readily purchased."

Nevertheless, there are often seen cases of phthisis in which a decided gain in weight follows the administration of a disproportionately small quantity of the oil. It is a most useful food in many conditions of debility, and is indispensable in the treatment of rickets and general tuberculosis.

It is found clinically to be of great service in a variety of forms of chronic inflammation and in cases in which there is old purulent discharge from any part of the body, as from the middle ear, or from a chronic abscess, like empyema, and in chronic bone diseases, such as caries.

Among other chronic diseases for which cod-liver oil is recommended may be mentioned chronic rheumatism and gout, arthritis deformans, a variety of skin affections, and advanced syphilis. It is of service also in pulmonary emphysema and in cases of chronic bronchitis with tenacious purulent expectoration, and by many it is believed to be of some specific value in loosening cough. It should be observed that oil when absorbed passes through the lymphatic system and is carried with tolerable directness into the pulmonary circulation, where fats in general are believed to be oxidised. It is suggested that this fact may possibly have some bearing on the influence attributed to cod-liver oil as an expectorant, although it seems more probable that the effect is derived from the improvement produced upon the general nutrition. Brunton attributes it to a stimulating action upon the epithelium of the bronchi. In cases of atonic dyspepsia, particularly among elderly people, cod-liver oil often relieves the " sinking " feeling at the epigastrium and the faintness of which they complain.

Ringer recommends cod-liver oil for vertigo in the aged which originates from feeble heart action, and for chronic endocarditis in children. It is also serviceable in relieving constipation in young infants, and it may be sometimes given with advantage in lieu of castor oil. Its loosening effect is more decided in children than in adults, and it is less likely to produce subsequent constipation than castor oil, besides being less disagreeable to take.

For marasmus the use of cod-liver oil is particularly indicated, and in infants when chronic diarrhœa obtains, some benefit may be derived from the topical application of the oil to the skin. To tuberculous children of the emaciated marasmic type in whom the skin is dry and wrinkled 15 or 20 drops of the oil may be given at night without fear of increasing the diarrhœa.

PART II

STIMULANTS, BEVERAGES, CONDIMENTS

STIMULANTS AND BEVERAGES

It is the almost universal experience of mankind that the taking of food and drink merely to satisfy the cravings of physical needs does not at the same time wholly satisfy the desire of the mind for occasional invigoration, for restoration of bodily function after fatigue, for support during sustained muscular exertion, for an incentive to activity, and for conviviality. In some form or other, although in greatly varying degree, a stimulant is demanded by almost every one to meet the emergencies with which he is from time to time confronted.

To this end the civilised European imports his tea from China, his coffee from Java, his cocoa from Brazil, his tobacco from America or Cuba, his opium from India, and his alcohol from more immediate neighbours. His semicivilised or wholly barbaric brother who lacks the ability or means to procure such refreshment from foreign sources relies upon his own ingenuity to devise fermented drinks from every available substance. Thus, the Tartar ferments milk into koumiss, the Mexican ferments the Maguey (*Agave Americana*) into *pulque*, the Central African ferments a wine from the palm, the Apache of southern Arizona ferments a cactus into the intoxicating mescal, the Kamtchatkan ferments a peculiar drink from a poisonous fungus, and honey, rice, corn, barley, rye, grapes, dates—in fact, nearly every cereal and every fruit—is in some part of the world made to yield the cup which cheers, and too often inebriates as well.

It is true that there are those who find it possible to live without ever tasting even the mildest stimulants of any kind, and there are sects of men, like the Mohammedans and Buddhists, to whom the use of alcohol in every form is absolutely forbidden by their religion; but most of them discover other means of satisfying an instinctive craving for occasional stimulation, and ready substitutes for the prohibited intoxicants are found close at hand in hasheesh, opium, excessive tea consumption, etc. The economic and social aspects of this subject alone are of vast importance, and the question of the utility of stimulants and beverages is in itself no small branch of dietetics.

The several substances classed under these headings are found to serve in one or more of the following ways:

I. To relieve thirst and introduce fluid into the circulation.

II. As diuretics.

III. As diaphoretics.

IV. As diluents of the food and of the waste material in the body.

V. As stimulants of the nerves and other organs.

VI. As intoxicants.

VII. As demulcents.

VIII. As tonics, and to promote digestion.

IX. As astringents.

X. For nutrition.

The effects of all beverages and stimulants are far more pronounced if they are taken into an empty stomach, which insures their prompt absorption.

I. To relieve thirst all fluids which are not too sweet may be used, but sour beverages, such as acid lemonade or raspberry vinegar, the effervescing carbonated waters, solutions of potassium bitartrate, or dilute mineral acids in water, are generally the most acceptable.

II. As diuretics the mineral waters and carbonated waters hold the first rank. With many persons coffee is also an active diuretic. So are beer, gin, champagne, and, to a lesser degree, other forms of alcohol, and tea.

III. As diaphoretics, hot spirits and water or hot tea may be used.

IV. As diluents of the ingested food and of the waste material of the body the alkaline and carbonated effervescing or bland waters are the best.

V. As stimulants of the nerves and other organs, the milder forms of alcoholic beverages, diluted spirits, tea, and coffee are used.

VI. As intoxicants, beers, ales, strong wines, champagne, and strong liquors are the most powerful agents. Koumiss as originally made in the steppes of Russia, and many fermented substances, are also employed for the same purpose.

VII. As demulcents, mucilaginous, farinaceous, and gelatinous beverages are used for fevers, etc. Such are decoctions of Iceland moss (*cetraria*) or Irish moss, barley or oatmeal water, arrowroot and other light gruels, solutions of gelatin, flaxseed tea, etc. When taken hot they are soothing for coughs and promote expectoration.

VIII. For use as tonics and to aid digestion may be mentioned malt extracts, ales, light wines, clarets, Burgundies, diluted brandy or whisky, chalybeate and arsenical waters, and alkaline waters drunk before meals.

IX. As astringents, red wines and tea are of chief importance.

X. For nutrition, cocoa, chocolate, malt extracts, "grape food," and, because of the milk or cream added, tea and coffee.

Stimulants have two separate actions: First, a prompt exhilarating effect or exaltation of the nervous system, which endures for a few hours, and, secondly, a period of depression which usually bears a more or less definite relation to the degree of previous excitation. The second period is sometimes longer or more intense than the first, producing an actual balance of loss of vitality in the system.

Various dietetic drinks have been advocated for their supposed specific action in stimulating a torpid liver and as laxatives or as diuretics; such, for example, are various "herb teas," etc., but they are of doubtful efficacy.

Many fruit essences and sirups are offered for sale for use in making cooling drinks and invalid beverages. When thoroughly reliable preparations are obtained they are of good service, but many of them are adulterated. For example—for lemonade, mixtures of malic, citric, and tartaric acids are often substituted. As a rule, it is better to extract the juice from the fresh fruit, and unless large quantities are required, this is almost as cheap. Unfermented California grape juice may be had in very pure condition, and it constitutes an excellent beverage for invalids, being wholly free from alcohol. "Grape food" serves a similar purpose (p. 188).

The preparations under consideration may be diluted with ice water, or with any one of the simple effervescing waters, such as carbonic-acid water, Vichy, Seltzer, Apollinaris, etc.

Of all these beverages, lemonade and orangeade are perhaps the most useful in the sick-room. These are agreeable, cooling, and refreshing in fevers, mildly diuretic, and beneficial in many ways. A very wholesome drink is made by putting the juice of two lemons with three or four lumps of sugar into a tumbler of iced Vichy, Seltzer, or Apollinaris, and stirring in a saltspoonful of bicarbonate of sodium; to be drunk while effervescing.

Root beer, sarsaparilla, and ginger ale are wholesome beverages when pure. Ginger ale is likely to cause colic unless a reliable article is obtained from a trustworthy dealer. It makes a useful "long drink" for alcoholic subjects who are attempting to recover from a debauch. They crave some beverage which has life and sparkle, and the ginger itself is helpful to the stomach.

Alkaline and Mineral Waters—Effervescing Waters

There are many spring waters which are used as beverages and drunk either with or between meals. They possess, in addition to the properties of plain water, a mildly tonic effect upon the mucous membrane of the stomach, due either to the carbon-dioxide gas or salts, or both, which they may contain, and, owing to their salts and water, they are also diuretic. Many of these waters are sold "plain"—i. e., without free gas, and others either hold natural CO_2 or are made "sparkling" by having this gas pumped into them under pressure.

These waters are very useful, when taken half an hour before meals, to cleanse the mucous membrane of the stomach and prepare it for the reception of food. They also serve to dilute and wash out waste materials from the system.

The effervescing or carbonic-acid waters are more highly charged with gas as sold from "fountains" at the druggists' or in siphons than when bottled.

Fruit sirups are combined in many ways with soda, carbonic-acid, or other effervescing waters, to make soda water and similar beverages.

Ginger ale, sarsaparilla, etc., are made effervescing, and are often used as cooling and refreshing drinks.

The habit which some persons form of drinking large quantities of alkaline waters independent of any special needs of the system should be condemned. It leads to the condition which Trousseau long ago described as "mineral-water cachexia."

All the effervescing waters when taken in excess are apt to excite or increase flatulency and give rise eventually to dyspepsia and debility, especially when combined with sweet sirups. They should be avoided in dilatation of the stomach, flatulent dyspepsia, and palpitation.

Some waters are drunk for their laxative or purgative action, and others for the salts which they contain, like those of sulphur, iron, or arsenic. This leads to the classification of mineral waters into alkaline, saline, chalybeate, sulphurous, acidulous, arsenical, etc.

Thermal waters are those which issue hot from their springs. Many persons believe that these waters possess special properties by virtue of being hot, which they lose as the heat departs, but there is no physiological ground for this belief.

Many table waters, like Poland water (a plain carbonic-acid water), Vichy, Johannis, Apollinaris, and Seltzer (effervescing carbonic-acid waters), are used mainly as an agreeable table beverage, and to dilute spirits, wines, lemonade, etc. They are cooling, refreshing, and wholesome. People will often drink fluid of this kind who are not willing to drink sufficient plain water.

Johannis water is an alkaline carbonated water which comes from a spring at Zollhaus, in the Taunus Mountains. It contains principally carbonates of lime, soda, and magnesia, besides traces of other materials, and considerable free carbonic-acid gas.

A glass of Apollinaris or similar water taken an hour after a too heavy dinner promotes digestion and helps remove waste products from the system. In fevers such waters are always useful, and they may be given very freely. They often allay nausea and vomiting. They may be employed for the dilution of liquors and milk for invalids. Some persons can digest milk better when diluted with Vichy, carbonic-acid water, plain soda water, or Seltzer. The addition of the latter tends to overcome the constipation which milk is apt to cause.

Some waters are sold as natural lithia waters, but the quantity of lithium contained in any spring water is usually very minute, and beverages of this class are generally re-enforced artificially by lithium salts. They are used to counteract the lithic-acid diathesis, gout, and rheumatism.

Kronenquelle water is an alkaline lithia water from Obersalzbrunn, in Silesia, which contains considerable sodium carbonate and traces of iron and manganese.

The Buffalo, Londonderry (New Hampshire), and other lithia waters are much prescribed in this country.

Below is given a list of some of the more noted waters which are extensively used in conjunction with dietetic treatment:

1. **Alkaline Waters.**—Vichy, in France; Ems, in Germany; Fachingen, in Germany; Saratoga Vichy (rich in CO_2), New York; St. Louis Springs, Michigan (poor in CO_2); Bethesda Springs, Wisconsin.

Other sodium chloride waters, containing also carbonates and CO_2, are those of Hathorn Spring, Congress Spring, and Kissengen Spring, in Saratoga, New York; Homburg, Wiesbaden, Kissengen, and Seltzers, in Germany; Bourbonne, in France.

The alkaline waters all contain more or less carbon dioxide, and their most important ingredients are the alkaline carbonates.

They also contain sodium chloride, and sometimes sodium sulphate. Some have one variety of salts, some another, which preponderates. Generally speaking, the European waters are richer in alkalies than are the American.

Alkaline waters are useful in the uric-acid diathesis and lithæmic conditions, gout, chronic rheumatism, obesity, hepatic engorgement, gallstones, hyperacidity of the gastric juice, chronic gastric ulcer, and catarrhs of the mucous membranes, especially of the stomach, respiratory tract, and bladder.

2. **Alkaline Sulphur Waters.**—Richfield Springs, Sharon Springs, Avon Springs, in New York; Greenbrier White Sulphur Springs, in West Virginia; Harrogate, in England; Neuendorf and Meinberg, in Germany; Aix-la-Chapelle, in Rhenish Prussia.

These waters, containing sulphuretted hydrogen in addition to other ingredients, are much used in gout, chronic rheumatism, obesity, and chronic eczema. They are often supplemented by a course of chalybeate waters.

Hot springs are found at the Hot Sulphur Springs of Arkansas and Virginia, and Schlangenbad and Plombières, in Europe.

3. **Alkaline and saline purges** contain a high percentage of sodium and magnesium sulphates. These waters are often called "bitter waters."

Such are: Püllna, in Bohemia (the strongest of all, and one of the oldest known); Carlsbad (Sprudel) and Marienbad (Kreuzbrunnen), in Bohemia; Friedrichshall, in Germany; Franz Josef, in Austria; Kissengen Bitterwater, in Bavaria; Hunyadi Janos, in Hungary; Rubinat Condal Spring and Villacabras, in Spain; Epsom, in England; Crab Orchard, Estill Springs, in Kentucky; Bedford Springs, in Pennsylvania; some of the Saratoga waters, and Mount Clement Spring, in Michigan, which latter water contains iron.

These waters are useful to counteract indiscretions in diet and the overloading of the liver.

The Rubinat water is effective and possesses the advantage of being less disagreeable than many of the others.

Villacabras water is a Spanish sodium sulphate, strongly purgative water, obtained not far from Madrid.

These waters should be taken either very cold or in a half-pint of very hot water. If drunk lukewarm their taste is nauseous, and may excite emesis. The dose varies from two to six or eight ounces.

4. **Chalybeate Waters.**—Schwalbach (Stahlbrunnen), Pyrmont (Neubrunnen) Spa, Belgium; St. Moritz, Switzerland; Rock Enon, Virginia. These waters serve as tonics for the blood and nerves, but if too long used they cause dyspepsia and anæmia.

5. **Acidulous waters** contain CO_2 in excess, and but little salts of any kind. Such are the waters of Clysmic Spring, in Wisconsin; Blue Lick, in Kentucky; Carlsbad (Dorotheënquelle), in Bohemia.

6. **Various waters** are the Alum Springs, in Virginia; Oak Orchard Acid Spring, in New York; Bourboule, in France, which contains arsenic. Roncegno water is a ferruginous arsenical water from the Tyrolean Province of Trent.

Tannin

Tannin is an astringent of vegetable origin which exists in tea, coffee, and many wines, especially the red wines, and as such it is worthy of brief separate consideration. It possesses no nutrient power whatever, and is mainly of interest to the dietetist from the harm it may occasion if taken too freely. In strong solution it precipitates the ferment of the gastric juice and renders it inert, and also gives rise to constipation by its astringency, which affects the mucous membrane of the intestine. For these reasons strong tea or tea drunk to excess materially hinders gastric digestion.

According to Fraser, the tannin in tea interferes with the digestion of fresh meat, but to a less extent with that of dried or smoked meat, such as tongue or ham, the fibres of which are already shrunken by curing.

Coffee contains much less tannin than tea, thus it has not the same effect upon the alimentary canal, in fact, it may be laxative.

Tannin is contained in red wines in considerable quantity, hence clarets are mildly astringent and constipating.

Tannin is useful for a variety of local astringent applications.

TEA

Method of Preparation.—Tea is a preparation made from the leaves of various species of a hardy evergreen shrub called *Thea.* The manufacture consists in plucking the young leaves of the plant and placing them in the sun; after they have become withered they are rolled and twisted. This process is sometimes conducted by hand, or even by the feet of the natives in China, and sometimes by machinery. The leaves are next pressed into small masses or rolled into balls and allowed to ferment while still moist, after which they are dried over a fire of a temperature sufficient to evaporate all the moisture. They are finally sifted and assorted into different qualities. The value of the tea depends upon its flavour, and this is mainly influenced by the process of fermentation, which must be supervised with great care.

Green and Black Tea.—The distinction between black and green teas is due to the variations in their mode of preparation, and not to separate species of the plant. Green tea is made by steaming the leaves before they are rolled and dried. The further difference between green and black tea consists in the relatively larger quantity of astringent material (tannin) which predominates in green tea. The following table, from an analysis by Mr. Y. Kozai, illustrates this point and exhibits the proportionate quantity of some of the more important ingredients of tea. It presents the difference in percentage composition between green and black tea prepared from the same plant:

	Green tea	Black tea
Crude protein	37.43	38.90
Fibre	10.06	10.07
Ash	4.92	4.93
Theine	3.20	3.30
Tannin	10.64	4.89
Total nitrogen	5.99	6.22

Because green tea contains more than twice as much of the astringent tannin than black tea it is generally regarded as less wholesome than the latter. It is also believed to have a somewhat less stimulating effect upon the nervous system, though this can hardly be accounted for by the slight variation in the percentage of theine shown to exist by the above table, this latter substance being the alkaloid, which is chiefly responsible for the stimulating influence of tea upon the nerves.

There has been some discussion in regard to the identity of theine with caffeine, and by many writers they are believed to be the same alkaloid. Rice says that most of the commercial caffeine is derived from tea leaves, but May finds that in frogs, at least, "theine produces spontaneous spasms and convulsions, while caffeine does not. Theine impairs the nasal reflex early in the poisoning process, while caffeine does not, if at all, until the very last stage."

Properties.—The peculiar stimulating properties which tea possesses, as well as its colour and agreeable flavour, depend upon the season of the year at which the leaves are gathered, the variety of the plant, the age of the leaves, which naturally become tough as they grow older, and the care exercised in their preparation. The flavour is produced by the formation of volatile oils which develop during fermentation. It is these substances which cause the minor differences in effect of tea and coffee.

The aroma as well as the flavour of tea is often artificially increased by the addition of such substances as the leaves of orange flowers, jasmine, or roses.

Tea made of small leaves packs closely, and if measured by the spoonful gives a stronger beverage than the coarser-grained varieties.

Infusion.—The flavour of tea depends not only on the character of the leaves, but upon that of the water which is added to them. About five grammes of leaves should be used for one infusion. The water should be poured upon the tea leaves when boiling, and the infusion should not last beyond three or four minutes if the flavour is to be delicate; if it is continued beyond this point materials become extracted from the leaves which, while they may make the tea appear stronger, materially diminish the delicacy of its flavour. The water should be neither too hard nor too soft. Soft water extracts more of the soluble materials of the leaves and yields a beverage of darker colour. Water which contains iron or lime salts should be boiled with sodium carbonate before it is used for tea infusion.

PHYSIOLOGICAL AND THERAPEUTIC ACTION

Good Effects.—Tea is mildly stimulating to the nervous system and tends to increase the activity of certain vital functions. It is refreshing and relieves bodily fatigue. For the latter purpose it has been found especially useful for soldiers on the march in hot climates.

Major Woodruff, U. S. A., says: "The universal experience of military men testifies to the absolute necessity of tea or coffee. The latter is generally preferred, but the writer's experience points to tea as preferable in the long run." For this purpose both these substances are better preserved if compressed into small bulk.

In some persons a cup of hot tea affords prompt and decided relief from headache, and when taken quite strong it is sometimes serviceable in the cure of chronic alcoholism. It is also used as an antidote for opium poisoning, but coffee is preferable.

The "strength" of tea as applied to the appreciation of its taste in distinction from its effect on the nerves is due to the quantity of tannin present, which is bitter. A bitter tea is not therefore necessarily a strong one in its stimulating properties, which are owing to the theine.

Tea, when employed as a beverage, possesses some effects which are not strictly due to action upon the nerves. It introduces considerable hot water into the system, which is beneficial when taken at the proper time in relation to meals, and when milk or cream and sugar are added its nutritive value becomes considerable. Tea is moderately sudorific in action, and it has a slight influence in regulating the circulation and temperature of the body, which, if too cold, becomes warm by the stimulating effect upon the heart, whereas if the body is too hot, tea may exert a cooling influence by increasing perspiration and evaporation from the surface. Hot tea will sometimes increase the action of aperients, but it is doubtful whether it has any more effect than a similar quantity of hot water.

Roberts gives the following analysis of

The Effects of Tea and Coffee on Gastric Digestion

Digesting mixture: 2 grammes of dried beef fibre, 0.15 c. c. hydrochloric acid, 1 c. c. glycerin extract of pepsin, varying proportions of tea and coffee, water to 100 c. c.

Proportion of Tea or Coffee contained in the Digesting Mixture.	Time in which digestion was completed. (Normal, 100 minutes.)		
	Tea, 5-per-cent strength.	Coffee, 5-per-cent strength.	Coffee, 15-per-cent strength.
10 per cent	105 minutes.	105 minutes.	160 minutes.
20 " "	140 "	140 "	Embarrassed.
40 " "	180 "	180 "	Almost no action.
60 " "	Embarrassed.	Embarrassed.	

Many elderly people find tea particularly grateful and soothing after reaching a period of life when the functional activity of the stomach is gradually weakened. A disproportion may exist between the quantity of food which the stomach can digest and the actual need of the body for nutritive materials to counterbalance the daily waste. In such cases tea enables the aged poor to live on less food than they would otherwise require, and is thus economical for them.

The refreshing effect of tea when taken into an empty stomach after bodily fatigue may continue between three and four hours, a period considerably longer than that of coffee or light wine.

Ill Effects.—The ill effects of excessive tea drinking—the "tea habit"—are referable to its action on the digestive and nervous systems and are cumulative. If taken in large quantities with meals, tea precipitates the digestive ferments, retards the activity of digestion, and may even occasion gastric irritation and catarrh. Constipation usually results, though there is sometimes diarrhœa, and more or less flatulency. The latter may itself cause insomnia. The effect of the "tea habit" on the nervous system is to overstimulate and then depress it, first producing restlessness, worry, and insomnia, and finally muscular tremors, sensory disturbances, and palpitation. Persons who are subjected to some unusual strain or anxiety find that tea for the time being disagrees with them, whereas they are able to drink it regularly when in ordinary health. Cheap teas are always much more apt to produce ill effects than the more expensive varieties. In many persons five cups of strong tea per diem produce symptoms of the "tea habit."

Indian teas contain a larger proportion of tannin than do those from China. For this reason they are more likely to produce disorders of digestion and constipation. They also occasion nervousness and sleeplessness to a marked degree when drunk in excess.

The ill effects of poor tea and of tea rich in tannin can be overcome in some degree, as suggested by Roberts, by the addition of carbonate of sodium in the proportion of ten grains to the ounce of dried tea leaves; this does not materially interfere with the taste.

When tea taken with milk and sugar is found to disagree, substitution of the juice of a slice or two of lemon makes it acceptable and beneficial to many persons. Tea which is "steeped" is more unwholesome on account of the extra tannin, etc., which is extracted.

Tea must be avoided in dyspepsia, gastric irritability from any cause, constipation, anæmia, insomnia, and "nervousness," and usually in gastric catarrh, although Bauer recommends weak tea as less likely than coffee to induce heartburn or aggravate diarrhœa. The ill effects of the "tea habit" are even more pronounced in children and youth than in adults.

A case of multiple neuritis caused by drinking between two and three pints daily of strong tea has been reported by Spratling, and several similar cases are recorded.

In a recent report upon insanity in Ireland tea is mentioned as a contributing factor. A very poor quality is there used, and it is often stewed nearly all day, water being added from time to time. This report continues: "Undoubtedly the method of preparation adopted and the excessive use of this article of diet, now so general among our poorer population, tends to the production of dyspepsia, which in its turn leads to states of mental depression highly favourable to the production of various forms of neurotic disturbance." Exceptionally the "tea habit" has been acquired through chewing the leaves.

Adulteration of Tea.—The adulteration of tea is extensively practised, but it can rarely be said to be injurious to the digestion, for the adulterants are either added in very minute proportion, as in the case of plumbago, indigo, or Prussian blue, for the purpose of colouring or "facing" the tea, or foreign leaves are mixed with the tea, which simply dilute it without necessarily making it injurious. Green tea is more likely than black to be adulterated. Catechu as well as salts of iron are sometimes added to increase the astringency.

Quantity Consumed.—It is interesting to make a comparison between the consumption of tea and coffee in the United States. The quantity of tea consumed in 1890 was 83,494,956 pounds, while the consumption of coffee during the same period was 490,181,755 pounds. On the other hand, London consumed per annum 25,000,000 pounds of tea (or 1.38 pound per capita) as against 2,740,000 pounds of coffee (1898). The amount of tea consumed per capita in the United States is 1.33 pound, while the amount of coffee consumed is 7.8 pounds. Slightly more than half of the tea drunk in the United States comes from China, and a large part of the remainder from Japan. The India teas are nearly twice as strong as the others, but they are much less commonly drunk in this country excepting in mixtures where they have been added to Chinese or Japanese teas to improve their flavour and strength.

Coffee

Composition.—Coffee consists of the berries or seeds of *Coffea arabica*, which are dried, roasted, ground, and subjected to infusion. The coffee drunk in the United States is mainly imported from South and Central America, Mexico, and Java, 63 per cent being imported from Brazil. The Rio berry is smaller than that from Java. The composition of coffee beans varies somewhat, but an approximate idea of it is obtained from the following table from König, which gives the percentage of the important ingredients:

Water	1.15
Fat	14.48
Crude fibre	19.89
Ash	4.75
Caffeine	1.24
Albuminoids	13.98
Other nitrogenous matter	45.09
Sugar, gum, and dextrin	1.66

The exhilarating effect of coffee is said to be caused by the ingredients caffeine, caffeotannic and caffeic acids, and a volatile oil developed during roasting.

The coffee berry contains no starch, and Wiley has shown that its principal carbohydrate is cane sugar or sucrose. There are present also a substance allied to dextrin and a reducing sugar. The well-known stimulant effect of coffee upon the nervous system is mainly due to the alkaloid caffeine, which is chemically identical with theine and possesses the same physiological properties, its action being chiefly upon the nerves and kidneys. Coffee also contains a little aromatic oil which is moderately stimulating to the nervous system. It has less oil than tea.

Method of Preparation.—The preparation which the coffee beans require consists of drying them by roasting at a temperature of fully 200° C., after which they are ground into small fragments to facilitate the solution of their ingredients by hot water. The heat converts the sugar of the beans into caramel and develops volatile and aromatic substances to which the agreeable aroma of the coffee is due. These substances being volatile, the aroma soon forsakes the beans, and they should not be roasted or ground long before they are to be used. The roasting also liberates gases in the beans, which cause them to increase in bulk while losing in weight.

The methods of preparing coffee as a beverage are three—namely, (1) filtration, (2) infusion, and (3) decoction or boiling.

(1) *In filtration* boiling water is allowed to percolate slowly through finely ground coffee. Air should be excluded as much as possible during the process; otherwise the oxygen alters the aroma. According to von Liebig, filtration only dissolves from 11 to 15 per cent of the coffee instead of 20 or 21 per cent, which is obtainable by other means.

(2) *Infusion* is the common mode of preparation of coffee employed in this country and in Europe. It is said to reduce the exciting influence of strong coffee without destroying its aroma or otherwise altering it. In conducting this process the finely ground coffee is put into water previously boiled, but removed from the fire, and allowed to stand for about ten minutes at a temperature of 180° or 190° F.

(3) *Decoction* is the method principally used in Turkey and elsewhere in the East. The coffee beans are ground to powder and placed in cold water, which is then heated to boiling. The beverage is drunk without straining. If boiled but a few minutes some aroma still remains, but it is soon driven off, and continued boiling extracts more caffeine than is obtainable by infusion.

Coffee long boiled or left standing in the coffee pot over the fire, as in the case of tea, becomes more and more indigestible from extraction of tannin.

Soft water extracts more coffee from the berries than hard, as it does from tea leaves.

Coffee should always be made from newly roasted and ground beans; and when economy is to be considered, or when strength and aroma are both desired, a larger proportion of the soluble ingredients may be obtained by combining the second and third processes, as described by Yeo: "After first preparing an infusion by passing boiling water over the coffee, the grounds left should be boiled in more water, and the boiling decoction thus obtained should be poured over another portion of freshly ground coffee; this, in turn, is also boiled with more water, to be used again with fresh coffee in the same manner, and so on. By this method all the soluble matters in the coffee are extracted and none of the aroma is needlessly dissipated." Ready-made coffee is sometimes preserved with condensed milk and sugar in tin cans. This preparation merely requires to be put into a cup of hot water to be fit for drinking.

PHYSIOLOGICAL ACTION

Good Effects.—Coffee, when taken as a beverage, has well-marked physiological effects, chiefly upon the muscular, vascular, and nervous systems. It removes the sensation of fatigue in the muscles and increases their functional activity; it allays hunger to a limited extent; it strengthens the heart action, and constitutes a valuable cardiac stimulant in some forms of collapse by its moderate quickening effect upon the pulse and influence upon the vascular tone; it acts as a diuretic, and increases the excretion of urea; it has a mildly sudorific influence; it counteracts nervous exhaustion and stimulates nerve centres. It is used sometimes as a nervine in cases of migraine, and there are many persons who can sustain prolonged mental fatigue and strain from anxiety and worry much better by the use of strong black coffee. In low delirium, or when the nervous system is overcome by the use of narcotics as in the case of opium poisoning, or by alcohol, or by excessive hæmorrhage, strong black coffee is serviceable to keep the patient from falling into the drowsiness which soon merges into coma. In such cases as much as half a pint of strong black coffee may be injected into the rectum.

Drunk in moderation, coffee is a mild stimulant to gastric digestion. In the bowels coffee has an opposite effect to that of tea, for it stimulates peristalsis, and for many people, when drunk early in the morning, it possesses a distinctly laxative effect. It thus indirectly benefits the liver. Strong coffee with a little lemon juice or brandy is often useful in overcoming a malarial chill or a paroxysm of asthma. It is the universal testimony of army officers that coffee is indispensable for troops in service to relieve fatigue and improve their spirits.

The stimulating and diuretic effect of coffee is more decided when it is taken into an empty stomach.

The nutrient value of coffee alone is too slight to be considered, but the addition of sugar and milk, as in the case of tea, makes it a valuable food. It does, however, possess some effect in diminishing tissue waste. The very general fondness which exists for the taste of coffee makes it a useful means of flavouring many kinds of foods for invalids, such as jellies, custards, etc. When the taste of milk is objected to, the addition of a very little coffee will often overcome the dislike for it.

Coffee is a useful temporary cardiac stimulant for children suffering collapse, but should not be given them as a daily beverage.

Ill Effects.—Strong black coffee taken after dinner tends to retard the digestive processes somewhat, and for this reason it should be avoided by dyspeptics; but to persons with sound digestion who, perhaps, have eaten rather more food than they need, this influence may not prove a disadvantage, and meanwhile its stimulating effect may arouse the overtaxed digestive functions.

Many persons find themselves able to perform much more active brain work by the stimulus afforded by drinking coffee and strong tea. If one is obliged to work late by night at severe mental labour, sleepiness may be avoided by this means. The continuance of this practice, however, soon results in forming a coffee or tea habit, in which the individual becomes a slave to the beverage and feels an imperative need for it at certain hours of the day, when, if it cannot be obtained, the system suffers from languor, prostration or restlessness, and craving. Exceptionally the coffee habit takes the form of eating the coffee beans. By drinking two or three cups of strong black coffee at every meal muscular tremors sometimes are developed with "nervousness," anxiety, dread of impending ill, with palpitation and feeling of precordial oppression, bradycardia vertigo, heartburn, dyspepsia, constipation, and insomnia. In such cases the symptoms usually promptly subside on suspending or restricting the beverage; but if they have been long continued, the use of sedatives may be necessary to control the ill effects. Extreme cases suggest the condition resulting from some drug habits, and there is irritability of the whole nervous system and mental excitement. Emaciation is common, and pruritus ani has been observed by Brown-Séquard. Those who are habituated to immoderate tea or coffee drinking do well to stop the habit abruptly in order to observe the degree of craving which results and the influence which these beverages is acquiring over the system. As an aid to breaking off the coffee habit, "postum" may be used. It is composed of cereals and has a flavour which many find agreeable. The published analysis gives 13.13 per cent protein, 66.11 per cent carbohydrates, 1.60 per cent fat, besides salts and water. In children the habitual use of coffee gives rise to insomnia, night terrors, nervousness, and tremor. Acute coffee poisoning differs from the chronic form in producing greater excitability, with tendency to delirium and tachycardia.

Quantity Consumed.—In connection with the comments often made in regard to the nervousness of temperament which characterises many Americans, it is not without interest to note a fact which may stand in the relation of either cause or effect to this condition—namely, that the people of the United States consume one third of the total coffee produced, which in 1899 amounted to 831,827,063 pounds, or more than Germany, Austria, Hungary, France, and the United Kingdom combined. On the other hand, England and her colonies consume one half of the world's output of tea, and the United States consumes but one fifth of it.

Adulteration.—The adulteration of coffee, more particularly when it is ground, is so easily accomplished that it affords great temptation to unscrupulous dealers. Almost all ground coffee sold to the poor is adulterated, but the adulterants are not usually of a character to render them injurious to health. Chief among them is chicory, which is added both for dilution and for its influence on the colour and flavour of the coffee. This substance, however, is actually preferred by many persons, and, as it is in no wise injurious, it is hardly fair to consider it as an adulterant when its admixture with coffee is acknowledged.

Chicory is prepared from the root of the chicory plant, or wild endive, which is roasted and ground. By roasting, an aroma is developed, as in the case of the coffee berry. Chicory contains no caffeine, but it holds a volatile oil and a bitter principle. Its admixture with coffee is detected by bleaching with chlorinated soda, which acts promptly on the pigments of chicory, but very slowly on those of the natural coffee.

In France, coffee is frequently flavoured with caramel instead of chicory, which is more extensively used in England and the United States.

Coffee is also diluted with various substances, such as peas, beans, peanuts, dried sweet potatoes parched, and ground acorns, corncobs, or date stones are sometimes used.

Imitation coffee beans are composed of pellets of roasted wheat flour, or sometimes wheat flour and chicory, or even sawdust. Rye, corn, and barley are also mingled with wheat for the same purpose.

Fat globules are present in impure coffee in considerable quantity. The substitutes for coffee are easily detected by the fact that, unlike the true coffee bean, which, unless overroasted, floats after roasting, they usually sink to the bottom of a glass of water.

Colouring matter, like ochre, burnt umber, charcoal, Prussian blue, and lead chromate, is added occasionally before the roasting, as well as burned sugar and sirups, in order to affect the appearance and colour of the beans. The beans are sometimes polished in cylinders, in which they are made to revolve with soapstone.

Substitutes for Coffee.—A substitute for coffee may be made from wheat, rye, or oatmeal, to which butter is added in the proportion of one part to eight of meal. The butter is melted in a hot iron frying pan and the meal is sprinkled over it and briskly stirred without burning. Thus prepared, the meal resembles roasted coffee, and when half an ounce is boiled in a pint of water it makes a beverage which is rather agreeable in taste. In Bavaria this substitute for coffee is used largely by the peasants, and it is also supplied in some charitable institutions in this country. Its use necessitates boiling the water, which, if it contains any impurities, is thus rendered harmless. There are several cereal substitutes for coffee sold in open market which are advertised as being highly nutritious. A number of them were analysed for the United States Department of Agriculture (Bulletin 122, 1900) by C. F. Langworthy, who says of them:

"The average cereal coffee infusion had the following percentage composition: Water, 98.2; protein, 0.2; and carbohydrates, 1.4, while the fuel value was 30 calories per pound. Skim milk, which is ordinarily considered a rather "thin" beverage, contains 3.5 per cent protein, 0.3 per cent fat, 5.15 per cent carbohydrates, and 0.8 per cent ash, or almost twenty times as much food material as the average of the beverages made from cereal coffee. If made according to directions, one would have to drink 4½ gallons of an infusion of one of them which made an especial claim to high nutritive value in order to get as much food as is contained in a quart of skim milk."

Maté, called also Paraguay tea, is manufactured from the dried leaves of a plant resembling holly. It is a mildly stimulating beverage which contains theine, but it has no special dietetic advantages over tea or coffee.

Relative Value of Coffee and Tea.—Much argument has been expended on the relative digestibility and usefulness of tea and coffee, but about all that can be said definitely in regard to the matter is, that many persons who can drink tea with impunity are made nervous and are kept awake by a similar quantity of coffee, whereas there are others who find that coffee aids their digestion while tea interferes with it, and that it affects them in every way more agreeably than tea; and still a third class cannot take either tea or coffee without producing indigestion, insomnia, and nervousness. Speaking generally, coffee is believed in the United States to be more digestible and useful than tea, but in other parts of the world, especially in England, China, and India, tea is regarded as more beneficial than coffee. In equal weight, tea contains more than twice as much caffeine or, as it is also called, theine. In this country, however, it is customary to use about 50 per cent more of coffee than of tea to the same quantity of water.

Coffee is said to irritate the mucous membrane of the stomach less than tea when drunk in very large quantities.

It has a more decided stimulant action than tea upon both the force and frequency of the pulse.

Cocoa

Cocoa and chocolate are both prepared from the cocoa bean, or pulpy seeds of the exotic cacao tree, *Theobroma cacao*. The major portion of the supply consumed in the United States is derived from Brazil, the British West Indies, Ecuador, Venezuela, and Dutch Guiana. In the United States in 1890 the consumption of chocolate amounted to 634,551 pounds, and of cocoa to 993,402 pounds.

The cacao tree attains a height varying up to twelve metres. It blossoms frequently and yields two crops a year of a bright-yellow soft fruit. The fruit, which bears some resemblance to a small cucumber, contains two or three dozen colourless seeds embedded in mucilaginous material. When dried in the sunlight, the seeds acquire a bright-yellow or brown colour and harden. The cocoa starch grains are spherical.

Preparation.—Cocoa may be either fermented or unfermented. The former variety is dried in the sun at once, and the latter is kept for some time, in quantity, in a cool, moist place, while fermentation proceeds. The process of fermentation greatly improves the flavour, for the natural acidity and bitter taste of the seeds succeeds to a milder, somewhat aromatic, and more agreeable flavour.

The husks of the cocoa beans are irritant to the alimentary canal, and possess little nutrient material.

The kernels when finely ground constitute "cocoa nibs," from which a decoction is made by boiling in water for about two hours, and removing the insoluble residue by straining or decanting; but the cocoa usually sold in market is made by grinding the kernels into a paste, to which starch or sugar is added. If starch has been used, the cocoa must be boiled for some minutes, but if diluted with sugar it is only necessary to mix it with boiling water or milk.

The different preparations of cocoa are very numerous, but the quantity commonly used for making a single cup of the beverage is a heaping teaspoonful or more.

Composition.—The cocoa beans, after being husked and dried, contain fat and theobromine, besides a little albumin, starch, pigment, and salts.

The average percentage of the principal ingredients of cocoa prepared for a beverage is shown in the following analysis by Stützer of a specimen of Holland cocoa:

Theobromine	1.73
Total nitrogenous substances	19.88
Fat	30.51
Water	3.83
Ash	8.30
Fibre and non-nitrogenous extract	37.48

Theobromine is the principal alkaloid of cocoa, and is almost identical, both chemically and in its physiological effect, with caffeine.

Cacao Butter.—The fat, which is called cacao butter, is the nutrient ingredient of most importance. It usually constitutes 50 per cent of the cocoa bean. It has an agreeable taste and odour, and it may be kept indefinitely without change. Because it melts readily at low temperatures, it is quickly dissolved in the alimentary canal, and it is used by itself for making suppositories.

Uses.—Cocoa is not as digestible as is generally supposed, because it leaves a large residue of unabsorbed material from the nitrogenous ingredients, and its relative deficiency in starches and salts prevents it from being regarded as a " complete " food. Whatever nutritive power cocoa possesses depends upon its fat and a small percentage of digestible albumin. If the cocoa is roasted by too high a temperature, the latter is destroyed.

The term " soluble cocoa " is erroneous, because neither the fat nor much of the albuminous material is truly soluble, and if they are removed the food value of the cocoa preparation is much impaired. These substances may, however, be reduced to a fine state of subdivision and held in suspension, but the cocoa bean contains so much fat that it cannot be powdered unless the fat is removed by artificial process or diluted with sugar or some form of starch. The various powders recommended for invalid diet, and which are sold as cocoa or broma, under different proprietary names, are made in this manner. They possess rather less strength than chocolate, but, on the other hand, because they contain less fat, they may be better borne by an enfeebled stomach. The Holland cocoa and other preparations are made with the object of obtaining a digestible cocoa without removal of the fat, which for this purpose is saponified by the use of sodium and potassium hydrate and magnesia. These alkaline substances, while they may be beneficial in some forms of dyspepsia, in other cases tend to interfere with digestion by neutralising the gastric juice.

Both cocoa and chocolate differ from tea and coffee in the fact that besides making an agreeable and very slightly stimulating drink, they contain more food substance. Their actual use for this purpose, however, is exaggerated. Cocoa further differs from tea and coffee in that the insoluble material is consumed as well as the soluble.

Various cocoa powders, essences, etc., are sold for use by infants, a teaspoonful of which may be dissolved in a half pint of hot water. Or an infusion of cocoa nibs may be made. Such preparations should never be given to very young infants, and, as a rule, it is best not to allow their use before the completion of the third year, but for young growing children after that age they afford an excellent beverage.

After suspension in hot water cocoa is apt to exhibit a scum of fat floating upon the surface of the cup. This may be skimmed off on a piece of bread or cracker and eaten in lieu of butter—a practice common among the Italians. Cocoa, on account of its large percentage of fat in comparison with starchy ingredients, forms a very good addition to a vegetarian diet.

Adulteration.—The sophistication of cocoa is very easy of accomplishment as well as profitable. It is principally done with sugars, starches, and fats. Iron salts and other colouring matters are often added. These adulterations are fraudulent, but not necessarily harmful.

Chocolate

Preparation.—Chocolate is manufactured from the husked, dried, ground, and fermented cocoa seeds, which are then roasted and made into paste and compressed into cakes by moderate pressure. To increase the flavour and nutrient power of the cakes more or less sugar (but at least 50 per cent) is added, and various flavouring extracts, such as vanilla, etc., or spices, are mixed with the paste before compressing it. The husks of the seeds are separately sold, and are used for adulteration in making cheaper varieties of chocolate. They are inferior to the seeds in all their properties.

Uses.—The value of chocolate as a concentrated food is in part derived from the sugar which is added, but it is very nutritious. Tested at the Austrian army manœuvres in 1900, a chocolate ration was found to equal five times its weight of beef. Like cocoa, if pure and carefully prepared, its ingredients are easily digested and absorbed. In cases of dyspepsia and various gastric disorders it forms an agreeable and wholesome drink, and it enables the patient to take additional nourishment in the form of the milk and sugar mixed with it. It is also mildly stimulating and exhilarating to the nervous system when exhausted through overwork or worry, and it possesses the advantage over tea and coffee that it does not produce wakefulness. The free use of chocolate, either eaten or drunk as a beverage, constituting what almost might be called a "chocolate habit," is not injurious to the nervous system after the manner of overindulgence in tea and coffee, but it produces more or less gastric dyspepsia on account of the large quantity of sugar which it already contains or which is added to it when drunk.

Chocolate made into compressed cakes forms a convenient portable food that will keep well for a long time, especially when protected from drying by a coating of tinfoil or otherwise. These cakes contain condensed nutriment which makes them very serviceable upon expeditions where provisions can only be carried in limited quantity. Condensed milk may be carried to drink with the chocolate. The fact that its flavour is so universally liked is an additional advantage.

The chocolate cakes are sometimes prepared with meat extract, or when dissolved and drunk, meat powder or raw meat may be added to them for phthisical patients or other invalids who require concentrated food.

Chocolate, when not too rich in fat, is a very wholesome food for growing children, and is better for them than the more stimulating beverages tea and coffee. Its agreeable flavour causes it to be extensively used as an ingredient of starchy foods and confections, and also to disguise the taste of disagreeable or bitter medicines, such as quinine. Many articles of invalid diet, such as cornstarch, farina, gelatin, etc., may be made palatable by the addition of chocolate, while their nutritive qualities are enhanced.

Kola

Composition.—The kola nut is the fruit of a tall tree of the order *Sterculiaceæ*, growing in the island of Jamaica, on the west coast of Africa, East India, and Ceylon. It resembles both coffee and chocolate in some of its properties, and its uses are practically the same. It contains caffeine, or theine and theobromine, besides a little fat, glucose, dextrin and starch, cellulose, albumins, tannin, mucilaginous material, a diastatic and a milk-digesting ferment, and other substances.

Uses.—Kola is believed to exercise a restraining influence upon tissue waste. It is also mildly stimulating to the heart and nervous system, and is diuretic as well as somewhat tonic in its action on the stomach. It is said to increase the capacity for endurance of muscular work.

Its efficacy has been repeatedly tested by European army surgeons—especially in France and Switzerland—for troops on the march, and has been shown to lessen fatigue and diminish the craving for both food and drink.

Kola made into an infusion like coffee, but only one third or one half the strength of the latter, forms a smooth, rich, dark-brown fluid without sediment or oily scum. It is drunk, like coffee or chocolate, with milk and sugar, and has a not unpleasant taste. It is said to be well borne by delicate stomachs, and may be prescribed in fevers. In large doses it may cause insomnia. As a substitute for food on forced marches or in mountain climbing it is said by those who have tried it to sustain strength for as long as forty hours, and to serve better than tea or coffee.

Alcohol

Alcohol is a substance produced by a process developed in certain sugar-yielding substances (such as grains, molasses, sugar cane, etc.) by the action of an organised ferment, the yeast fungus *Saccharomyces cerevisiæ*. The chemical changes involved are complex, but the chief products are ethyl alcohol and carbon-dioxide gas. A little glycerin, succinic acid, and other bodies may be formed. The fungus is always floating in the air, so that when saccharine fluids are exposed to it the fermentation proceeds of itself. Two parts of sugar yield approximately one of alcohol.

Alcoholic drinks may be economically distilled from a great variety of cereals, vegetables, and fruits which contain sugar, or substances which can be artificially converted into it. There are no civilised races, and but few uncivilised or semicivilised people, with the exception of the Mohammedans, the northern Eskimos, and one or two other tribes mentioned below, who do not practise the distillation of alcohol in some form or other from the materials most available. For example, the spirit fermented from the potato is drunk in Lombardy, and that from rice in Japan, and the Fiji Islanders use a drink, "*kava*," made by fermenting with their own saliva the *Piper methysticum*. Even the stems of plants are used, as in the case of alcoholic beverages made from the sugar cane and the palm. The expressed juices of many fruits besides the grape and apple can be easily fermented into intoxicating drinks, and when the alcoholic fluid obtained lacks flavour it is often re-enforced by some organic extract.

General Discussion of the Value of Alcohol.—The question whether alcohol is, properly speaking, a food, or is only to be regarded as a beverage and stimulant without power of nutrition, has given rise to much warm discussion, and it invariably plays an important rôle among the advocates of teetotalism. A full presentation of the alcohol question would be foreign to the limits of the present work, but the following general propositions comprise the belief of many authorities who have devoted careful research to this exceedingly important topic:

1. The use of alcohol in any form is unnecessary for the human organism in health. It does not exist as a natural product. The very lowest types of man—Australian and many Polynesian savages—know nothing of it, and drink only water and fresh fruit juice, such as that of the cocoanut, although they speedily acquire a fondness for alcoholic beverages when given them.

2. A large number of persons are undoubtedly better without alcohol and may prolong their lives by total abstinence.

3. The lifelong use of alcohol in moderation as an occasional beverage with meals does not necessarily shorten the duration of life or induce disease in some persons, while in others it undoubtedly produces gradual and permanent changes, chiefly of a cirrhotic character, in the blood vessels and in viscera, such as the liver and kidneys. These alterations, which may be slow and subtile in character, may not in themselves materially impair the health or cause an ultimately fatal result, but they tend to weaken vital organs and produce premature senility, so that if the patient acquire any severe disease—as, for example, an acute infection, like pneumonia, or a chronic one, like tuberculosis—the resistance of the body to the invasion of the disease is impaired. There is a prevalent belief that these cirrhotic changes are as much due to toxic products of indigestion caused by alcohol as to the alcohol *per se*.

4. There are many persons whose constitutional inheritance is such that they should be particularly warned against the use of alcohol, and in some such cases, as, for example, among those who are subjects of well-marked gouty diathesis, it is better that the use of alcohol should be imperatively forbidden.

5. The abuse of alcoholic stimulation is invariably injurious, although the extent to which evil influences become manifest depends upon the constitution of the individual, in connection with the two factors of heredity and environment.

6. There are a number of diseases in which the temporary use of alcohol is of positive service, and there are a number of cases in which it becomes a necessity in order to prolong life.

7. In many cases of malnutrition and malassimilation of food, alcohol is itself a food, and its consumption under proper direction results in an increase of body weight and strength and improvement of functional activity. These results are accomplished in part through the action of the alcohol as a definite food, and in part through its remarkable effect in force production. The latter is due to its own direct combustion, by which in chronic diseases and in critical acute and exhausting affections it spares that of the tissues of the body.

Although alcohol is such a strong force producer and heat generator, its effect in this direction is very soon counterbalanced by its stronger influence in lowering the general tone of the nervous system and in producing positive degeneration in the tissues. In the condition of health more food is usually eaten and more force is developed than is actually necessary for the body, and there is always a reserve supply of energy on hand which may be utilised for any extraordinary exertion, and hence the constant use of alcohol as a food or stimulant in health is both unnecessary and inadvisable. When alcohol is consumed in health in addition to a normal or excessive quantity of solid food by its more ready combustion it prevents the complete oxidation of the latter and favours the accumulation of suboxidised waste products, which are always harmful in the system. Excesses in eating are thus doubly aggravated by the effects of alcohol. It is the almost universal testimony of army surgeons and the experience of those who, like Greely, Stanley, and others, have led long and perilous exploring expeditions, involving great fatigue and unusual endurance, that muscular overwork and climatic hardships are much better endured if alcohol is entirely abstained from.

It has always been found in armies that when good food was at hand the issue of alcohol with the regular ration produced an increased percentage of sick days and of incapacity for work. Colonel Alfred A. Woodhull, Surgeon, U. S. A., writes me in regard to this matter: "I do not think that any of our medical officers would seriously advocate the issue of alcohol as a measure of health, but I believe that its habitual use during the civil war was prohibited for reasons of discipline, while it still might have been occasionally issued as if for health. On the rare occasions when it might serve a good purpose as a temporary stimulant *after* a long and wet march, the waggons would be in the rear owing to the same conditions that fatigued the men."

While all this applies to prolonged effort of any kind and to conditions where other food can be obtained and assimilated, it does not detract from the fact that alcohol is a most helpful food and stimulant in emergencies when other food cannot be had or when the body is temporarily endangered from acute disease and the higher rate of combustion in fever, or from failure to assimilate other nourishment.

Major Woodruff, U. S. A., says: "Spirits can never be used in the army as a regular issue; the practice is thoroughly vicious, and was virtually abandoned sixty years ago. On extraordinary occasions of great fatigue they are allowable in moderation. Under such temporary stimulation the men will brace up and perform the necessary work of making earthworks, etc., when without it they would be too exhausted to do anything. Without stimulation a man is not worth much after he has made a forced march of forty miles."

The problem whether the world as a whole is better or worse for the existence of alcohol aside from all ethical questions, and viewed merely from the scientific standpoint of the influence of alcohol upon mortality, is difficult of solution, for to offset the numerous cases of fatal alcoholism and the still larger number of cases of diseases which would not presumably be fatal without the existing condition of chronic alcoholic poisoning of the system, are very many cases among both infants and adults in which life is undoubtedly saved by the prompt resort to this food and stimulant and its energetic use. So long as man is exposed to hardships and conditions arising from improper and deficient food supply as well as to the numerous infectious diseases to which he is heir, alcohol must still be regarded rather as a blessing than a curse, for there is no form of stimulant and food combined or stimulant alone which, taken all in all, can be so completely relied upon in cases of emergency. Alcohol when taken alone will prolong life beyond the period at which it would terminate from starvation.

Physiological Action.—The physiological effects of alcohol may be considered under several headings:

I. Action as a Food. II. Action as a Stimulant to the Nerves and Circulation. III. Action upon the Muscular System. IV. Action upon the Body Temperature. V. Action as a Diuretic. VI. Action upon Mucous Membranes. VII. Action upon Gastric Digestion. VIII. Alcohol Absorption—Hypodermic Use. IX. Elimination of Alcohol. X. Alcohol Poisoning. XI. Alcohol and Climate.

I. **Action as a Food.**—As a food, alcohol adds to the nutrition of the body by its prompt absorption, requiring no preliminary preparation by the digestive organs, which are therefore not taxed in any degree, and it is immediately conveyed in the general circulation to the liver and other parts of the system. The chemical changes involved in the assimilation of this form of hydrocarbon are but ill understood. Alcohol, even when digested in very large quantity, does not reappear to any extent unaltered in the urine, and, if not taken in excess, it is not exhaled from the breath, demonstrating that its combustion is complete. This combustion results in the formation of water and carbon dioxide. The fact that the body weight may increase under its use, and that the storage of fat in the tissues may be also increased even to an abnormal degree, does not absolutely prove that the alcohol itself has entered into their structure. Its action may be exerted through modification of oxidation processes or by preventing the burning up of other food materials, which are thereby enabled to be themselves added to the protoplasmic elements of the body; yet there is reason to believe that while the latter is the chief effect of alcohol as a food, it also may be directly stored in the body in the form of some other product, although this has been denied by M. Chauveau. Whatever controversy still exists over the physiological effect of alcohol as a food, it is undeniable that in some cases of disease it is clinically indispensable.

Writing of the nutritive value of alcohol in disease, Atwater says:

"What is wanted is a material which will not have to be digested, can be easily absorbed, is readily oxidised, and will supply the requisite energy.

"I know of no other material which would seem to meet these requirements so naturally and so fully as alcohol. It does not require digestion, is absorbed by the stomach, and presumably by the intestine, with great ease. Outside of the body it is oxidised very readily, within the body it appears to be quickly burned, and it supplies a large amount of energy."

Professor Atwater, in 1899, made valuable experiments upon man in his respiration calorimeter (described on p. 10), in which 500 grammes of pure alcohol was given, disguised in a coffee mixture, and intended to replace a portion of the fats, starches, and sugars of ordinary diet. He found that "the alcohol was almost completely oxidised. The kinetic energy resulting from that oxidation agrees very closely with the potential energy of the same amount of alcohol as measured by its heat of combustion as determined by the bomb calorimeter, and the alcohol served to protect body protein and fat from oxidation."

It is, however, inferior to carbohydrates as a protector of body protein from consumption. In some cases it may even increase protein consumption, as, for example, when taken in such excess as to affect the nervous system and inhibit normal metabolism (Atwater).

In referring to the influence of alcohol upon metabolism Bauer says: "The increase of albumin suffers thereby no appreciable change; that of fat, on the other hand, is reduced by small quantities of alcohol, while by very large doses it is increased at any rate in animals. Alcohol also, in consequence of its fat-sparing action, behaves in the character of a food." The sugar which is contained in considerable quantity in sweet wines, *liqueurs*, etc., is an additional source of nourishment or of fat production. It is a matter of common observation that many heavy drinkers are stout. They usually indulge more freely in unsweetened liquors or malt liquors than in wines, however. Heavy drinkers are often heavy eaters, and may be as unable to control their appetite for food as for drink. This of course does not apply to cases of alcoholic gastritis, in which, temporarily at least, all desire for food may be in abeyance. In a general way, alcohol is believed to lessen tissue waste.

The consumption of alcohol is said to increase the quantity of oxygen inspired and lessen the carbonic acid exhaled.

II. **Action as a Stimulant to the Nerves and Circulation.**—As a stimulant, alcohol acts primarily upon the nervous system and the circulation, although it increases the functional activity of many organs in the body, and gland secretion may be promoted by its use. The influence of alcohol upon the nervous system in moderate doses is to quicken the transmission and enhance the effect of nerve currents, accelerating slightly the heart action and, to a lesser degree, the respiration, while the mental processes are stimulated in part by its direct influence upon the cerebrum, and in part also by the greater rapidity of the circulation.

If alcohol is given in large doses at frequent intervals, it may overstimulate the heart, which subsequently becomes exhausted as the result of the stimulation. This is sometimes true of the senile heart.

III. **Action upon the Muscular System.**—Alcohol used within physiological limits tends to remove muscular fatigue and to increase the force of muscular action.

In the training of athletes for contests in rowing, sparring, and other sports, alcohol is usually absolutely forbidden, and it is believed that the breakdown in health which by many athletes is ascribed to overwork is not infrequently due to violations in regard to the simple physiological laws of the effect of alcohol which the accompanying features of a "sporting" life tempt them to infringe. The question is well stated by Ringer, who says: "There can be no doubt that healthy persons capable of the fullest amount of mental and physical exercise without the stimulation of alcohol not only do not require it, but are far better without it." But, as he remarks, the statement applies to the continued use of strong alcoholic spirits, and not to beers and light wines which, in addition to the alcohol, contain other ingredients which may be serviceable as food. In the latter form of beverages the quantity of alcohol is comparatively small, and the constant use of them is found, by the practical experience of many persons whose occupations preclude them from abundant exercise in the open air in the country, to improve their digestion and enable them to sustain various functions of the body which would otherwise be impaired by their mode of life. This is especially true of elderly people and those who suffer from insomnia and retardation of gastric digestion. Experiments to test the sustaining power of alcohol were made upon three regiments of the British army and reported in 1899. The men were subjected to fatiguing exercises. To one regiment a ration of whisky was allowed, to a second a ration of malt liquor, and to the third no alcohol. The men taking whisky exhibited more energy for about four days than either of the other groups, but then became fatigued and weak; whereas those taking none steadily gained in endurance, and those taking malt liquor showed an intermediate condition. As a result of these experiments, the use of liquor was absolutely forbidden in Kitchener's Soudanese campaign, which was characterised by remarkable immunity from disease in the desert.

IV. **Action upon the Body Temperature.**—The physiological effect of alcohol upon the body temperature may also be regarded as proceeding primarily from its stimulating influence, acting through the vasomotor nerves. In moderate doses, alcohol, by quickening the rapidity of the circulation and by dilating the peripheral blood vessels, enables more blood to reach the surface of the body and to pass through the superficial capillaries in a given time, and hence there is a tendency to lower the body temperature. On the other hand, the combustion of the alcohol itself within the body results in the production of a large number of heat units. The total balance of these processes is usually on the side of an absolute reduction of the temperature. It is in part for this reason that alcohol is of benefit in fevers.

As a result of an elaborate series of experiments made by Reichert to determine the action of alcohol on animal heat functions, he concludes "that alcohol does not affect the total quantity of heat produced; that more heat is dissipated than produced; that the fall of temperature is due to the excess of dissipation, and is in direct proportion; and that in all likelihood alcohol, by undergoing oxidation, yields energy in the form of heat, thus conserving the tissues and acting as a food."

V. **Action as a Diuretic.**—Alcohol in some persons, although not in all, is a very strong diuretic, and its effect depends largely upon the variety of the beverage used. For some persons gin has a much more decided diuretic action than other strong liquors, such as rum or brandy, and in many beer possesses a diuretic action which indicates a special stimulating effect upon the total quantity of urine excreted beyond that produced by a similar bulk of water, but the total of urea, sulphates, and phosphates eliminated is diminished. Chittenden found that uric-acid excretion is doubled. As a general rule, alcohol which is moderately diluted, and which is taken upon an empty stomach, is much more promptly absorbed and possesses a stronger diuretic action than when taken with food or when given in a concentrated form.

VI. **Action on Mucous Membranes.**—Strong alcohol is astringent to mucous surfaces, and it is sometimes used diluted with equal parts of water as a gargle for sore throat. Claret, which also contains tannin, may be employed in this way.

If taken in too large quantity or too strong, the astringent effect upon the stomach is highly irritating, causing local congestion, and even inflammation upon the mucous coat, which becomes covered with tenacious mucus. The tongue soon becomes coated, and the appetite is destroyed as well as the secreting power of the gastric glands.

VII. **Action upon Gastric Digestion.**—Taken with food in the stomach, alcohol in small quantities, not exceeding the equivalent of half an ounce of the pure substance, given in the form of any alcoholic beverage, does not materially affect the action of the gastric juice. In larger quantities, or if the gastric juice itself is feeble, alcohol precipitates pepsin, coagulates the albuminous materials of the food, and greatly retards if it does not altogether destroy gastric digestion. On the other hand, while not interfering with the action of the gastric juice, alcohol may stimulate its secretion so that, as Moleschott says, "a glass or two of good old wine increases the quantity of gastric juice, which performs mainly the digestion of albuminous foods."

Some interesting experiments are reported by Roberts (Lectures on Dietetics and Dyspepsia) upon the effect of malt liquors on gastric digestion. They were conducted as follows: By adding together 2 grammes of dried beef-fibre, 0.15 c. c. of hydrochloric acid, 1 c. c. of glycerin extract of pepsin, and varying quantities of malt liquors, with water up to 100 c. c. The result is tabulated:

Proportion of Malt Liquors contained in the Digesting Mixture.	Time in which digestion was completed. (Normal, 100 minutes.)		
	Burton ale.	Light English table beer.	Lager beer.
10 per cent	115 minutes.	100 minutes.	100 minutes.
20 " "	140 "	115 "	115 "
40 " "	200 "	140 "	140 "
60 " "	Embarrassed.	180 "	180 "

In considering the relation of alcohol to other foods, the fact should be emphasised that monotony of diet with bad cooking of coarse, tasteless food, especially when associated with overwork, may be a potent factor in establishing a liking for liquors among the poor. In the United States, among the poorer classes the art of varying the diet and of serving food in an agreeable and properly seasoned manner is but imperfectly understood, and the statement is confidently made by Williams, who has given years of personal attention to the matter, that "the raw material of the dietary of the French and Italians is more inferior than that of the English, but a far better result is obtained by better cookery, and the same unfavourable comparison can undoubtedly be made with the poorer classes in America." The Italians have the art of making comparatively tasteless food, such as macaroni, into very savoury and nutritious dishes. Osler expresses the opinion that more ill arises from abuses of eating than of drinking, especially in America.

VIII. **Alcohol Absorption.**—Alcohol is highly diffusible, and is promptly absorbed from mucous surfaces as well as from subcutaneous tissue.

Its effect is always more immediate when taken into an empty stomach. It is then rapidly absorbed, and its influence is exerted suddenly. When there is food in the stomach, some of the alcohol is temporarily taken up by it like water by a sponge, its absorption is delayed, and, since its elimination is quite rapid, the system is less likely to become overcharged with it.

Alcohol is well absorbed from the rectum, and to patients who for any reason are unable to retain it in the stomach it may be given in this manner. For this purpose it is best to use spirits diluted with from one to four parts of water, and an ounce of whisky or brandy should be given for a dose.

Hypodermic Use.—Very little alcohol can be made to pass into the body by rubbing it upon the skin, although it is a diffusible substance, but it is very promptly absorbed when injected hypodermically, and where its immediate stimulating effect is required it can be thus sooner obtained. Owing to the local irritant action of alcohol, not over a drachm or two should be placed beneath the skin at any one point, for it is often quite painful. The surface should be rubbed to promote its absorption. In emergency, two or three ounces may be quickly given in this way in divided doses.

IX. **Elimination.**—The questions of what intermediate products may be formed by the splitting up of alcohol in the blood or tissues, of the influence of the combustion of alcohol, and of the combustion of the tissues themselves, involve great difficulties in the way of chemical analysis, and the liabilities to error are considerable. It may be regarded as proved, however, that when taken in moderation alcohol is completely consumed within the body, or so completely that a mere trace escapes in the urine and perspiration, and a little more in the exhaled air. If the dosage of alcohol is very much increased, however, its elimination, unaltered, becomes proportionately active, although it is still consumed in large amount in the body. The excretion of CO_2 by the lungs is lessened.

Alcohol is believed to prevent the elimination of tissue waste under some conditions, and, in spite of the fact that it acts as a diuretic, it may lessen the excretion of urea and uric acid.

X. **Alcohol Poisoning.**—This topic will be more conveniently discussed with the treatment under the heading Alcoholism.

XI. **Alcohol and Climate.**—It is an established fact that climatic conditions exercise an important influence upon the degree to which alcohol influences the system. Many persons find that they can drink more spirits and wine during a prolonged residence in a climate like that of England without apparent ill effect than they can in the more stimulating and bracing climate with greater extremes of temperature which exists in many parts of the United States. If men are to be exposed to cold and hardship for a considerable period of time it is highly unwise for them to indulge freely in alcoholic drinks on account of the rapid fall in the body temperature, which is promoted by the external cold when alcohol relaxes the capillaries. In illustration of this principle, a story is told of a party of engineers who were lost during the winter in the Rocky Mountains, where, after prolonged exposure to cold and hardship, they were one night obliged to sleep without shelter with the thermometer below zero. They had whisky with them and but little food; some of the party drank heavily, others drank in moderation, and a few of the wiser took no alcohol at all. In the morning the latter awoke, cold but refreshed by the night's rest, while others who drank in moderation were very much more uncomfortable and had suffered far more from the exposure, and one or two of those who had drunk freely were frozen to death.

Otto Snell interrogated sixty expert mountain-climbers, and only five declared that liquor was not injurious if taken before or during their exertions.

In the arctic expeditions of Greely, De Long, and others, although pure alcohol was carried for cooking purposes, very stringent regulations had to be enforced to prevent the men from drinking alcoholic beverages, which were only kept for emergencies and sickness. The northern Eskimos are ignorant of such drinks, having nothing which they can ferment to produce them. On the other hand, the natives of tropical climates are in the habit of distilling many varieties of alcoholic drink from the fermentation of vegetable food.

Clinical Uses of Alcohol

1. **Use as a Tonic.**—Very moderate doses of alcohol increase the flow of gastric juice, and for this reason it may be employed with advantage in cases such as the following: 1. By those whose nervous system is readily overtaxed and who when fatigued or worried lose all appetite. 2. By persons of sedentary habits who have greatly enfeebled digestions. 3. In protracted convalescence from severe forms of acute diseases. For any of these patients a mild cocktail, a little whisky and water, or a glass of simple bitters may be ordered to be taken directly before meals in order to improve the "tone" of the stomach. In all cases care should be exercised, especially among persons who may possibly inherit the alcoholic habit, that the beverage be not prescribed too often, for sometimes cases of chronic alcoholism originate among persons who begin by resorting to this food and stimulant to tide them over emergencies such as the above, and who find when the emergency is passed that they are unable to relinquish the acquired fondness for the drink. When troops have been exposed to exhausting service in a hot, humid atmosphere such as that of some of the Philippine Islands they suffer greatly from nervous exhaustion and insomnia. In such cases, besides an ample ration, the use of from two to four ounces of whisky or other liquor per diem, greatly diluted, appears to be of value as a tonic and digestible food. Writing of this matter, Major Charles E. Woodruff says: "Experience has demonstrated that in

a hot climate the moderate use of intoxicating drink is essential to continued health and efficiency."

2. **Use as a Vascular and Cardiac Stimulant.**—If there is general arterial relaxation from debilitating disease, the use of alcohol in proper quantities contracts the vessels and improves the firmness and quality of the pulse to a remarkable degree. Alcohol undoubtedly can be given the first place among the cardiac stimulants, for its combined action in strengthening the heart and regulating the calibre of the blood vessels is most useful. For this purpose it is best to use strong liquors, such as brandy or whisky, which vary but little in composition, and which may be diluted according to need. In all cases of sudden heart failure occasioned by shock, violent hæmorrhages, either internal or external, fainting, etc., it is best to give alcohol in the form of diluted spirits.

It is an interesting fact that the mere mechanical action of deglutition stimulates the heart action and increases the rate of pulse beats by fifteen or twenty in the minute. Stimulants sipped slowly by repeated acts of swallowing for this reason alone may have a greater effect than the same quantity of fluid drunk all at once. In extreme emergencies, whether the patient is able to swallow or not—as, for example, in shock from prolonged anæsthesia, or from the use of anæsthetics which are not well tolerated, and in an urgent case when the alcohol is given by hypodermic injection—it may be used undiluted. Its influence in these conditions is almost immediate, and the stimulation of the pulse may be appreciated in two or three minutes. A little more time is required for the full effect if the stimulant is given by the stomach or rectum. The benefit of alcohol is further shown by the tongue and skin becoming more moist, by the slowing of the pulse, and by the breathing becoming more tranquil. Since alcohol regulates arterial tone and brings the pulse to a nearer normal standard, the volume of the pulse is not so important a consideration as is its compressibility as a factor in estimating the value of alcohol in a given case. The very soft pulse of considerable volume may diminish in volume under the use of alcohol, but it becomes firmer and of better character, showing an improvement in the arterial tone. The rules for observing the effect of alcohol may be definitely applied in almost every case, and the dosage can be regulated accordingly. In acute diseases, such as pneumonia, in which the emergency of cardiac failure or great prostration may be fairly anticipated, it is often better to withhold alcohol until there are definite indications for its use than it is to prescribe it in a routine manner at the commencement of the disease; its effect when actually needed is enhanced if it has not been already given for too long a time. For persons with feeble constitutions, however, and for aged people it may be necessary to commence the use of alcohol at an earlier period. In urgent cases full doses, such as an ounce an hour, may become necessary for a few times, and the quantity and intervals for its administration may then be gradually reduced. Usually when the stimulating and supporting influence of alcohol is urgently needed it is better to give it in quite frequent doses and in moderate quantity than in large amount infrequently. The stimulation is then more uniform and constant, and the digestive organs are less likely to be deranged.

3. **Use in Nervous Diseases.**—Alcohol is of service for many forms of diseases of the nervous system. Neuralgic pains are sometimes allayed by the use of alcoholic drinks which contain volatile ethers, but they should be prescribed with care. In any neuralgic or nervous affections, such as hysteria, which are more or less chronic, it is well to observe that many of the so-called elixirs, nerve tonics, etc., which are recommended for cases of this nature, and especially for treatment of nervous prostration, contain a large percentage of alcohol, and their constant and indiscriminate use is liable to establish permanent alcoholism. In the stomach alcohol may act as an anæsthetic in cases of irritant nervous dyspepsia.

4. **Use in Fevers.**—The whole question of the employment of alcohol in fevers is obviously of grave importance.

The value of alcohol in the treatment of fevers is now universally recognised, and its beneficial effect is manifested in two ways: first, upon the vital functions of the nervous system, circulation, and heat regulation; and, secondly, in sparing the tissues from too rapid combustion and wasting by furnishing fuel in their stead. In fever the increased nitrogenous waste is evidenced by the greater elimination of urea from the kidneys, while the quantity of urine and perspiration are lessened. The use of alcohol meets all indications by lessening the production of nitrogenous waste, by acting as a diuretic, and by regulating the peripheral blood pressure and increasing the perspiration. To accomplish these results, usually six or eight ounces in the twenty-four hours, and often much more, must be given.

As a mere antipyretic the influence of alcohol is less striking than that of many special remedies which have the power of reducing the body temperature, but it has the decided advantage over most of these remedies that its proper use is accompanied by stimulation rather than depression of the heart action.

It may be regarded as a general rule that when given in large quantities if the odour of alcohol is not present in the breath several hours after it has been ingested, and if the pulse is slowed and delirium is reduced under its use, the amount taken is clearly being oxidised as a food and is doing good. On the other hand, if the odour persists in the breath and the pulse is not improved, or the patient becomes more delirious, it indicates that too much alcohol is being given, and the dosage should be accordingly reduced.

The effect of alcohol in fevers is shown by the fact that in health, when drunk in large quantities, it excites gastric catarrh and occasions dyspepsia, whereas a similar amount taken in the height of an acute fever may be very beneficial.

It must not be inferred from the foregoing statements that alcohol should be given at once in fever, or that it should be given in every fever. There are many cases in which it is contraindicated. Such are of sthenic type and of short duration. There are others in which it is a mistake to give it too early, and its use should be postponed until the conditions are present of prostration and nervous exhaustion. There are still other cases in which it should be prescribed at once, as, for example, in pneumonia in feeble or elderly subjects.

The general indications for the use of alcohol as a food in continued fevers or for an increase of the quantity already being given are found in the predominance of one or more of the following symptoms: Increased weakness or faintness, low muttering delirium continued even when the patient is undisturbed, tremor of the tongue and hands, great dryness of the tongue, extreme feebleness of the voice, irregularities in the respiration and pulse, enfeebled or irregular heart action, and absence of either of the cardiac sounds.

There is a tendency at the present time to abandon excessive dosage of alcohol in severe acute febrile infectious diseases, such as pneumonia and typhoid fever, in which it was formerly given at the rate of an ounce an hour or twenty-four ounces per diem, for it is found that other stimulants, such as digitalis, strychnine, caffeine, etc., make it possible to use less spirits. A full discussion of this topic will be found under the heading Dietetic Treatment of Fever.

In the treatment of convalescence, when patients are able to digest and assimilate more and more food, less alcohol is required.

Proper Time for giving Alcoholic Beverages.—Whenever an alcoholic beverage is prescribed by the physician, the time at which it is to be given should be explicitly stated, and there should be supervision over the quantity used, depending upon the influence upon appetite and activity of digestion. When needed as a tonic, the beverage should be given either immediately before or in connection with meals, in order that its effect may be modified by that of other foods. There is less fear of establishing a craving for drink if this rule be observed. It is the habit of drinking between meals without definite purpose which is particularly dangerous.

In some cases of neurasthenia, anæmia, etc., it may be advisable to recommend a glass of claret or sherry between the principal meals, in the middle of the morning or afternoon, but even then it should be taken with some article of light and easily digestible food, such as a biscuit or sandwich. The fact that moderate doses of alcohol improve the functional activity of the stomach affords an opportunity for the better digestion of food given in connection with alcohol, which should not be lost by giving the latter alone.

There are some patients having chronic atonic dyspesia and persons with but limited nervous energy for whom it is better to prescribe alcohol half an hour or more before eating in order that its stimulating influence may be felt in the system before the nervous forces are called upon for digestive functions.

Selection of the Proper Form of Alcoholic Beverage.—In all severe cases in prescribing alcohol it is a rule that the stomach is much less likely to be upset by adhering to a single form of beverage than by making frequent changes. Persons having robust physiques may be able to assimilate several kinds of wines, including champagne, at dinner, followed by liquors and brandy; but these beverages, if taken in such variety without food, will almost invariably derange the stomach, and the unpleasant after-effects which characterise even moderate overindulgence in this respect are usually more decided if a variety of beverages have been used than if only one kind has been taken. The combination of whisky and beer or strong liquors and champagne will promptly disagree with many persons who could take either form of alcohol alone with impunity. In fever the stomach is always temporarily enfeebled, and the importance of adhering to one simple form of alcoholic beverage is emphasised. It may be changed from time to time in conformity with the taste of the patient, but mixtures of beverages should never be given.

With persons who are predisposed to irritating coughs the use of malt liquors sometimes increases the difficulty, whereas strong liquors and wines may prove beneficial. Beer, ale, porter, stout, etc., cannot be drunk by some persons without producing a subsequent feeling of lassitude and drowsiness with headache and suffusion of the face, and yet diluted spirits may be well borne. Some persons find that sherry produces acid dyspepsia, and others find that different sweet wines, such as port, similarly disagree, and in others again they excite attacks of gout. When porter, ale, or stout do not derange the stomach, they may be advantageously used by those who suffer from exhausting discharges or by women who are weakened by prolonged suckling. Alcohol should be emphatically forbidden in all forms of gonorrhœa and syphilis, and a single infringement of this rule may often aggravate the complaint. Some clinicians prefer the use of wines which are well charged with volatile compound ethers as a stimulant for enfeebled heart action and weak digestion. The use of beer as a beverage for fevers is more common in Continental Europe than in the United States. If there is no tendency to flatulent dyspepsia, it may sometimes be used with advantage in such cases, when it will slake the thirst which is not quenched by other drinks. Passing fashion to some extent influences the variety of alcoholic beverage consumed, as illustrated by the fact that in this country the annual importation of Scotch whisky has lately risen from 30,000 to 100,000 gallons for a single firm. Rum and port are much less drunk than formerly.

As a preventive of drunkenness and the evils of chronic alcoholism, the introduction of the milder malt liquors into this country to partially supersede the use of strong spirits has proved a decided advantage. The total annual consumption of all alcoholic beverages in the United States exceeds one billion gallons. In 1870 the per capita consumption of distilled liquors was 2.07 gallons, and twenty-five years later this fell to 1.12 gallons, whereas during the same period the consumption of malt liquors rose from 5.31 to 14.95 gallons. The consumption of wines has remained at about 0.32 gallon.

The annual per capita consumption of alcoholic beverages in 1900 in several countries as compared with the United States is estimated in gallons as follows:

	Beer.	Wine.	Spirits.
England	30.31	0.39	1.02
France	5.1	21.8	1.84
Germany	25.5	1.34	1.84
United States	12.3	0.44	0.84

Italy, France, and Spain grow two thirds of the world's wine, and in France the annual consumption of spirits is only 3.80 litres per capita.

A Committee of Fifty for the Investigation of the Liquor Problem was organised in this country in 1893. The committee consists of eminent jurists, physicians, physiologists, philanthropists, and others, and their object is to collect and study impartial scientific data regarding the consumption of liquor which shall furnish a reliable basis for controlling future legislation in regard to the liquor problem and influence public opinion in regard to its evils. In co-operation with this investigation, Prof. Henry W. Farnam states (in 1899) that "the native-born Americans fall midway, being, as a rule, more addicted to liquor than the Germans and Scandinavians, but less so than the English, Canadians, and Scotch. The coloured race, however, as compared with the white, shows a good record."

Malt Liquors

BEER

The lager-beer industry was introduced into the United States about the year 1842.

Composition.—Beer contains alcohol in strength varying between 3 and 8 volumes per cent (sometimes even 10 per cent). Besides this alcohol and much water, beer contains a variety of ingredients, such as bitter and resinous extractives from hops, sugar, dextrin, albuminates, glycerin, free acids, and ash—the latter only as a trace. The sugar of beer is fattening, and the bitter matter is more or less of a stomachic tonic.

By process of manufacture much beer is made to contain only water, alcohol, and bitter principles. Hop extracts possess a narcotic influence, and hence beer may give rise to drowsiness, whereas other alcoholic beverages—like champagne or whisky—prove enlivening. This effect is, however, quite variable.

Beer produces biliousness in persons of weak digestion. It is sometimes called "fluid bread," but the expression conveys a wholly exaggerated idea of its food value, although it is certainly fattening when drunk in large quantity.

Beer Brewing.—*Malt* is the name given to any germinating cereal, but to prepare it for beer brewing, malt is made from barley grains as follows: The grain is steeped in water at a temperature which causes germination and the development of diastase. It is next couched and "floored," during which process germination continues, and it is finally kiln-dried.

Brewing of beer is accomplished as follows: The prepared barley malt is first cleaned by screening, sifting, and blowing, is crushed and then "mashed" or infused with water in large tubs at a proper temperature. This process extracts the existing sugar and dextrin and aids in converting the residue of starch into maltose and dextrin. The "wort" thus formed is a solution of diastase, dextrin, sugar, proteids, and salts. It is drawn off, and the residue of grain is washed with hot water by a process called "sparging," which extracts any remaining useful material. The wort is run into copper kettles and boiled for about four hours. During the last hour hops are poured in. The boiling concentrates the wort, extracts the hop essence or lupulin with tannin, causes coagulation and precipitation of any albuminous substance, and finally it checks further fermentation for the time being. The wort is next cooled and yeast is added in the proportion of about a pound to the barrel. The yeast sets up a new fermentation, which converts the saccharine substances into alcohol and carbon-dioxide gas. This fermentation is retarded by continued application of cold. When it is concluded, the beer is drawn into settling tuns, and then into casks, where it is stored from five to eight months, after which it is ready for bottling. While resting in the casks the beer is subjected to "fining"—i. e., beech-tree shavings are added to it, to collect any floating solid particles. This process allows so much carbonic acid to escape that a second fermentation is sometimes set up by adding new beer to the old in the proportion of 1 to 5.

Beer which is kept long fermenting increases in alcohol and diminishes in extractives. Its natural intensity of colour varies with the method of drying the malt, and increases with long boiling.

White beer is brewed from wheat instead of rye. It is less clear than rye beer, paler, and more frothy and sour.

The low Bavarian beer is fermented by a variety of saccharomyces, which acts at a temperature of 6° to 8° C.

Certain varieties of saccharomyces, acting at different temperatures, set up undesirable fermentation in both beer and wine, making them sour, and developing peculiar odours.

Ale.—Ale is made from pale malt by processes resembling the brewing of beer. It contains from 3 to 6 per cent of alcohol. Strongly alcoholic ales are less used than formerly, having been largely supplanted by the lighter varieties and by beer. The amount of hops used determines the bitterness of the ale, and their aromatic bitter principles furnish the peculiar flavour. Bitter ale has been so far fermented as to contain but little sugar.

Porter.—Porter is made from pale malt with the addition of high dried malt, which gives it colour and flavour. It contains about 6 per cent of alcohol, and is regarded as more digestible than ale of the same alcoholic strength (Pavy). Both ale and porter contain sugar and acid, but these substances are present in less degree in malt liquors than in wines.

Stout.—Stout is similar to porter, but is characterised by a preponderance of extractives.

The stronger malt liquors, such as porter, stout, and heavy ales, are nutritive and fattening.

All stale, flat malt liquors without a "head" are apt to nauseate and prove unwholesome.

WINE

Composition.—Wine made from the expressed juice of different varieties of the grape consists of an alcoholic solution varying in strength from 6 to 25 volumes per cent, and containing flavouring and other substances.

The maximum normal percentage of alcohol which fermenting grapes are capable of developing is not above 15 per cent, but alcohol is often added to equal 18 or 25 per cent or more.

The pulp of the grape furnishes sugar for fermentation of alcohol, and also organic acids or their salts, such as citrates, malates, and tartrates. The stones or seeds furnish essential oils, some of which give the "bouquet" of volatile ethers, and the skins and stems furnish pigments and tannin. The latter is preservative; it precipitates albuminous substances and prevents mouldiness. The chief pigment of wines is primarily of a blue colour, but it is reddened, like litmus, by free acid, more or less of which is always present.

The fermentation of wines is caused by germs, which exist upon the stems or skins of the grapes.

Besides water, sugar, alcohol, volatile ethers, and carbonic acid are added in the manufacture of the different kinds of wine.

Leoser gives the following list of minor substances, traces of which are more or less constantly present in wines: "Gelatin, gum, fat, wax, albumin, gluten, tartaric acid, potassic tartrate, racemic acid, malic acid, calcic malate, oxide of manganese, oxide of iron, potassium sulphate, sodium chloride, calcium phosphate, magnesia, silicic acid, tannic acid."

The composition of the subtle substances which impart the flavour and aroma or bouquet to different wines is unknown. Most of these substances develop during fermentation, but a few grapes, such as the Muscatel, yield their own aroma to the wine.

According to König, the average percentage composition of grape must is water, 74.49; sugar, 19.71; nitrogenous material, 0.28; non-nitrogenous material, 4.48; ash, 0.40; acid, 0.64.

The sugar fluctuates sometimes as much as 24 per cent and the acid 1.2 per cent, and these substances usually stand in inverse proportion to each other.

General Properties.—The perfected wine has the properties of colour, "body" or substance, and flavour, aroma, bouquet, or "fruitiness." Different wines are valued for their astringency (tannin), sweetness (grape sugar), strength (alcohol), acidity (organic acids), colour or sparkle, flavour, and ability to stimulate the appetite and digestion.

Fermentation.—Wines are both naturally and artificially fermented, and many varieties are re-enforced by flavouring extracts and fortified by addition of alcohol. The latter method has the twofold effect of adding to their strength and of preserving them from further fermentation, and hence is used especially for the wines of the Cape, Madeira, and Portugal. In the cooler climate of France, Germany, and Hungary fermentation proceeds more slowly and fortification is less necessary, for the wines of these countries are drier, less fruity, and require less time to mature. They also have stronger bouquet, because they possess more acid, which combines with alcohol to furnish the aroma (Pavy).

Sugar.—The quantity of sugar present in wines varies considerably. It is sometimes almost completely eliminated by fermentation into alcohol, or it may be added in excess to make the natural flavour sweeter.

Flavour and Bouquet.—Some Greek wines have a peculiar flavour, the liking for which is an acquired taste. This flavour is derived from rosin contained in the wood of casks used for preserving the wines, which induces chemical changes.

The Hungarian wines have agreeable fruitiness, but they are not so completely ripened as French wines, and are hence likely to turn sour when transported.

Both glucose and saccharose can be oxidised into acids instead of fermenting to alcohol, and when this process occurs extensively in a wine it becomes sour, like vinegar, and is unfit for consumption.

In general the flavour and bouquet of a wine depend upon (1) the nature of the soil in which the grape is grown, (2) the climate and temperature, (3) the quality of the grape, (4) the use of but a single variety of grape for a given wine, (5) the ripeness of the grape, (6) the duration of fermentation, (7) the addition or subtraction of material by the art of the wine grower, (8) the age of the wine.

In vineyards where the best wines are made the grapes are tested from day to day to determine the right time to pick the vines, for the quantity of sugar and acid present depend upon the degree of ripening and influence the flavour of the wine.

White Wines.—White wine is made from grapes of any colour, the greatest care being taken not to macerate the berries in expressing the juice, and to allow no coloured juice to flow. As a rule, however, the better class of white wines is made from selected white grapes, which are crushed with their skins. The mass is left for several days, so that the skins may impart what little soluble matter they contain to the pulp. The juice is then obtained by further pressure and allowed to ferment. The crushing of grapes was formerly done by the feet of men who trampled upon them, but several lives were lost by carbonic-acid gas poisoning, and the process is now generally conducted by machinery.

After several months, or longer, the ferment and the salts which are insoluble settle in a sediment called lees, and the supernatant fluid is carefully drawn off and casked or bottled.

During the first year or so of storage some wines are recasked several times, for they continue to deposit lees on the bottom and sides of the cask, consisting mainly of "argol," an acid salt from which cream of tartar may be prepared.

When fermentation has proceeded long enough it is stopped, according to the nature of the wine, by the addition of alcohol or strong sugar solution, or if left to continue after the wine is stored, the sugar and extractives very gradually disappear, and alcohol continues to develop.

Hence, if a wine can be bottled early without being too green or immature it is sometimes a decided advantage, for more of the aroma and flavour may be thus retained.

In other cases wines should remain in the casks for from one to four years before bottling—the more delicate varieties being kept the longest—for certain changes depend upon the size and nature of the containing receptacle, which are checked by bottling. Pavy says: "By keeping in a cask, wine increases in alcoholic strength. This is to be accounted for by wood being more easily penetrated by water than by alcohol. Thus it happens that water is lost by evaporation from the outside of the cask in larger quantity than the alcohol, and the wine is left in a more concentrated condition."

White wines are produced in more variety than red wines. On the average they contain from 9 to 12 per cent of alcohol, from 0.30 to 0.50 per cent of sugar, and about 0.50 per cent of acid.

Red Wines.—In making red wine dark grapes are used, and both skins and stones are left to ferment with the pulp, to which they furnish tannin, pigment, and extractives.

Red wines, on the average, contain from 8.5 to 11 per cent of alcohol, 0.55 to 0.65 per cent of acid, and 0.15 to 0.20 per cent of tannin and pigment. The red wines are, as a rule, more easily digested than white, and are more nutritive.

The following practical statements are quoted from Leoser:

"Bottled red wines that are rich in tannic acid, like port, for instance, deposit a sediment and grow lighter in colour. Those that contain less tannic acid generally grow darker. The cause of this is a gradual diminution in the quantity of free acid in the wine. The effect of this acid is to turn the colouring matter red, and as it diminishes, therefore, the wine grows darker or more purple."

Red wine (claret) is often drunk diluted with Vichy, when "the potassium carbonate of the water saturates the free acid of the wine, and so destroys the red colour and permits it to become darker, while the action of the alkali upon the colouring matter gives it a cloudy appearance."

The deeper the colour the rougher is the flavour of the wine in most cases.

"If two wines of equal alcoholic strength be taken it will be found that equal doses of each will produce their effect much more quickly in the case of the white wine than in that of the red. The reason of this is that the astringent action of the tannic acid retards the effect of the alcohol upon the organism. It may be that this indicates in a general way the superiority of white wines as stimulants and red wines as tonics."

Various substances are used for "fining"—that is, to clarify wine—such as cream, milk, blood, solutions of egg albumin, gelatin, isinglass, nutgalls, lime, etc. Their effect is largely mechanical, but the alkalies neutralise part of the acids.

Other substances are occasionally employed, having in view the better preservation of wine, but many of these are unhealthful in their effects on the system. Such, for example, is the use of calcium sulphate, which is converted into potassium sulphate, or the use of alum, sulphuric or other acids, etc. Impure alcohol holding fusel oil is sometimes added. The object of storing wine in enormous tuns is to diminish the surface exposed to the air in comparison with the bulk.

THE VARIETIES OF WINES

The following classification of wines, with the examples and comments, is largely derived from Chambers, and will be found convenient and practical from a purely dietetic standpoint.

Wines may be classed as—

I. Strong Dry Wines. II. Strong Sweet Wines. III. Aromatic Wines. IV. Acid Wines. V. Sparkling Wines. VI. Perfect Wines. VII. Rough or Astringent Wines.

I. **Strong Dry Wines** are those in which the sugar of the expressed grape juice or "must" has fermented into alcohol, either by process of time or by artificial means. When left to itself, this alcoholic fermentation is extremely slow, occupying many years before its completion, but the natural process is better than any artificial one yet discovered. These wines also contain considerable alcohol, often 17 or 18 per cent, which makes them less available for general dietetic uses than weaker wines. Examples are strong, dry old sherry, port, Madeira, and Johannisberg. (The name "sherry" is often used as a generic term for white wines grown in Spain.)

These wines, especially sherry, are sometimes used for stimulation in fevers or other diseases, in lieu of spirits, where the taste of the latter is strongly disliked. If drunk too freely they congest the stomach, and have the evil effects of strong spirits or of strong alcohol in general. (See Alcohol, Evil Effects.) They often contain some sugar, and taken with meals they may interfere with digestion, causing acetic fermentation, and especially disturbing the digestion of fats.

Port is a wine in which the original fermentation has been arrested by the addition of alcohol, and it has a proverbially bad reputation for precipitating attacks of gout. In England, where much more is consumed than in the United States, it is even held responsible for causing the disease in some instances.

It is well known that port improves more by long rest in the bottle than does any other wine. It is a useful temporary tonic, and, like claret, its astringency makes it serviceable in diarrhœal diseases, but many persons, especially in this country, find it altogether too heavy for daily use. This is not altogether due to its high percentage of alcohol, for a greater quantity of strong spirits will sometimes be found to do less damage. It is a poor wine for dyspeptics, and should be proscribed in all bilious states, lithiasis, cases with tendency to gallstone formation, gravel, gout, and rheumatism. It has been largely replaced by claret of late years as a dinner wine.

Port as well as Burgundy is sometimes spiced or "mulled," and prescribed diluted, as a tonic for elderly people. Taken before retiring, with a biscuit, or mixed with a light gruel, it may promote their sleep.

II. **Strong Sweet Wines** are those which contain, either natural or artificially added, fruit sugar in sufficient quantity to exercise a preservative influence, and further fermentation is checked by boiled grape juice. Examples are Tokay, Malaga, sweet sherry, sweet champagne, Malmsey, Madeira, Lachrymæ Christi, and other *vins de luxe*. They are much too sweet to be drunk in quantity, but this quality is sometimes made to disguise the bitterness of other substances, as when Tokay is added to coca extract to make "wine of coca." If long kept, the sweetness is reduced but the peculiar agreeable flavour remains. Alcohol may be added to further insure preservation and increase the strength of the wine, and sweet port is sometimes made in this manner.

The sweet heavy wines, such as sweet port, sherry, and Madeira, contain about 19 to 22.5 per cent of alcohol, 3.5 to 6 per cent of sugar, and about 0.50 per cent of acid. Malaga and Tokay contain more sugar and less alcohol.

The chief use of these wines is not for tonic or dietetic purposes, but for their agreeable flavour. They are better taken between meals, if at all, both because the delicacy of their flavour is more appreciated when the mouth is free from other tastes and because their sweetness may interfere with digestion. Like all sweet wines, they must be forbidden to the gouty, rheumatic, bilious, lithæmic, and dyspeptic.

III. **Aromatic Wines** have a peculiarly choice bouquet, and contain abundance of essential oils with considerable alcohol. They are best when drunk in their native countries—in Spain, France, Italy, etc.—for they bear transportation poorly unless re-enforced by additional alcohol, which detracts from their delicacy of flavour and aroma. Examples are the choicer Rhine wines, Moselle, Capri, Château-Yquem, and Orvieto. Some wines of this class are "more noted for their acid than aroma" (Chambers). Such are white Burgundy (Chablis) and white Bordeaux (Sauterne), which are often drunk with salads and rich foods. The Moselle and Rhine districts produce acid grapes with abundant aroma, and the wines which bear these names are many of them almost free from sugar.

IV. **Acid Wines** owe their distinguishing property to tartaric acid chiefly, but wines which have turned sour on keeping or by exposure to the air contain acetic acid and resemble vinegar.

V. **Sparkling Wines** are those in which carbon-dioxide gas, formed by fermentation after the wine is bottled, is set free upon uncorking, and continues to be liberated for some time thereafter.

The gas gives additional flavour to the wine and increases its exhilarating effect. Such wines are champagnes, sparkling Moselle, and vino d'Asti. The better the wine, the longer it continues to give off gas and aroma after uncorking. Good champagne is bottled under a pressure of about five atmospheres.

These wines, especially good champagne, are very serviceable for invalids, and some persons with delicate stomachs can digest no other form of alcohol; but poor champagne causes gastric derangement sooner than any other wine.

When nausea and vomiting exist they have special power for allaying the gastric irritation. They are absorbed with great rapidity, and act promptly by invigorating the nervous system and circulation. They may sometimes be substituted for spirits in fevers when there is need of alcoholic stimulation. Their cost, unfortunately, places them out of the reach of many, and it also affords much temptation for adulteration.

Champagne.—The essential difference between champagne and other wines is that it contains carbon-dioxide gas in solution.

Manufacture.—Champagne is made of different grades, representing the first, second, and third expressing of the grape juice respectively. It contains approximately 12 per cent of alcohol, or less.

Good champagne is made as follows: The juice is allowed to ferment for about two weeks, when it is poured into casks and kept for a period varying from two to six months, after which it is bottled and kept from two to nine years in racks arranged to hold the bottles with their mouths down, so that on opening them all sediment which has collected in their necks can be removed or "*disgorged.*" The final process is the addition of sugar-candy sirup dissolved in old wine and white cognac brandy. For the "*sec*" brand 8 per cent of sirup is added; for other brands varying quantities up to 16 per cent are poured in. A little alcohol, too, may be added, after which the wine is again corked, and left standing.

French champagnes sometimes have liqueurs or cordials added for flavouring, but American champagnes depend solely upon the grape flavour.

Dryness.—Much emphasis is placed on the value of "dry" champagne for invalids, which means that the sugar which it originally contained has disappeared, and hence the wine is less apt to produce flatulent dyspepsia or aggravate conditions in which saccharine food is harmful. True "dryness" is the result of age, and is due to a very slow conversion of sugar into alcohol, such as goes on in port wine which has been kept for several decades, but, as pointed out by Chambers, this process of slow ripening does not remunerate the dealer, so he induces a quicker acetous fermentation by which all the sugar is transformed in a few months, instead of many years, or else he puts but half the quantity of sirup into the wine—4 instead of 8 per cent. It is champagne manufactured in this manner which is usually shipped out of France for foreign consumption, and hence this wine often has a " dry " taste because it is sour, and not because it is wholly free from sugar. When this is the case, it imparts a bright-red colour to blue litmus, even after the free carbonic acid which it contains has been allowed to escape. The various brands called " dry," " extra dry," or " *sec*," " *très sec*," usually represent only varying degrees of acidity. " *Brut* " refers to wines left to undergo natural fermentation.

Undoubtedly one of the reasons why champagne is so exhilarating to many persons is the fact that it is promptly and completely absorbed, even when taken with food. Its effects are therefore suddenly felt by the nervous system.

VI. **" Perfect " Wines** are those which are classified by Chambers as having their several ingredients—" alcohol, water, sugar, ethereal flavours, fruity extractives, and acids "—commingled without giving characteristic prominence to either one. Such are many of the best clarets, but the red wines usually, from one cause or another, fall under some other class.

Bordeaux, Burgundy.—The best Bordeaux is fully fermented, but the commoner Burgundies and red Rhones contain " too much fruity extractive, which decomposes unless re-enforced by alcohol, and are unwholesome unless ripe when drunk " (Chambers). When a red wine is so decomposed it is unfit for consumption. Re-fermentation in it may be discovered by lightly corking a half-filled bottle, letting it stand for some hours in a warm place, and then shaking it. If carbonic acid is present, it will rise in bubbles and expel the cork. Wine of this sort deranges digestion, causing acid eructations and gastric discomfort.

Prime Burgundies, on the contrary, like Chambertin, have more " body," and, because they contain a larger percentage of alcohol, do not ferment. Moleschott gives the average volumetric percentage of alcohol in red wines as follows: Clarets or red Bordeaux, 10.61; red Rhone, 10.39; red Burgundy, 11.19.

Therapeutic Uses.—Prime clarets, Bordeaux, and Burgundies are useful tonics for invalids, to be given in moderation with meals, or in some cases with a biscuit or light sandwich as a luncheon between meals. They contain little or no sugar, and are of excellent service in convalescence from protracted fevers, such as typhoid, or from the grippe, etc. The lighter forms, if of good quality, are the best form of wine for daily consumption by brain workers or those whose sedentary habits or whose advanced age make desirable a slight stimulus to appetite and digestion. Claret is almost the only wine which it is at all safe to allow gouty or diabetic patients.

Beaujolais is intermediate in effect between claret and Burgundy.

In diarrhœa, the red wines, according to Lichtenstern, have a twofold beneficial action: first, by depressing exalted reflex excitability in visceral nerves, and, secondly, by controlling intestinal putrefaction. Those which contain considerable tannin are also mildly astringent.

VII. **Rough Wines** are those in which an excess of tannin causes decided astringency. They usually contain pigment, but not much alcohol. Some clarets belong with this group.

As a rule, these wines are not available for general dietetic or invalid use, and are mainly employed to add to other wines to aid in their preservation and otherwise alter them, although they are sometimes drunk by peasants in the countries in which they are produced.

Concentrated Wines.—Attempts to concentrate wines by heat evaporation of the water contained in them result in the loss of the ingredients which furnish "bouquet" or "aroma," and which are more volatile than the alcohol. A process has been devised in France by which concentration is secured by cold without this loss. In congealing to ice the water does not include the volatile ingredients of the wine. The wine is submitted to a temperature below freezing, the ice meanwhile being mechanically broken into minute particles, which are then separated by a centrifugal machine. The result is a wine composed of uncongealed concentrate and condensed to from 60 to 80 per cent of its original bulk, thereby improving its capacity for preservation and greatly lessening cost of storage and transportation. The same ingenious process has been successfully applied to milk and fruit juices. Upon addition of water the original bulk and degree of flavour is restored.

Raisin Wine.—An inferior quality of wine is made by restoring the water of the grapes which has been lost by drying them into raisins. Wine is now sometimes made in France from raisins dried in California.

Influence of Wines upon Digestion.—Roberts has thus determined the effect of several wines upon peptic digestion by adding together two grammes of dried beef-fibre, 0.15 per cent of hydrochloric acid, 1 c. c. of glycerin extract of pepsin, varying proportions of hock, claret, or champagne, and water to 100 c. c.

Proportion of Hock, Claret, or Champagne in the Digesting Mixture.	Time in which digestion was completed. (Normal, 100 minutes.)		
	Hock.	Claret.	Champagne.
10 per cent	100 minutes.	100 minutes.	90 minutes.
20 " "	115 "	140 "	100 "
40 " "	150 "	180 "	130 "
60 " "	Embarrassed.	Embarrassed.	180 "

Liquors

Strong spirits, such as rum, whisky, brandy, and gin, are the worst forms of alcohol for daily drinking, and liquors of this class are responsible for nine tenths of the evils of inebriety. In localities where their consumption has been brought into competition with or has been superseded by that of beer, drunkenness has often diminished. As the system acquires toleration for the stronger forms of liquor, it is found that its desired effects can only be obtained by constantly increasing the strength or the frequency of the drinks, and meanwhile the alcohol absorbed is gradually converting the different tissues of the body into pathological specimens.

The drinking of new and raw liquors is particularly injurious, for time mellows them somewhat and reduces the quantity of their most hurtful ingredient—fusel oil—while their flavour improves. The difference in taste of liquors depends upon the substances from which they are made much more than upon any skill in their manufacture or modifications in their fermentation, circumstances which so materially affect wines. The taste varies with the relative quantity present of aldehyde, compound ether, higher alcohol (fusel oil), and volatile bases.

Brandy and other strong spirits are distilled from a variety of carbohydrate foods: such are potatoes, corn, rye (whisky), beets, rice (arrack and *saké*), molasses (rum), crushed grapes, apples (applejack), peaches, plums, cherries (*Kirsch*), and other fruits. These spirits contain from 45 to 60 per cent of alcohol, besides cane sugar and extractives.

French Cognac is a strong, pure brandy, distilled either from wine, or directly from crushed grapes. It may be coloured by caramel. Common brandy is distilled from wine.

Whisky.—American whiskies are classed as (1) rye and (2) Bourbon, from the county of that name in Kentucky.

Manufacture.—The proportion of materials used in making the "mash" for distillation is, on the average, cornmeal 0.8, rye 0.1, and malt 0.1 (Leoser). This mixture is placed in tubs, and scalded with "slop," the refuse from former distillation. After cooling, it is raked, or mixed by a stick called a "masher." Water is added, and the mass ferments for two or three days.

Sweet mash is scalded with water instead of slops, and yeast is added to induce fermentation.

Sour-mash whisky is made without yeast but with slop. The wort is then heated by steam, and the low wines, called "singlings," are run off from the residue or slop and redistilled, and the whisky is ready for barrelling (Leoser). It should then be kept from three to five years to ripen, according to the details of its manufacture.

Pure rye whisky is distilled by an identical process, but the corn is wholly replaced by rye.

Scotch and Irish whiskies are distilled from a barley mash.

American whiskies are kept in charred barrels, and grow darker from colour derived from the wood (Witthaus). Scotch whisky derives its colour from lying in old sherry casks.

Proof whisky contains equal parts of absolute alcohol and water.

Leoser says: "The difference in quality in different kinds of whisky is infinitesimal, and for therapeutic processes may be neglected, provided the taste of the patient is consulted."

The evil effects of poor whisky are largely due to the presence in excess of a regular constituent, an aldehyde called furfural.

Gin is distilled from rye mash, and flavoured by immersing a bag of juniper berries in the vat towards the completion of distillation.

It is variously known under the names Geneva, Hollands, and Schiedam, the two latter referring to its Dutch source, the former being derived from the French word for juniper, *genièvre*, of which gin is a corruption (Pavy). Gin may contain 17 per cent of alcohol, but it is often diluted, and when sweetened besides, it is known as "Old Tom."

Rum is distilled from a mash of molasses. The wort contains about 15 per cent of sugar, and the fermentation process requires from nine to fifteen days. Rum was formerly made in New England, but it now comes chiefly from the West Indies, and that made in Jamaica is considered the best. Other rum is made from rectified proof spirit. It is a liquor which improves very much on keeping for several years. The flavour of rum, which is principally due to butyric ether, is produced by adding molasses, caramel, and sometimes fruits, such as pineapple or guava. Acetic and other ethers are also present.

Therapeutic Uses of Liquors Compared.—The spirits in common use have different physiological action. As their alcoholic basis is substantially the same in quality, the effects are varied mainly by aromatics. Gin is the most distinctly diuretic of the liquors. Given with a little lemon juice and diluted with some effervescing water, it promptly increases the urinary secretion. Brandy is somewhat more astringent than whisky, which is sometimes laxative. Brandy is therefore to be preferred in cases of diarrhœa, but in this country at least it is very apt to be impure. The rôle of liquors as tonics and stimulants will be referred to under the heading of the different diseases in which they may be required, and their influence in producing alcoholism is discussed under that heading.

Adulteration of Liquors and Wines.—Liquors are flavoured and also adulterated by a variety of substances. Among those mentioned by Chambers as oftenest found are cocculus indicus, ginger, quassia, wormwood, caraway and coriander seeds, hartshorn shavings, nux vomica, gentian, alum, cream of tartar, chamomile, juniper berries, bitter almonds, orange peel, licorice, honey, rhatany, and catechu.

Much of the cheapest claret sold in this country is little more than a decoction of logwood, and the flavour of some of the better grades is cleverly imitated. For example, Château-Latour is sophisticated with almonds or other nuts, Château-Lafitte with violets and nuts, and to other grades cherry juice is added. Wines are often adulterated with artificial pigments, alum, tannin, fusel oils, cider, perry, and lime salts.

The cheaper grades of strong liquors contain an excess of fusel oil or amylic ether, which is not an adulterant in the sense that it has been added for sophistication, but because it is a poisonous natural product which is difficult to eliminate. It is responsible for much of the headache, foul tongue, nausea, dyspepsia, and even cirrhotic changes in the viscera which are incident to dram drinking.

Liqueurs play no part in invalid diet. With the exception of absinthe and Angostura, they contain a very high percentage of sugar with essence, and they all have a large proportion of alcohol. They are used as luxuries, and are seductive beverages, for their agreeable flavour sometimes begets the habit of alcoholism. This is especially the case with absinthe.

Analysis of Liqueurs (Rupp)

100 C. C. LIQUEUR.	ALCOHOL.		Extracts.	Sugar.	Salts.
	Volume.	Weight.			
	Per cent.	*Per cent.*	*Grammes.*	*Grammes.*	*Grammes.*
Absinthe	55.0	44.0	1.80	1.10	0.220
Anise	40.0	32.0	33.20	30.90	0.310
Kummel	32.5	26.0	29.80	28.20	0.100
Peppermint	35.0	28.0	44.00	43.20	0.090
Angostura	48.0	38.4	12.00	7.50	0.140
Curaçoa	52.5	42.0	27.90	26.50	0.075
Benedictine	53.0	42.4	35.00	33.40	0.110
Chartreuse	44.0	35.2	35.40	34.00	0.091

The essences are distilled or expressed from aromatic plants, and such colouring agents are used as saffron, cochineal, indigo, etc. Vermuth contains only 17 per cent of alcohol.

The following table by Duckworth is a convenient summary of the average percentages of alcohol in round numbers in the different beverages above described:

Spirits	35 to 44 per cent.	Bordeaux	8 per cent.
Port wine	19 " "	Rhine wines	8 " "
Madeira	18 " "	Porter	6 per cent or more.
Sherry	17 " "	Ale	3 to 6 per cent.
Champagne	11 " "	Cider	4 per cent.
Burgundy	10 " "		

Fig Wine is made in countries bordering upon the Mediterranean, and has an alcoholic strength of between 7 and 8 per cent. It also contains considerable mannite. It is often used for the sophistication of grape wines.

Cider.—Cider made from ripe apples usually contains from 4 to 8 volumes per cent of alcohol besides malic acid, extractives, sugar, and salts.

It is slightly laxative. The excess of carbonic acid generated by cider protects it from the atmospheric air, but when the gas disappears acetic fermentation converts the cider into vinegar.

Cider is sometimes made from condensed apple juice, which is added in the proportion of one part to twenty of water when ready for use.

CONDIMENTS AND SPICES

Properties.—Condiments and spices are substances which are used as adjuncts to food, and which in themselves supply but little nourishment, their effect being mainly of a stimulating character either to the nerves of taste or secretion. They add flavour to otherwise insipid food, and relieve monotony in diet. Some condiments, such as mustard, contain a slight amount of nutritious material, but the total quantity of any of them which can be taken is so small in comparison with the bulk of the food that they may hardly be said to subserve nutrition.

Curry powders of various sorts are prepared by mixing strong condiments, such as Cayenne pepper and ginger, with starchy food and turmeric.

Some foods are themselves so stimulating to the mucous membrane that they answer the double purpose of food and condiment combined; such, for example, are onions and garlic.

In the mouth condiments produce an agreeable taste, with an increased flow of saliva, and the desire for food in the stomach is stimulated. They also increase the secretion of gastric juice.

Uses.—In some dyspeptic conditions of the stomach accompanied by local sensation of weight or oppression, or even of pain, the use with the food of strong condiments—such as mustard, Cayenne pepper, or Tabasco—affords relief by exciting the functional activity of the stomach. Cayenne, in fact, is a favourite ingredient of various dinner pills.

With the exception of salt, the use of which has been elsewhere fully described (p. 45), none of the condiments are absolutely indispensable in the sense of being essential for prolonging health, but so accustomed are all classes of men to their use from heredity or personal experience that, despite the aphorism of Plutarch that "hunger and salt should be man's only sauce," without other relishes the appetite soon fails. There are many cases of feeble digestion and diminished activity of the gastric juice which are decidedly benefited by their use in moderation.

Harmful Effects.—The use of some condiments is likely to be abused, and this is particularly true of peppers, curry, pickles, and vinegar. If consumed habitually in excess, these substances excite gastric hyperæmia and catarrh by overstimulation, and may disorder intestinal digestion as well. They at first cause more food to be eaten than necessary, and eventually destroy the appetite, developing chronic dyspepsia of an aggravated type. Persons living in tropical climates where food and service are cheap are apt to lead indolent lives and indulge too liberally in the pleasures of the table, and the overloading of the stomach tempts them to add quantities of condiments to their food for the purpose of stimulating an already overworked digestive system to the performance of further duty. The heat of the climate prevents active exercise, which in turn reduces the oxidation processes of the assimilated food. The rational diet for those not acclimated to the tropics should consist largely of vegetables and fruits, while nitrogenous food, strong condiments, spirits, bitter beer, etc., should be carefully shunned. I have seen one case of the ginger habit, in Bellevue Hospital, in a woman thirty years of age. It was first acquired by chewing the roots of Jamaica ginger, and subsequently the patient drank large quantities of the beverage sold under that name, and ate powdered ginger of every variety. The patient became maniacal and greatly emaciated. The symptoms in general resembled those of the cocaine habit.

Varieties of Flavouring.—Next to salt (see p. 45), the most useful condiments are pepper, mustard, ginger, and vinegar, but much difference in taste exists in the use of condiments, and their selection is to some extent a race characteristic. Thus the Persian prefers his asafœtida, which no one else can tolerate; the Spaniard and Mexican his garlic; the East Indian his curry; and the Frenchman his salad with vinegar.

From long-continued association certain condiments appear to serve best with definite foods, and so accustomed are most persons to their combination that we cannot easily recall the one flavour without the other; thus mustard is associated with ham, black pepper with eggs, red pepper with raw oysters, vinegar with spinach and raw tomatoes, etc., and when deprived of the usual relish the food tastes insipid. Such details, insignificant as they may ordinarily appear, become very important for certain classes of invalids in whom it is necessary to preserve the appetite by pleasing the palate in order that they may take food enough to sustain them. Such are cases of phthisis, empyema, and other forms of chronic wasting diseases.

Often by varying the flavouring slightly from day to day two or three times as much of the same food will be taken by the invalid.

A skilful use of condiments may do away with the necessity for alcoholic stimulation and serve a better purpose.

Beef tea and meat broths, which become wearisome to many invalids, will be often relished if a taste of some savoury aromatic herb be added, such as parsley, thyme, sage, marjoram, or mint.

Mustard does not greatly stimulate the gastric secretion, but many persons find that it increases the appetite somewhat, and it often produces a sensation of warmth or mild burning in the stomach or a feeling akin to hunger. It is used to advantage in moderation in salad dressings or with cold meat, and is sometimes serviceable in those cases in which the main difficulty is a lack of appetite without special enfeeblement of the digestive organs, but it has very little positive value, and while its use in health may be left as a question of individual taste, it is scarcely ever to be specifically recommended, and its abuse, like that of all condiments, may give rise to gastric irritation. The general irritating effect of mustard in large quantities applied to the skin or gastric mucous membrane is well known, and diluted with lukewarm water (a teaspoonful of mustard to a pint of water) it constitutes a very prompt and valuable emetic. Mustard is said to make the evacuations of the bowels somewhat more moist (Ringer). The seeds are sometimes eaten for their laxative action. The diuretic effect which has been attributed to mustard is not established.

Black pepper is the berry of a plant, the *Piper nigrum*, which grows in the West Indies, Sumatra, and other Eastern countries. The whole berry is dried and ground for use.

White pepper is made from the same berry by previously soaking off the outer husk in water. About thirteen million pounds of black pepper are annually consumed in the United States. It is often adulterated, and to avoid deception it may be purchased in corns and freshly ground at the table.

Cayenne pepper is not a true pepper, but is made from the crushed pod of various species of *Capsicum*. It grows in the tropics, especially along the eastern coast of Africa and in Zanzibar.

The *Capsicum annuum* is cultivated in this country for the making of pickles from the large unripe green fruit.

The *Capsicum fastigiatum* is a variety employed medicinally, and recognised by the Pharmacopœia.

Chilies is a common name given to this pepper in England, and chili sauce is an essence prepared from it. It is the strongest variety of capsicum.

Capsicum, called also Cayenne or red pepper, like mustard, is a strong irritant to both the skin and the mucous membranes. Overdoses of it excite violent local inflammation and gastro-enteritis. Like mustard, it is doubtful whether capsicum in any degree promotes the secretion of the gastric juice, but it sometimes stimulates a flagging appetite and produces a feeling of warmth in the stomach; the latter readily becomes tolerant to increasing doses of capsicum, and it is found that more and more is required by those who have to use it habitually to excite the accustomed stimulation. Its chief use is as a substitute for alcohol for dipsomaniacs, especially where the effort is being made to stop drinking abruptly. Its fiery nature temporarily satisfies the craving of the stomach. When chronic alcoholic gastritis exists, the stomach digestion is often improved and the craving to satisfy it by strong liquor may be relieved by the tincture of capsicum given in doses of ten or fifteen minims diluted.

The use of capsicum in health is far from necessary, but it forms an agreeable condiment for many persons. It forms an ingredient of many dinner pills which are taken by elderly people with inactive digestion for the purpose of promoting the appetite.

Red pepper, like black, is often adulterated. When pure it may be partially but not entirely suspended in water. Red lead has occasionally been used as an adulterant.

Capers are the flower buds of a bush, the *Capparis spinosæ*, which grows in Eastern countries bordering on the Mediterranean. They are preserved in salt and vinegar, and are used for flavouring sauces for mutton and other foods. They contain tannin, volatile oil, yellow pigment, and a bitter principle.

Spices are solely of value in giving variety of taste to the food, and hence tempting invalids or convalescents with lagging appetites to eat more. Comparatively tasteless food, such as rice, may be made very attractive by spicing.

For children the most useful flavouring substances are cinnamon and ginger, and, although not a spice, vanilla extract. For invalids there may be added nutmeg and cloves, although any agreeable spice may be used in moderation, such as mace or allspice. Patients who will not drink hot water when it is ordered will often do so if they can steep a few cloves or a small piece of cinnamon in it, and this can rarely do harm. Those who object to the taste of milk punches, custards, and simple farinaceous foods will often take these substances when slightly flavoured with a trace of some agreeable spice. The latter as ordinarily used for flavouring is never injurious. Only in large doses are such spices as those above mentioned capable of such irritant action in the stomach as may be produced by curry or mustard. Several cases of nutmeg poisoning are recorded. The symptoms are excessive thirst, vertigo, and muscular prostration. Such effects are produced by taking a whole nutmeg, ground and mixed with hot water.

Ginger is useful both as a condiment and as a food. It is the dried root of the *Zinziber officinale*, which grows in Jamaica, China, and elsewhere. The rhizome is scraped and either dried and powdered, or, if it is to be preserved, it is washed and boiled for twenty-four hours, and then soaked for another day in salt water. It is then washed, sun-dried, and boiled for half a day with an equal weight of sugar (Clark). It is placed in jars for several days, and then once more boiled, when it is finally sealed in jars. It is excellent for flavouring rice and other insipid farinaceous foods for convalescents and children.

Vanilla is derived from vanilla beans, grown in Mexico, Java, and other tropical regions. It makes an agreeable flavouring extract for foods for invalids and children, such as farinaceous gruels, custards, blancmange, or ice cream, for, unlike the spices, it is very bland. Its chief use is in the manufacture of chocolate (p. 226).

Vinegars are made from wine, beer, cider, various fruits, and even from the dry distillation of wood. They contain, besides acetic acid, traces of dextrin, sugar, organic acids, pigment, extractives, and acetic ether. White vinegar is the best in taste and odour.

The acetic acid in good French vinegar exists in the proportion of 5 per cent. Ordinary table vinegar contains between 2 and 7 per cent.

The acidity enables this condiment to soften muscle fibre so that the digestion is facilitated of tough meat, such as corned beef, boiled beef, and other foods with hard fibre, like salmon, lobsters, or hard-boiled eggs.

The action of mild acids, such as vinegar, favours the digestion of tough cellulose, and aids the formation of sugar. For this reason vinegar is a wholesome addition to coarse, fibrous, or stringy vegetables, such as beets, cabbage, spinach, lettuce, celery, etc., and to raw vegetables, such as cucumbers, cole, lettuce, and like materials used in salads. Vinegar is often eaten with baked beans, but it is said to make their legumin less soluble (Chambers). If vinegar taken in a salad dressing disagrees, white wine may be substituted with pepper or mustard and oil.

Vinegar has a well-known antiseptic and preservative action, and hence its use for pickling fish, oysters, fruits, and vegetables.

Pickles are indigestible, and should take no part in an invalid dietary.

An excess of vinegar habitually consumed with pickles, or otherwise, causes anæmia and emaciation by lessening the number of red corpuscles and reducing the alkalinity of the blood.

Vinegar is often adulterated, or spurious articles are substituted for it. This is especially true of that used for the cheaper varieties of pickles, and weak sulphuric acid is quite commonly employed for this purpose.

Sauces, such as Worcestershire, Tabasco, tomato catsup, etc., are used to stimulate a flagging appetite, and add flavour to soups, broths, etc. Taken in great moderation, they are not injurious, and in cases of alcoholism they are sometimes useful by inducing the patient to take more food and less liquor.

For invalids, for whom strong sauces of this kind should always be forbidden, a very good substitute may be made for use with broiled fish, etc., as suggested by Chambers, by boiling a few plain aromatic herbs, like parsley or mint, in a little water, and adding pepper and salt.

Horseradish is a condiment which excites the flow of saliva and gastric juice when eaten early in the course of a meal with meat or raw oysters, or otherwise.

PART III

COOKING
FOOD PREPARATION AND PRESERVATION
THE QUANTITY OF FOOD REQUIRED

COOKING

The Object of cooking Food.—While man is so constituted that it is possible for him to live upon raw food for a considerable length of time, it is apparently designed by Nature that a large portion of his food should be cooked, for there are no savage races known who do not practise the art of cooking, in however elementary a fashion, and progress in the scale of development and civilisation is uniformly accompanied by advance in the art of cooking. Prehistoric man may have lived wholly on raw food, berries, fruits, shellfish, etc., but this diet is not suited for most tribes of man to-day, although the northern Eskimo still prefers to eat his meat raw and frozen.

It is owing to the practice of cookery that the dietary of civilised man has been so much enlarged, and that it covers a wider range of materials than that which serves for the nourishment of the lower animals. There are many articles of diet in common use, and many others which may be employed as food in an emergency, which are not only unpalatable but are wholly indigestible in the raw state, but which are rendered nutritious by cooking, and it is far less difficult to modify the mechanical preparation of foods than the secretions which digest them.

Generally speaking, foods, excepting fruits, having organised structure require cooking.

Of the different varieties of food, that which is derived from animals as a rule requires cooking more than vegetable food. It is well known that some vegetables and most fruits are eaten raw by preference without palling upon the appetite, but raw meat of almost any kind soon becomes wearisome, and if consumed exclusively may even excite disgust. Raw milk, eggs, and bivalves are an exception to this statement. The process of cooking food accomplishes in general the following purposes:

I. Cooking develops certain flavours in the food, in meat particularly, which are agreeable to the palate, and thereby enables man to secure variety in taste, which is so important a stimulus to the appetite.

II. Most food is altered in consistence and made softer by cooking, although this is not always the case (eggs, for example, become harder when boiled). The food is therefore easier masticated and mixed with the various digestive fluids. It may be observed that the mere question of solidity of food does not necessarily imply greater toughness—in fact, the albuminous ingredients of meat are coagulated and made actually more solid by cooking, but at the same time they become much less tough or are more friable, in which condition they are more easily ground, torn, and separated by the teeth.

III. The chemical changes produced in food by cooking seem in some instances to favour the action of the digestive juices upon the food. This is particularly true of some of the forms of starch and of many meats.

Comparatively little attention has been paid to the chemical alterations produced in food by the various processes of cooking. Analyses of food are usually conducted upon the raw materials, and the important alterations which are occasioned by heat in various degrees are still imperfectly understood by most persons.

IV. By cooking, many varieties of parasites and germs which may be contained in the food are destroyed, and bad food which might otherwise be highly poisonous or injurious is made perfectly harmless.

V. The temperature of food which is sometimes eaten hot may in some cases favour the digestive processes, although the importance of this consideration may be exaggerated.

VI. The appearance of the food may be improved, and it becomes more appetising on this account.

Varieties of Cooking.—The several processes of cooking which are in common use are as follows: 1. Boiling. 2. Stewing. 3. Roasting. 4. Grilling, or broiling. 5. Frying. 6. Braising. 7. Baking. 8. Steaming.

There is undoubted advantage in varying the different methods of cooking as well as of flavouring the food from time to time. Monotony of diet and of flavours lessens the appetite and fails to stimulate the digestive organs into activity. When a reasonable variety of food cannot be obtained, variety in cookery may be made to replace its advantages to a great extent. Every one is familiar with the effect on the appetite of an occasional change of cooks or of a meal served in unwonted surroundings.

It is not within the scope of this work to discuss the details of cooking for the sick. Miss Nightingale wrote that "a good sick-cook will save the digestion half its work," and invalid cookery should form the basis of every trained nurse's education. It is impossible here to do more than explain the theory of the chief methods of cooking and suggest occasionally their influence upon digestion. As a rule, twice-cooked meats are undesirable for invalids. They are apt to be drier and less nutritious and digestible than when fresh. In meat "hash," for example, the meat fibre is too much hardened. Such preparations are often made too greasy by recooking for delicate stomachs. The same statement applies to canned meats when warmed over, for they have been already cooked once in the tin.

It is undesirable to combine foods which require different periods for their thorough cooking. For example, soup needs less boiling than the vegetables added to it, and they should be partially cooked alone beforehand, or they will be underdone.

The necessary heat for cooking is obtainable in many ways—from coal, wood, gas, oil, steam, and even electricity—and these different methods each possess advantages for particular foods.

Cooking, as a rule, at a prolonged low temperature is more economical in its results upon food than a much shorter application of high heat, and this is the theory of the famous "Count Rumford kitchen."

1. **Boiling.**—The primitive method of boiling water consisted in heating the water in a hollow dug in the ground by plunging in hot stones taken out of the fire. Later, as the arts of pottery making and metal working became known, utensils were employed.

In some excellent remarks by Williams on the subject of so-called boiled food, he points out that the expression "boiled" beef, or eggs, or potatoes, implying that the food has been boiled in the same manner in which the water is boiled, is an absurdity. The food is merely heated by immersion in boiling water, and even such water as is contained in the meat or potato is not itself boiled in the process, for, he says, "its boiling point is higher than that of the surrounding water, owing to the salts it holds in solution. Thus, as a matter of chemical form the boiled leg of mutton is one that has been cooked but not boiled, while the roasted leg of mutton is one that has been partially boiled. Much of the constituent water of flesh is boiled out and fairly driven away as vapour during roasting or baking, and the fat on its surface is also more or less dissociated into its chemical elements, carbon and water, as shown by the browning due to the separated carbon."

It is a scientific fact which is not appreciated by many persons that when water has once reached the boiling point, its temperature cannot be further elevated until it is all converted into steam, for all the additional heat which is required above that needed to warm the water and drive off the air-bubbles in the process of ebullition is expended in vapourising the water into steam. Consequently, however hot the fire, or however prolonged the cooking, the temperature of the food suspended in boiling water cannot be increased above that of the water itself; and, in fact, the temperature of the interior of large masses of food, like potatoes or meat, is by no means as great as that of the surrounding water. For this reason, piling fuel upon the fire when water has once reached the boiling point will have no further effect than that of accelerating the rate of ebullition, without actually raising the temperature of the water or any food immersed in it.

Five and a half times as much heat is required to convert water at the boiling point into steam as that which is needed to raise water from the freezing to the boiling point. Count Rumford over a century ago remarked that, while the boiling temperature of water varies considerably at different levels, meat or eggs are just as thoroughly cooked at an elevation in which the water boils at 209.5° as they are at the sea level, where the boiling temperature is 212° F.

There is practically no distinction to be made between "simmering" and boiling as a process of cooking. The violent boiling of some foods tends to soften them somewhat on account of the effect of the commotion produced in the water by the rising bubbles which cause currents to form that carry particles of suspended food with them and triturate them.

The operation of boiling if continued for an hour or more gradually converts the connective tissue of meat fibre into gelatin, which is partially dissolved in water, and the heat of the boiling water usually melts a little of the fat, which, being unable to mix with the water, forms a scum upon the surface. A small proportion of the juices of meat usually osmoses or soaks out into the surrounding water, and the aqueous solution thus formed is called broth or bouillon. The richness of the broth will depend principally upon the method of conducting the boiling process. When it is desired to have the broth as nutritious as possible the meat must be finely minced and put into cold water, which is gradually warmed but not actually brought to the boiling point. By this process the juices of the meat are slightly dissolved out into the warm water, and thereafter, if the temperature is not carried above 160° F., coagulation of the albumin in the muscle fibres does not occur, and more and more of their constituents are dissolved out into the surrounding water—but this is not true boiling. In this manner the natural flavour is very much better preserved; in fact, the common extracts of meat are made by soaking finely chopped meat in cold water and subsequently evaporating the water from the ingredients which are found in it.

On the other hand, when broth is not wanted for nutriment it is desirable to prevent the solution of the juices in the water as much as possible, and this is accomplished by immersing the meat suddenly into water actually boiling, where it should be left for five minutes, by which time the outer layer of the mass will be hardened by coagulation and will have a firm coating which is not permeated by the juices within. When meat is cooked in this manner the broth is scarcely of any food value, but the meat is much more palatable. After the boiling temperature of the water has been maintained for five minutes the further cooking should be continued at a lower temperature of, say, 165° to 170° F. If the heat is less than this, the interior of the joint or other piece of meat is imperfectly cooked and its albumin is insufficiently coagulated, so that it has a raw appearance. If the actual boiling point is long maintained, the albumin is too firmly coagulated, and the meat becomes tough and stringy. The latter error in boiling is very commonly perpetrated by cooks, and it must be observed that the coagulation point of different forms of albumin varies considerably, ranging from below 90° to above 165° F., and since many varieties of albumin occur in the different kinds of animal food which are in common use, it will be found that they are not all equally well cooked by exactly the same temperature. It is important that the coagulation temperature of a given albumin should not be greatly exceeded or long maintained if the food is to remain tender and digestible. Parkes says that ammonium sulphite is liberated by continued boiling, and also an acid resembling acetic acid.

When meat is plunged into boiling water so that the external layers are solidified some of the water which they contain is squeezed out into the surrounding fluid, and an actual loss of weight in the meat occurs which may reach as high as 30 per cent.

The addition of salt to water in boiling fish or meat is described by Williams as having a threefold action: (1) It directly acts on superficial albumin with coagulating effect; (2) it slightly raises the boiling point of the water; (3) by increasing the density of the water, the exosmosis or oozing out of the juices is less active, and hence the flavour is better retained.

When very salt meat is to be cooked, if steeped too long in boiling water its nutritive properties are impaired, the muscle sarcolemma becomes too hard, and the meat tasteless and tough. In such cases it may be well to boil meat less completely, and finish the cooking by some other method, such as frying.

2. **Stewing.**—Stewing differs from boiling in the fact that the juices of the meat or vegetables are dissolved in the heated water, whereas in boiling, the juices are kept from passing out into the water by the coagulation of the external surface of the food mass produced by immersing it suddenly into boiling water. The proper

temperature for stewing is between 135° and 160° F. In thick stews the juices dissolved in the water are eaten together with the cooked food, but in some instances, as in the making of beef tea and some kinds of soups, the aqueous solution only is used. Obviously, the more the food is subdivided the greater the surface exposed to the solvent action of the water, and hence the object of mincing meat thoroughly which is to be used in the preparation of beef tea. If such minced meat has been soaked for a long time in cold water, a part of the albumin and the extractive materials are obtained in solution, but the meat which is left is colourless, tasteless, and unpalatable; in fact, animals fed upon it soon deteriorate in strength.

The manner in which stewing differs from other processes of cooking is well described by Williams, who says: "Instead of the meat itself surrounding and enveloping the juices, as it should when boiled, roasted, grilled, or fried, we demand in a stew that the juices shall surround or envelop the meat." And more or less water enters the substance of the meat to replace the juices which have passed out by osmosis and diffusion into the surrounding fluid. After meat has been stewed for some time a scum containing a little coagulated albumin and more or less fat is usually seen floating upon the surface. This is usually removed in the preparation of beef tea for invalids in order to make it more palatable and more agreeable to the eye, but its removal is at the expense of considerable nutritious material. In the preparation of extracts of meat, such as Liebig's Extractum Carnis, the scum is removed before the solution is concentrated by evaporation.

Stews which are simply made in the manner described above, and which consist largely of meat and plain sliced vegetables, are fairly digestible; but if other materials or rich sauces are added to them, this is not the case, and if saturated with fat, they are quite unfit for invalids. As both the solid substance of the meat and vegetables and the fluid materials which have been extracted from them are eaten together in the stew, this is an economical form of preparing food. Nothing is lost by evaporation, and nothing is thrown away.

3. **Roasting.** 4. **Grilling.**—The processes of roasting and grilling or broiling, when performed over a very hot fire, result in cooking the meat in a manner which is in some respects analogous to stewing; in fact, the interior portions of the meat are stewed in their own juices instead of in water (Williams). A coating of coagulated albumin forms upon the outer surface of the meat, while the albuminous material or myosin of the interior is gradually warmed and more slowly coagulated. The outer coating prevents the evaporation of the juices of the meat which, together with the extractive materials, are retained, and add flavour to it. Roasted and broiled meats therefore have a decided advantage in flavour as well as in

nutritive value over meat which has been boiled for a long time, although the latter may be tender and easily digested.

Roasting and broiling are the most universal methods of cooking. For them the savage or the hunter requires no utensils, but boiling implies the aid of the potter or worker in metals. The Polynesian cooks his meat by roasting it on a hot stone, and sprinkles it with sea water to obtain the salt. The primitive hunter incases his meat or fowl, skin and all, in damp clay and roasts it in hot coals. The Australian savage, the lowest type of man, does all his cooking by roasting.

In roasting, the high temperature which is applied suddenly to the meat produces a firmer coagulation of its outer layers than occurs with boiling. Owing to this fact, the natural juices of the meat are almost completely retained, and, as in boiling, the heat should be strong when first applied, but it may subsequently be reduced to prevent charring of the surface. This may be accomplished by removing the meat farther away from the fire.

The process of roasting and grilling is conducted mainly by radiant heat, although there is slight convection through the air. The main object of an oven is to prevent burning by uneven cooking.

The principle of a proper roasting oven is formulated by Williams, who says " the meat should be cooked by the action of radiant heat projected towards it from all sides while it is immersed in an atmosphere nearly saturated with its own vapour," and the heat applied after reaching a maximum is kept uniform throughout the process.

In boiling or stewing, the heat is applied to the meat by convection through water, and this is an important discrimination because the air which surrounds the roasting meat is constantly removing the water which tends to evaporate upon its surface, and therefore to dry the external surface of the meat. From 20 to 24 per cent of water is lost in this manner, and the meat therefore weighs less. The evaporation of this water, which continually passes from the interior of the meat towards the outer surface, produces a loss of heat in the meat itself which keeps the interior from becoming overheated. If the roasting or broiling is long continued, the water gradually passes out more and more from the interior of the mass, which finally becomes dry and hardened or burned. If too much air surrounds the meat, it is poorly roasted, dry, and leathery, whereas if the heat is applied more directly by radiation from glowing embers, the sudden hardening of the outer coating of the meat, even though it be slightly burned, forms a barrier against the evaporation of water from the interior.

Broiling or grilling is a means of quick cooking which requires very much less time than roasting or boiling, because intense heat is applied to comparatively small pieces of meat or fish. It is really roasting on a smaller scale.

The object of broiling as well as of quick roasting should be to raise the interior of the mass promptly to the point of coagulation, or about 180° F., so that the water formed shall not have time to wholly evaporate. It is consequently advisable for the meat to be cooked as near the glowing surface as possible to increase the radiation and diminish the convection of air currents (Williams). It is for this reason that steaks and chops are often better cooked in restaurants, where specially adapted grills are used which bring the meat in closer relation to a radiant surface of glowing coals than it is usually possible in domestic cookery. A properly cooked steak or chop is thickened in the centre, but if badly grilled it is thin and dry. It should be remembered that the evaporation depends upon the extent of the surface of the meat, and for this reason thinly cut steaks or chops become comparatively dry and shrivelled in the centre. This principle is well described by Williams, who says that "the smaller the joint to be roasted, the higher the temperature to which its surface should be exposed," and when very large masses of meat are being cooked, it becomes necessary to secure time for the heat to penetrate into the interior without drying up the outside. This object is accomplished by constantly basting the surface in order to keep it wet and prevent evaporation, for while the surface is moistened, its temperature will not rise above the boiling point of the liquid which is used to moisten it. Pouring melted fat or melted butter over the meat checks evaporation almost completely, and in the case of large joints it prevents the external portion from becoming too dry and indigestible before the albumin of the interior has been coagulated. Small lean joints of meat require more frequent basting with fat.

The roasting of any meat, however, cannot be accomplished without the effusion of some of the meat juice and the melting of a portion of the more superficial fat and of gelatin. These substances together constitute the meat gravy, which is itself quite nutritious and which is advantageously used for basting the meat to prevent drying, as well as to distribute the heat more uniformly over the surface. In overroasted or "burned" meat the external layers become scorched or charred, and this is due chiefly to the carbonising of the fat. Before the fat has become fully burned, certain volatile fatty acids are liberated which have a very disagreeable odour, and various products are developed which are not only of no value for nutrition, but which may be positively irritating to the alimentary canal. According to Yeo, for beef, mutton, and game, a temperature of 130° F. is sufficient for proper cooking, and the meat is "rare" or "underdone," retaining a good deal of its reddish colour; but veal and poultry should be cooked at a higher temperature—at from 158° to 160° F. These temperatures are lower than those often used, and apply rather to the degree of heat which is to be maintained after the meat is first placed in position for roasting, when, as previously stated, the temperature may be much higher.

Game or meat which is "high" or somewhat tainted is extremely repulsive if cooked by boiling or stewing, when it disintegrates more or less and the elements of decomposition pass into and flavour the whole mass. Such meat, however, is sometimes palatable, and is not necessarily unwholesome if cooked by roasting, when the external layers which have first commenced to decompose are thoroughly browned and thereby disinfected. Some persons prefer that a leg of mutton should be hung until it becomes slightly odorous before it is roasted, but it must be fresh for boiling.

5. **Frying.**—Frying is a process of cooking by which the heat is transmitted by the contact of the food with melted fat, butter, or oil, and not by radiation, as in the case of broiling or roasting. As explained by Williams, the fat does not necessarily boil, for the food, as well as the fatty material itself, may contain a considerable proportion of water which, by being suddenly vaporised, produces the familiar spluttering which accompanies the process of frying.

The boiling point of fats is very much above that of water, and the vaporisation of the latter is complete at 212° F. Between 300° and 500° F. may be required to vaporise the so-called volatile oils, but fats and oils used in cooking do not apply to this class, and when heated above 400° F. they turn dark brown or black and emit a disagreeable odour and smoke, leaving a non-volatile carbon residue.

The process of frying bears somewhat the same relation to boiling that the broiling of meat does, in that the heat employed is considerably greater. It is suddenly applied, and as a result the external surface of the food mass is coagulated and hardened before the juices in the interior have time to escape. For this reason, delicate fish, like the trout, is much more highly flavoured and palatable when fried than boiled. More or less butyric acid is developed from fat in frying.

The popular idea in regard to frying is that the fat used, whether butter, lard, or drippings, is simply for the purpose of preventing food from adhering to the frying pan, but, from the explanation of the process quoted above, it is seen that this is not the case, and the best frying is done by immersing the food completely in a bath of fat or oil. Even olive or sperm oil may be used for this purpose, and the fish or other food is lowered in an open wire basket or netting into a deep pan which contains the fat, in which it is completely submerged. There is no danger of the fat soaking into the food if it is sufficiently hot and if the process is not too long continued, for, as stated by Williams, "the water amid the fibres of the fish is boiling and driving out steam so rapidly that no fat can enter if the heat is well maintained to the last moment." Fritters cooked in this way are light and puffy from the sudden expansion of the water which they contain into large bubbles of steam, and are consequently decidedly more digestible. Bacon fries in its own fat.

Frying is less perfectly understood by cooks than almost any other method of preparing meat, and the process as usually carried out results in very unwholesome products. The pans used are too shallow, and the food and fat are apt to become scorched.

When the meat or other material is dipped into hot melted oil or fat, more or less of it clings to the surface of the food, and for this reason may render it unfit for persons with feeble digestive powers. In the case of fish cooked in this manner with their scales, the fat which adheres to them may be easily removed when eaten, and the meat within will be found to be quite digestible; but meat, such as steak, cooked by frying is notoriously indigestible. Salt meat may be cooked first by boiling before frying, as in the case of hams, although the latter may be subsequently roasted instead of fried. Such meats always require prolonged cooking. According to Yeo, the addition of a little vinegar tends to make them more tender.

6. **Braising.**—Braising is a method of cooking meat by which it is immersed in a solution of vegetable and animal juices called "braise," contained in a covered vessel, in which it is exposed to a strong but not boiling temperature. It is of value especially for cooking tough meat of any sort or meat which is too fresh or young. The cover of the kettle is so arranged as to prevent evaporation from occurring to any extent; the meat becomes permeated in the long cooking with the juices of fresh vegetables and herbs, and is kept from drying.

Towards the end of the process cooking-sherry or spices may be added, such as cloves or mace, or thin slices of bacon. The amount of fluid used should be but barely sufficient to cover the meat, and in this way the surrounding broth is kept very concentrated. Sometimes the meat which is braised is partially roasted.

7. **Baking.**—Baked meat is prepared by cooking in a confined space, which prevents the volatile products which are driven off in roasting from escaping, and consequently the meat has a somewhat stronger and less delicate flavour than when roasted; it is also richer, and disagrees with dyspeptics. It becomes saturated with empyreumatic oils unless its surface is protected by a pie crust, but even that does not add to its digestibility.

The baking of bread is described on page 140.

8. **Steaming.**—Cooking by steaming is a method but little used, and is mainly applied to cereals, puddings, etc.

Soups.—Meat soups are made by continued boiling, which converts the connective tissue of meat fibres into gelatin, which is gradually dissolved into the water. The soup thus becomes an aqueous solution of gelatin, with some of the extracts of the meat for flavouring. Whatever albumin is dissolved and what little fat may be melted forms a scum on the surface. The insoluble albumin becomes coagulated and floats about in small particles, which are strained away if the soup is to be clear, but this process makes it less nutritious for invalids. If a really rich soup or nutritious broth is to be made from any piece of meat, so much of the latter is dissolved into the water that the residue is tasteless, tough, and so indigestible that it is practically useless. On the other hand, there are many scraps of meat or parts which are unsightly or less useful for food from which very nutritious broth may be made, and the inedible bones are utilised in the same manner.

The extent to which soups and broths may be made nutritious depends largely upon the character of the meat used, and Parkes placed meats in the following order in regard to the nutritive value of their broths, commencing with the strongest: Chicken, mutton, and beef. He said that the best broth made from beef contains 150 grains of nitrogenous nutriment to the pint and 90 grains of salts, for nearly all of the salts of the beef, chiefly chlorides and phosphates, dissolve out into the surrounding water.

When a few drops of dilute hydrochloric acid are added to minced meat immersed in water, the acid converts the muscle albumin into syntonin, which is soluble in cold water, and after soaking in it for several hours a moderately nutritious broth can be obtained. Such broth may be heated to 130° F. without coagulation, when it will be found to contain nearly 50 per cent of the meat albumin (Parkes) (See Receipts for Beef Tea.)

Experiments on Losses in Cooking Meat, conducted in 1903 by H. S. Grindley and Timothy Mojonnier, at the University of Illinois, led to the following very practical conclusions:

"1. The chief loss in weight during the boiling, sautéing, and panbroiling of meats is due to water removed by the heat of cooking. In the roasting of meats the chief loss is due to the removal of both water and fat.

"2. The losses of nutritive material in the panbroiling of meats are very small as compared with the losses which take place in boiling, roasting, and sautéing.

"3. When beef was cooked in water in these experiments, 3.25 to 12.67 per cent of the nitrogenous matter, 0.60 to 37.40 per cent of the fat, and 20.04 to 67.39 per cent of the mineral matter of the original uncooked meat were found in the broth. The nutritive material thus removed has been designated as a loss, but is not an actual loss if the broth is utilised for soup or in other ways.

"4. The experiments here reported show that when meat is sautéed 2.15 per cent of the nitrogenous matter and 3.07 per cent of the ash occurring in the uncooked meat were taken up on an average by the fat in which the meat was cooked, while the cooked meat contained 2.3 times more fat than before cooking.

"5. When the meats were roasted, 0.25 to 4.55 per cent of the nitrogenous matter, 4.53 to 57.49 per cent of the fat, and 2.47 to 27.18 per cent of the mineral matter present in the uncooked meat were found in the drippings.

"6. Beef which has been used for the preparation of beef tea or broth has lost comparatively little in nutritive value, though much of the flavouring material has been removed.

"7. In the boiling of meats, the fatter kinds and cuts, other things being the same, lost less water, nitrogenous and mineral matter, but more fat than the leaner kinds and cuts.

"8. In cooking meats by boiling, sautéing, panbroiling, and roasting, the losses increased in proportion to the degree of cooking. In other words, the longer the time and the higher the temperature of cooking, other things being the same, the greater the losses resulting.

"9. As a rule, the larger the piece of meat cooked by the methods of boiling and roasting, the smaller were the relative losses.

"10. The experiments indicate plainly that different cuts of the same kind of meat behave very differently as regards the amount and nature of the losses which they undergo when cooked in hot water.

"11. Thorough investigation confirms the conclusion that when meat is cooked in water at 80° to 85° C., placing the meat in hot or cold water at the start has little effect on the amount of material found in the broth."

Cooking of Fish.—Fish may be cooked by boiling, grilling, baking, frying, or stewing. Of these several methods, boiling is decidedly the most advantageous for persons with feeble digestions, and next in order is broiling. When fish is boiled without the addition of salt to the water it becomes soft and disintegrated, but if boiled in sea water or artificially salted water it maintains its shape and flavour. The quantity of salt present regulates the osmosis of the juices of the fish into the water. As a rule, fish requires much less time than meat for cooking.

If fried fish is to be eaten by dyspeptics, it should be cooked whole, and the skin must be carefully removed subsequently. It is never as digestible as boiled fish.

Cooking of Vegetables.—The object of cooking vegetables, as in the case of cooking meat, is to render them more digestible, to give variety, to modify their flavour, and in some cases to preserve them.

Some coarse vegetables, such as turnips, carrots, beets, and potatoes, while they make good raw food for animals, are unpalatable and indigestible for man, and require softening and alteration by prolonged boiling in soft water or by some other form of cooking.

The cooking of vegetables macerates the cellular fibres or walls of the cells and softens their contents, rendering the vegetable much more easy of mastication, while the effect of the heat and moisture is to cause swelling and rupture of the starch granules, in which condition they are more easily and promptly acted upon by the starch-digesting ferments contained in the saliva and pancreatic juice.

Many vegetables contain albuminous substances, besides sugars, gums, and starches. The albuminous material is coagulated by appropriate temperature and the other matters are more or less soluble in water.

Most vegetables contain a very large percentage of water in their natural state, but in many of the cooking processes to which they are subjected, excepting perhaps in baking potatoes and the like, water is always added in considerable quantity, either hot or cold.

FOOD CONCENTRATION—CONDENSED FOOD

The concentration of food is based upon the fact that many foods contain a large percentage of free water, which can be driven off by evaporation, thereby reducing the weight, and usually the bulk of the food as well. Slight further condensation may be accomplished by pressure through machinery which is capable of applying a force of several tons to the square inch.

Drying. Desiccation. Extracts.—If the process of drying is not carried beyond a partial evaporation, the food is called "condensed." It may, however, be continued until the food is wholly dry, in which case the substance may be either "desiccated"—i. e., torn into shreds—or pulverised. Condensed and powdered foods may be added to other foods in order to thicken them or add to their nutritive power.

The nutritive principles of foods may be extracted by glycerin or acid solutions and other materials, and the resulting extract is condensed by evaporation to the consistence of a paste or powder. Beyond this it is not possible to concentrate foods by chemical process, for a definite bulk of food must be daily consumed from which to derive the energy for the body and the substance needed for repair.

Drying is conducted either in the heat of the sun or by artificial means. The class of dried foods embraces the various forms of dried and desiccated meat and fish, dried milk, dried vegetables and fruits, such as peas, beans, lentils, corn, okra, apples, peaches, cocoanuts, grapes (raisins), figs, etc. The addition of sugar, flour, or salt by abstracting moisture, aids the drying and helps to prevent decomposition. (See Food Preservation by Drying, p. 278.)

Milk may be dried *in vacuo* and preserved by itself as a powder, or mingled with other materials, such as malt and various starchy foods. Condensed milk has been already described (p. 95).

Eggs may also be successfully dried; they keep well, especially when mixed with farinaceous materials (p. 108).

Froissart relates how the King of France in the invasion of England in 1386 had the yolks of eggs packed and stored in barrels to furnish rations for the troops. Egg albumin dries in the form of thin scales which may be indefinitely preserved.

Meat.—The preservation of meat and fish by drying is probably the oldest, as it is the most primitive, method in use. Meat drying is practised extensively among savage tribes in almost all parts of the world, but especially where purity of the atmosphere combined with intense heat and dryness of climate will cause the water to evaporate from the meat so rapidly that germs do not have time to decompose it. For this purpose only lean meat can be used, as the fat does not part with its water with sufficient readiness. Dried meat loses much in weight, becomes hard and tough, and in many cases tasteless. It is therefore usually indigestible, and requires prolonged cooking and proper seasoning. When prepared in this way, the drying process may be applied very thoroughly, and the food is more easily cooked and seasoned. Dried meat may be predigested, evaporated, powdered, and made into a paste for broths, or used to re-enforce various food preparations for invalids. Powdered meat is sometimes mixed with sugar and salt, or pulverised dried cooked vegetables, bread, etc. Meat extracts have been described in detail on pp. 113 to 120.

Pemmican is a preparation of dried powdered meat, which has been described on p. 200.

Dried vegetables keep even better than dried meats. Tea and coffee are good examples of dried vegetable substances. They may be extracted and then concentrated by evaporation. Potatoes are concentrated by drying to less than one third of their original weight, and they may be thus preserved in slices or in granular form. Many other vegetables are prepared by drying, and, in addition, some are compressed, as, for example, cabbage, cauliflower, carrots, etc. The compression still further excludes air and moisture. As a rule, dried vegetables are only serviceable for relieving monotony of diet when fresh vegetables cannot be obtained. Desiccated vegetables have been used with some success in the United States navy, but they have less antiscorbutic property than fresh foods.

Bread may be preserved for a long time by drying, but it usually becomes tasteless, and is useful in this condition only in emergencies, or to make variety in the rations of sea biscuits, hard-tack, etc., which are furnished to soldiers and sailors in active service.

Major Woodruff, Assistant Surgeon, U. S. A., writes of this subject: "The Germans have been the first to take advantage of drying and compressing processes in the manufacture of a dried, compressed bread. The great difficulty in the use of bread for field service consists in the inability to supply it so that it will keep a long time and be digestible. Hard-tack is ruinous to many soldiers, as already pointed out. If baker's bread is compressed, it sinks into a heavy dough. Only strong stomachs can digest it, and it is far worse than the wet, soggy, hot breakfast bread with which we cultivate dyspepsia. If the bread is merely dried, it is too bulky for transportation. By a new process, which probably consists in drying the bread and at the same time compressing it by improved machinery, the Germans have secured a variety of field bread which is spoken of in very high terms. Small bits of it thrown into soup swell up like a dried sponge when thrown into hot water. The soldiers are said to be very fond of it, and as far as known it is entirely successful. . . .

"The French Department of Intendance has been experimenting with dried bread, which is said to be superior for campaigning purposes both to biscuit and ordinary bread. From the results of the experiment, which are given in the Revue du Service de l'Intendance Militaire, it appears that this dried bread will absorb from five to six times its own weight of water, milk, tea, coffee, or bouillon. Biscuit absorbs hardly its own weight of liquid, although when thoroughly dried it contains only about 10 per cent of water, whereas the bread contains from 12 to 14 per cent. It can be made in cubes of convenient form."

Diet of Concentrated Foods

There are many complex dried foods in market prepared especially for invalid diet, and supposed to possess high nutritive value with small bulk. As compared with fresh food, their lighter weight and greater concentration make them valuable articles for temporary invalid diet, but they cannot be said to possess any special advantage over freshly made broths, scraped beef, etc., excepting in those cases in which it is important to lessen the bulk and increase the strength of the food.

Attempts have from time to time been made in the German army and elsewhere to supply healthy men with a daily diet of concentrated foods. If this could be done, it would be of great economic advantage for troops on the march, explorers in unknown countries, sailors on long voyages, and for use in many ways, but after a few days or a week of such treatment men lose in weight and deteriorate in strength. It is not found practical to give food for any length of time in which the total solid ingredients are concentrated to less than twenty-two or twenty-three ounces for the day's ration, although for a few days food may be used in which they have been reduced to ten or twelve ounces (Parkes). Pea meal (p. 167) and pemmican (p. 200) are the most noted rations of this class, to which bacon, hard-tack, concentrated meat extracts, coffee, and chocolate are often added.

In a series of very instructive and important articles upon Military Food, published in the Journal of the American Cavalry Association, Major Woodruff says: "Concentration only means the exclusion of the indigestible portions and part of the water. Thus the garrison ration gives to each man about five pounds of food, of which only four pounds are eaten, and it is impossible to condense this amount so that it will be much less than three pounds. All foods that are compressed and dried still contain from 5 to 12 per cent of water. The German soldier's war ration is equivalent to about two pounds of water-free food in the above sense. This is not enough for American soldiers during hard work, yet it is possible in an emergency to give the soldier fairly good nourishment with these improved foods, and not allow the weight to be over two pounds, as seen in the following table, in which the analyses are only approximate:

Articles.	Grammes.				Calories.	Weights.
	Protein.	Fats.	Carbohydrates.	Salts.		
3 cubes dried compressed bread, ¼ pound each.....	35	4	250	2	1,233	¾ pound.
3 packages compressed soup, 6 ounces each...........	100	150	200	28	2,625	1⅛ "
3 tablets compressed tea or coffee ready for use, possibly a tablet of dried fruit..	...	...	...	..	....	⅛ "
Total................	135	154	450	30	3,858	*2 pounds.

* Gross weight.

"The composition of the bread is assumed to be the same as ordinary flour, and the tablets of soup can be manufactured of the given composition. As usually made, the tablets do not contain so much fat, which is here purposely increased in order to give the necessary energy. Even with this increase they would not contain as much as the first specimens of Erbswurst.

"For purposes of detached service the United States soldier has been supplied, as seen in the following table:

Articles.	Grammes.				Calories.	Weights.
	Protein.	Fats.	Carbohydrates.	Salts.		
1 pound hard-tack......	50	5	340	2½	1,644	1 pound.
¾ pound bacon.........	27	236	...	8½	2,310	¾ "
Coffee, sugar, and salt...	..	...	...	19	....	¼ "
Total.............	77	241	340	30	3,954	2 pounds."

Food Preservation

The different methods of food preservation have of late years received much attention, for it is owing to them very largely that it is possible to maintain large armies and navies in action and to permit of the aggregation of men in communities away from all immediate sources of food supply.

It was originally believed that contact with air was *per se* the cause of the decomposition of food, but it is now known that the great number of germs contained in even comparatively "pure" atmospheric air are the agents of putrefaction rather than the air itself, but the exclusion of the latter implies the exclusion of the former.

The different methods of preserving foods are therefore all dependent upon the principle of preventing fermentative changes which are liable to occur when germs, derived either from the atmospheric air or contamination with unclean substances, come in contact with foods under favourable conditions of warmth and moisture. The conditions which are inimical to the development of bacteria are those which may be successfully adopted for the preservation of food.

Ferments and putrefactive germs require for their activity a fair degree of moisture, a moderately warm temperature, which for many putrefactive germs ranges between 60° and 100° F., while certain germs must, in addition, have free oxygen derived from the atmospheric air.

The principal means employed for preserving food are included under the following headings:

I. Drying. II. Smoking. III. Salting. IV. Freezing. V. Refrigeration. VI. Sterilisation. VII. Exclusion of Air—Canning. VIII. Addition of Antiseptic and Preservative Substances.

I. **Drying.**—Drying in the sun or before a fire is probably the oldest of methods of preserving food. At present it is used mainly for fruits and vegetables, although in some excessively dry and clear atmospheres, comparatively free from putrefactive bacteria, meat also may be preserved in this way. "Jerked" meat is kept by cutting it into thin slices and drying in the sun for several days. Familiar instances of preservation by drying are found in raisins, figs, dates, prunes, dried apples, peaches, desiccated cocoanut, etc. Some vegetables are also preserved in this manner, such as Lima beans, okra, corn, etc. Others are cut into slices and then dried, but the latter are apt to become tough and tasteless. Fish, such as the cod, is desiccated and preserved by drying, but with the addition of salt. The desiccated meats and vegetables which are used for making soups have the advantages of portability and permanency.

They are nutritious, and may be added to strong beef tea to increase its flavour and make it more palatable.

This subject is further discussed under the heading Food Concentration (p. 275).

II. **Smoking.**—Smoking is the preservation of meat or fish by means of volatilised creosote and other substances developed from wood or peat smoke, which have an antiseptic action. It is chiefly applied to beef, tongue, ham, bacon, and fish. The meat or fish is hung in a confined chamber and saturated with wood smoke for a long time, so that it absorbs a small percentage of antiseptic materials, the fat is prevented from becoming rancid and the albumin from putrefying. The smoking is commonly employed after salting and in connection with drying. Painting the surface of meat with a solution of wood creosote in vinegar has the same preservative action.

The outer surface of meat, such as ham or bacon, preserved by smoking becomes considerably drier and tougher than the interior, but the latter is not made especially tough by the smoking if it was originally tender. Well-smoked bacon cut thin and thoroughly cooked is a digestible form of fatty food for tubercular patients, and smoked beef may sometimes be eaten for the sake of variety by patients who are placed upon a meat diet. The digestibility of hams is enhanced by the smoking process to which they are subjected.

The process of smoking is applied to fish upon a very large scale, and their digestibility and flavour cannot be said to be destroyed by it in many cases; in fact, in some instances, as in those of smoked mackerel, herring, and salmon, while the flavour is very different from that of the fresh fish, it is agreeable to many persons, and these articles afford an important and appetising variety of food.

III. **Salting.**—The process of salting is a primitive but still desirable method of preserving meat and fish. Salted meat usually becomes pale from the action of the salt upon the hæmoglobin contained in the blood vessels of the muscle fibre. The addition of a little saltpetre helps to preserve the original reddish colour of salted meat. Salt also absorbs moisture from the food, and thus dries it while preserving it.

Brine, a strong solution of common salt, may be used to temporarily preserve meat and other substances. The Chinese have long practised the art of preserving fruits, roots, and flowers in it. Corned beef is made by soaking the meat for some days in such a solution. The brine acts upon the muscular tissues and toughens it. Brine, concentrated by long-continued use, has been known to acquire poisonous properties from changes in the organic matter which has passed into it from the meat. The process of soaking in brine causes much of the extractives and natural salts of the meat to osmose out from it, and the loss of organic material and salts occurring in this way has been estimated by Liebig and Parkes as equal to fully one third, for myosin itself is soluble in strong salt solution. For these reasons salted meats, such as corned beef, require prolonged cooking. Salt meat of all kinds is drier, less digestible, and slightly less nutritious than fresh meat.

IV. **Freezing.**—Food may be kept in a frozen condition almost indefinitely. On being thawed, it must be cooked immediately, otherwise decomposition may set in at once, and, omitting milk and cream, food is not easily eaten in an actual frozen state, excepting by the northern Eskimos, who take their meat in that form by preference.

Meat and fish may be kept for many days frozen in blocks of ice without losing much in flavour, but vegetables are not as good when cooked after freezing.

In 1867 Dr. Carl von Baer reported to the Royal Society of London the discovery in arctic Siberia of the body of a frozen mammoth, the meat of which was preserved. As this animal has been extinct since the days of prehistoric man, it afforded an illustration of the marvellous preservative power of intense cold. Another such animal was found, in 1799, being eaten by wolves in Siberia.

In 1861 the entire bodies of three Swiss guides, who forty-one years before had been buried by an avalanche over the Glacier de Boissons, were found in a state of excellent preservation. With these examples of the influence of cold, it is little wonder that meat may be preserved for a few months in ice and yet be quite fit to eat. In freezing meat for export it is subjected to a temperature of about 20° F. below zero. When quite hard the carcass is sewn in thin cotton cloth and placed in a refrigerating chamber on shipboard, where it keeps in good condition throughout long voyages.

Meat actually frozen should be cooked as soon as it is thawed, and meat thus preserved is better cooked by roasting than boiling, unless it has been imperfectly thawed, in which case the central portion may remain frozen after the external layers have begun to cook, and when the latter are thoroughly roasted, the inside may still be found almost raw. Frozen meat loses 10 per cent of its nutritive value in cooking. Such meat has been transported in fresh condition as far as fifty miles inland in the Philippines.

V. **Refrigeration.**—The process of refrigeration does not involve the actual freezing of meat or vegetables, but implies their preservation in chambers at a temperature which is maintained but a few degrees above the freezing point. This causes less alteration in flavour than freezing. The cold is artificially generated, and beef, fish, fruits, and vegetables are now successfully transported for thousands of miles in refrigerator cars and rooms fitted for the purpose on steamships.

The refrigerating processes applied to the preservation of meat, etc., are several. In most of them the actual reduction of temperature of the meat is maintained by cold air and not by contact with ice.

One method consists in the adaptation of the principle that compressed air on expanding derives the energy for its expansion from heat, which it abstracts from all surrounding bodies. The liberation of strongly compressed air, therefore, produces intense local cold in its immediate vicinity. The air is originally compressed by a force pump, and the heat which is developed by the compression is removed by a circulating stream of cold water. The cooled compressed air is then liberated with the effect described. Other apparatus is constructed on the principle of ice machines, which are operated by evaporating ammonia, which produces extreme cold.

The keeping of meat by refrigeration is rapidly superseding the canning process for this kind of food, over which it has many decided advantages. Between 15 and 20 per cent of all the mutton eaten in Great Britain is brought from New Zealand and the River Plate in a refrigerated condition.

Major Woodruff, U. S. A., writes: "The French Government is taking the initial step towards applying this new industry to the purposes of war. They have succeeded in keeping dressed beef in a perfect condition for three or four months with the present appliances.

"A moment's thought will show what a revolution this matter of cold storage can make in military practices. It will obviate all necessity of keeping live cattle near the army, a system that so often results in diseased animals and fatal epidemics among the soldiers. It will help to wipe out of existence all the salt meats formerly supplied, and will thus avoid that large list of diseases of stomach, bowels, and nutrition that salt meats have been accused of causing."

VI. **Sterilisation.**—By sterilisation of food is meant the process of rendering it germ-free by heat, and it includes the preservation of such food in sterilised vessels. Practically all thoroughly cooked food is for the time being "sterilised," and overdone meat keeps longer than underdone meat, for if the outer layers are firmly coagulated and dried by the heat of boiling or roasting, they form an envelope which is less pervious to the atmospheric air and germs. (See Cooking, pp. 263, 264.)

Canned food (p. 282) is also sterilised, but the latter term is applied chiefly to milk which has been treated by the method described on p. 85.

VII. **Exclusion of Air.**—Exclusion of air from contact with food is accomplished not only in the process of canning, but by such means as varnishing or covering it with substances which are comparatively impermeable, as in the case of varnishing eggs, covering fish with oil, or *pâté de foie gras* with lard, etc.

Eggs undergo decomposition from the entrance of the atmospheric air and germs through their shells, and this process may be prevented, sometimes for several years, by covering fresh eggs with almost any substance which is more impermeable than their shells, such as gum, fat, butter, oil, beeswax, or fresh milk of lime. The sawdust or salt in which eggs are commonly packed serves the double purpose of insuring safety in transportation and excluding to some degree the air. Similarly meat may be preserved by coating it with paraffin, gelatin, collodion, or layers of powdered charcoal or of lard after the manner of potted meats. Beef has been sent in good condition from Australia to England by merely dipping it into hogsheads of melted fat, in which it was allowed to remain after the fat cooled and solidified. The preservation of meats in air-tight skins, like sausages, has long been practised.

When food is preserved by any of these methods care must be exercised to have it perfectly fresh at the start and to drive off by heat or otherwise any air which may be present in the food itself or in its containing vessel.

Canning.—The original idea of the preservation of foods by canning was that the exclusion of air was the sole object necessary of accomplishment. It is now known, however, that many putrefactive bacteria are anaërobic, and that the food must be thoroughly sterilised before the can is closed. This should be done by heat, but since it can also be accomplished by the addition of antiseptics, the introduction of the latter is practised by some unscrupulous manufacturers to the detriment of the public health.

The process of canning meat or vegetables is conducted as follows: The food is placed in clean new tin cans, filling them as completely as possible. Lids are then tightly soldered on the cans, leaving a minute pinhole opening only for the escape of air and steam. The cans are then immersed in a bath of boiling fluid, such as zinc-chloride solution, having a higher boiling point than the water within the cans. The latter boils, expels at first air, then steam, and thoroughly cooks the food, making it aseptic by killing all germs. Before the cans cool, their minute openings are soldered, and they are then ready for storage.

The long boiling of meat in this manner toughens its fibres by hardening the syntonin. Such meat is apparently tender, but in reality it is not very digestible (Williams).

To avoid the necessity of cooking food at a high temperature in order to exclude the air, various modifications in the process of canning are employed. One of these—McCall's—is based on the disinfection of the air by sodium sulphite. In another process sulphurous acid and nitrogen are used to replace the air.

H. W. Wiley, who has made an exhaustive study of canned foods, says, in an instructive report on Foods and Food Adulterants, made by him for the United States Department of Agriculture (Bull. No. 13, Part VIII):

"All manner of food is canned, and that at prices which place it within the reach of the humblest pockets. Preserved food has been a great democratic factor, and has nearly obliterated one of the old lines of demarcation between the poor and the wealthy. Vegetables out of season are no longer a luxury of the rich. . . . In the American grocery pineapples from Singapore, salmon from British Columbia, fruit from California, peas from France, okra from Louisiana, sweet corn from New York, string beans from Scotland, mutton from Australia, sardines from Italy, stand side by side on the shelves."

Much light is thrown by Wiley upon the economic value of the substances under consideration in the following important statements from the report above quoted:

"The quantity of dry food material in canned goods varies within wide limits. It is very low in such vegetables as string beans, asparagus, etc., and quite high in such materials as canned corn, succotash, and other bodies of that description. The lowest percentage of dry matter in string beans of American origin was 4.17. In other words, in buying one hundred pounds of such material the consumer purchases 95.83 pounds of water.

"The price of the packages of string beans [bought in open market] varied within wide limits, depending both upon the size of the packages and the labels they bore. The highest price paid was thirty-five cents, and the weight of the contents of the package was a little over three pounds. The lowest price paid was ten cents, and this was paid in many instances. The highest price paid, according to the percentage of dry matter, was in sample 10,928, costing thirty cents and containing only two hundred and fifty-four grammes of string beans, 31.1 grammes of dry matter, and 94.37 per cent of water. The price of the dry matter in this package was nearly one cent per gramme, which would be almost five dollars per pound. The enormous cost of food in canned goods is illustrated to the fullest extent by this sample, showing in a striking way that such food materials must be regarded in the light of luxuries or condiments rather than as nutrients to support a healthy organism. An expenditure of ten or fifteen cents for a good article of flour or meal will procure as much nutriment for a family as the investment of three or four dollars in canned goods would.

"A general view of the digestive experiments must lead to the conviction that the process of canning, especially when preservatives are employed, such as salicylic acid and sulphites, tends to diminish the digestibility of the albuminoid and other bodies. The low percentage of digestible albuminoids will be remarked with some degree of astonishment in all the analytical tables."

Of the dangers of poisoning from canned foods Wiley says: "Vegetables are usually canned in the fresh state, and if they are in any degree spoiled at the time the fact is usually conspicuously evident to the taste, so that the canner cannot afford to use them. Bacterial action seldom occurs in the can without bursting it or rendering it unsalable. Ptomaines may, however, develop where the canned food is allowed to stand for some time after opening, though even then this is unlikely in the case of preserved vegetables.

"It may be said, therefore, that the principal risks to health which may arise from the use of canned foods are those due to the use of preservatives, or to the presence of the heavy metals—copper, tin, lead, and zinc. . . . In this country there is no restriction whatever in regard to the character of the tin employed, and as a result of this the tin of some of the cans has been found to contain as high as 12 per cent of lead. . . . The analyses of numerous samples of solder employed show that it contains fully 50 per cent of lead. In addition to this there is no care taken to prevent the solder from coming in contact with the contents of the can. It is a rare thing to carefully examine the contents of a can without finding pellets of solder somewhere therein.

"Another great source of danger from lead has been disclosed by the analytical work, viz., in the use of glass vessels closed with lead tops or with rubber pads, in which sulphate of lead is found to exist."

The frequency of poisoning by eating canned lobster, crabs, or shellfish is due mainly to the rapidity with which they decompose and develop ptomaines after the can has been opened. The contents of such a can partially used should not be kept until the next day.

Canned beef is boiled and steamed under pressure at 250° F. It loses most of its extractives and has the tastelessness, therefore, of meat from which soup has been made. Vegetables may be added to improve the taste, either in the canning process or subsequently during cooking.

Canned beef should be eaten promptly after opening, for it is liable to spoil within a few hours, especially in tropical climates. Severe gastro-enteric disorders may arise from eating such spoiled meat, and epidemics of such poisoning have been observed in a French garrison at Tours (1898), among the British troops in South

Africa (1900), and among our own troops in Cuba (1899). In the latter case much public scandal arose in connection with this subject, and from the further fact that manufacturers do not always resist the temptation to can meats of inferior quality, or which may be already partially decomposed, especially when hurried demands for canned goods are made to meet the exigencies of warfare. At the commencement of the Spanish-American War, in 1898, 7,000,000 pounds of canned roast beef were purchased by the commissary department for use by the United States soldiers.

VIII. **Antiseptic and Preservative Substances.**—A long list of chemical substances have been used from time to time in the preservation of food, but most of them have been supplanted by the safer process of canning, refrigeration, etc.

The use of various antiseptic or preservative fluids is designed to prevent the activity of germs and fermentation. Sugar, like salt, in strong solution possesses decided antiseptic powers, and hence the employment of strong sirups for the preservation of fruits, and of sugar itself in making candied fruits. Other harmless preservative materials which are added are oils, chiefly serviceable for keeping fish, and vinegar and spirits of wine for pickling such products as chilies, tarragon, and shallot.

Vinegar is used to preserve oysters, lobsters, and other sea food, as well as cucumbers, cauliflower, and other vegetables, as "pickles." Spices, mustard, and similar condiments are usually added.

"Soused" fish, such as mackerel, are immersed in mixtures of cider vinegar flavoured with cloves, nutmeg, parsley, bay, onions, etc. After being "soused" once or twice the food is heated in the fluid to 140° F., flavouring substances are added, such as Worcestershire sauce, extract of anchovy, and lemons, and the whole is put in air-tight jars (Clark).

Among the materials sometimes employed for preserving foods may be mentioned the fumes of burning sulphur (sulphurous acid), acetic acid, weak carbolic acid, bisulphite of calcium, and the injection into the blood vessels of meat of alum, chloride of aluminum, etc. Borax, boric and salicylic acids, formaldehyde, and other materials have been extensively used in the preservation of milk, beer, meats, etc. Sodium sulphite is added to preserve chopped meat and Hamburger steak, and a mixture of borax, nitre, and salt is used in sausages.

A new method of meat preservation has been introduced by a Mr. Jones in England. It consists of injecting the animal the moment after it is killed with a solution of borax, which is so uniformly distributed through the circulation to all the fibres of the meat that but a very small quantity of the antiseptic need be employed.

The use of borax and boric acid as food preservatives is so common that it is a matter of great importance to determine the influence of these substances upon nutrition. This Prof. R. H. Chittenden and William J. Gies have done. (American Journal of Physiology, No. 1, 1898.) After elaborate experiments upon animals, these authors conclude as follows: Doses of borax up to 5 grammes per diem, continued for some time, do not disturb proteid metabolism or general nutrition. In larger doses borax retards proteid and fat assimilation and increases the weight of feces. Very large doses cause nausea, vomiting, mucous diarrhœa, and lessen the urine secretion (through which borax is eliminated). Boric acid in doses amounting to 10 or 15 grains per diem does not affect nutrition or proteid metabolism; it does not affect the volume of urine or irritate the alimentary canal. Neither drug controls intestinal putrefaction.

Later experiments upon man, reported by H. W. Wiley in 1904, show that when either borax or boric acid is ingested with food 80 per cent of these substances is excreted in the urine and 20 per cent in the perspiration. Existing albuminuria is increased by their use, body weight is lost, nitrogen elimination is inhibited, and more phosphoric acid than normal is eliminated.

"Embalmed beef." This term is applied to meat which has been coated with a preservative antiseptic wash of some sort. A solution of boric acid is sometimes employed, but formalin is used more often. Flies avoid the coating and do not alight upon it.

Formaldehyde, or formalin, is a strong antiseptic. It is not especially harmful in moderate doses, but Halliburton, of London, has shown that it is especially active in inhibiting the action of the normal digestive ferments. Given in milk it is injurious to infants.

Glycerin has been used as a preservative, but it cannot be employed in any quantity on account of its aperient action.

It is true of practically all of these latter substances that food preserved by them if used in excess or for any length of time is apt to endanger the normal digestive functions, besides being somewhat less nutritious and more tasteless than other preparations.

Substitutes for Food

Men are often placed under conditions in which, from poverty or exposure, sufficient quantities of food cannot be obtained. Under these circumstances, the craving of hunger may be diminished and the actual tissue waste may be retarded by the substitution of certain mild stimulants and beverages. Tea, coffee, and tobacco all possess moderate action in this respect, and alcohol, under such conditions, is both a stimulant and a food. The natives of various barbarous or semicivilised countries, while performing long feats of marching, being often unable to obtain sufficient food with regularity, make use of a variety of different substances for the purpose above indicated. Among these may be mentioned betel nut, kola nut, Siberian fungus, the cocoa leaf, and pepperwort, which are chewed from time to time; hasheesh and opium, which are both eaten and smoked; *maté*, and various forms of alcoholic fermented drinks. All these substances are used to enable men to prolong periods of fasting.

Quantity of Food Required

The quantity of food required to maintain the body in vigour depends upon the following conditions:

1. External temperature. 2. Climate and season. 3. Clothing. 4. Occupation, work, and exercise. 5. The state of individual health. 6. Age. 7. Sex.

In civilised communities, where cooking is a fine art, the number and variety of food preparations is so great that the appetite is often stimulated beyond the requirements of the system, and consequently more food is eaten than is necessary or desirable to maintain the best standard of bodily health and vigour.

Persons in this country who live in comfortable circumstances often eat a dozen or fifteen ounces of solid food at breakfast, and again at luncheon, and perhaps thirty ounces more at dinner, making a total of, say, fifty-five or sixty ounces, to which are added only fifty or fifty-five ounces of fluids. This is about a third more than the amount of solids actually needed, forty ounces of solid food (which equals twenty-three ounces of water-free food) being a fair average for the daily necessities of most persons, one fourth of which should be animal and three fourths vegetable food. They eat too much and drink too little fluid in proportion. (See Water, p. 19.)

Gluttony results in overdevelopment and overwork of the digestive apparatus. The stomach and bowels become enlarged, the liver is engorged, and a predisposition is established to degenerative changes, fatty heart, etc. (See Overeating.)

The most northern Eskimos, for example, who often eat but one meal a day and then gorge themselves with tough meat, develop big jaws and distended abdomens (Cooke). Hayes described Eskimos who ate daily from twelve to fifteen pounds of food, about one third of which was fat, and the rest mostly meat; and Captain Hall, when on his arctic expedition, declares that he saw a native consume twenty pounds of raw meat and drink a quart of train oil within twenty-four hours.

It is stated by competent students of dietetics that more disease arises from abuse of food in regard to both quantity and quality than from abuse of drink.

Sir Henry Thompson says (Diet in Relation to Age and Activity): "More mischief in the form of actual disease, of impaired vigour, and of shortened life accrues to civilised man, so far as I have observed in our own country and throughout western and central Europe, from erroneous habits in eating than from the habitual use of alcoholic drink, considerable as I know the evil of that to be."

1. The external temperature increases the rate of oxidation processes in the body as it becomes colder by stimulating the respiration and circulation, and there is a consequent increased demand for food.

2. Climate and season influence the quantity of food eaten. Cold, bracing atmosphere stimulates the appetite, tempts one to exercise vigorously, and hence demands a larger consumption of fuel or food. A hot climate or season, with enervating, moist air, disposes man to languor and inactivity, and diminishes the appetite as well as the need for food.

3. Abundant clothing in a cold climate conserves the body heat, and less food is therefore required to maintain life than if the body is but scantily clad.

4. Exercise and muscular work also promote oxidation in the tissues and augment waste production from the muscles. This waste must be replaced, and energy must be supplied for work by additional consumption of food. Outdoor work demands more food than indoor work, and mental labour less than physical. Where men are fed upon a carefully regulated diet—as in prisons—it is found that those who are performing hard labour require about one fifth more solid food than the others. The hard-labour prison dietary in England comprises fifty ounces of solid food, chiefly bread and vegetables. (See Diet in Prisons.)

5. The state of health of the individual greatly modifies the amount of food required both indirectly, through influencing exercise and work, and directly, by the local condition of the digestive system.

Feeble and inactive persons may live on a third or less of the ordinary ration. Patients having chronic, purulent discharges, such as come from old sinuses, empyema, and tubercular abscesses, need large quantities of food—if they can digest it—to maintain their strength against the constant drain on their systems.

The nursing mother should have abundant food, for she must eat for two.

6. The age of the individual not only modifies the absolute amount of food required, but also the relative quantity in proportion to body weight. In the first year of life the infant grows six or eight inches, and at the end of a twelvemonth it should weigh two or three times as much again as at birth. This rapid growth necessi-

tates a relatively larger consumption of food than at any other period of life, and hence the child is fed at first once every two hours, and later every three hours. During the second year the proportionate growth is half that of the first year, and during the third year it is one third that of the first. After the third year the weight and growth increase more uniformly, but the child must still have a large relative quantity of food, a great proportion of which must be tissue-forming —i. e., nitrogenous.

The following table is given by Prof. Arthur Goss (U. S. Department of Agriculture, Bulletin No. 54):

One meal of boy 14 to 16 years of age, inclusive, equivalent to 0.8 meal of man.
One meal of girl 14 to 16 years of age, inclusive, equivalent to 0.7 meal of man.
One meal of child 10 to 13 years of age, inclusive, equivalent to 0.6 meal of man.
One meal of child 6 to 9 years of age, inclusive, equivalent to 0.5 meal of man.
One meal of child 2 to 5 years of age, inclusive, equivalent to 0.4 meal of man.
One meal of child under 2 years of age equivalent to 0.3 meal of man.

The rapidly growing, active boy often eats more animal food than the adult, and the middle-aged man eats more than the aged. A man of seventy years may preserve good health on a quantity of food which would soon starve his grandson.

7. Sex influences to a considerable extent the quantity of food consumed, but allowance must be made for totally different habits of life. There are many women who eat as much as men, but the majority require less food, even when doing the same work. Under equal conditions in penal institutions men require about one fifth more solid food than women. Female factory operatives eat from one tenth to one fifth less food than men. Prof. Arthur Goss gives the equivalent that one meal of woman averages 0.8 meal of man at moderate muscular labour.

Mrs. E. H. Richards, as the result of observations (Food as a Factor in Student Life) upon 130 young women students at the University of Chicago, whose average weight was 120 pounds, gives the following table of food consumption in grammes per diem:

Protein	120
Fat	161
Carbohydrates	402
Total	659
Potential energy in calories	3,383

Women, on the average, weigh less than men, take less exercise, work less, and live less in the open air, and hence require less food. As a consequence of their habits of life they are more liable to dyspepsia and constipation, which are also factors in reducing the quantity of their food below the standards for men. There are naturally many exceptions to all these general statements.

It is ordinarily impossible or impracticable to definitely weigh the food for individual consumption, but where large numbers of men are being fed by contract in institutions, or as sailors or soldiers, or on exploring expeditions, it becomes necessary to estimate carefully the quantity of food required per diem to maintain normal health and vigour. To facilitate such estimates, tables have been carefully computed based upon the nutrient value of different foods.

Quite exceptionally, persons are observed who subsist in good health upon an abnormally small quantity of food. They usually do but little work, and they are often, but not always, advanced in years. (See Food in Old Age, p. 312.)

Fothergill referred to the case of one Wood, a miller of Billericay, who for eighteen years subsisted solely upon a daily allowance of sixteen ounces of flour, which he ate as sea biscuit made into a pudding. By this diet he reduced his figure from extreme corpulency to normal size, and maintained good bodily vigour.

In the preparation of food to be eaten it is customary to allow 10 per cent of waste in calculating the gross quantity for dietaries of institutions, army rations, etc. Mrs. E. H. Richards found that this percentage is somewhat too low.

In computing the quantity of food needed for daily consumption its composition must be taken into account. The estimates of different authors vary somewhat in regard to the necessary quantity of different kinds of food in a mixed diet, but notwithstanding this there is a general correspondence between them. The chief discrepancy concerns the amount of fat to be eaten, and it will be noticed in the following tables that, as a rule, when the fat is cut down the carbohydrate estimate is correspondingly increased.

Standard Daily Diet for an Adult Male at Ordinary Work

Computed in grammes.

	Moleschott.	Pettenkofer and Voit.	Ranke.	Playfair.	Foster.	Landois.	Dujardin-Beaumetz.
Albuminates	130	137	100	119	133	120	124
Fats	84	117	100	51	95	90	55
Carbohydrates	404	352	240	530	422	330	430
Salts	30	30	25				
Total water-free food	648	636	465	700	650	540	609

Healthy Adult Man, Abundant Diet and Rest (Bauer)

	Taken in.	Consumed.	Stored up.
Albumin	137	137	
Fat	117	52	65
Carbohydrates	352	352	

An Ideal Ration of Solid Food (Mrs. E. H. Richards)

Material.	Amount.		Proteid.		Fat.		Carbohydrates.		Calories.
	Grms.	Oz.	Grms.	Oz.	Grms.	Oz.	Grms.	Oz.	
Bread	453.6	16	31.75	1.12	2.26	0.08	257.28	4.04	1,206.82
Meat	226.8	8	34.02	1.20	11.34	0.40	......	....	243.72
Oysters	226.8	8	12.52	0.44	2.04	0.07	......	....	70.01
Breakfast cocoa	28.3	1	6.60	0.23	7.50	0.26	9.60	0.34	135.42
Milk	113.4	4	3.63	0.13	4.42	0.16	4.88	0.17	75.55
Broth	453.6	16	18.14	0.64	18.14	0.64	90.72	3.20	613.21
Sugar	28.3	1	.....	....	.....	....	27.36	0.96	112.17
Butter	14.17	½	0.14	....	12.27	....	......	....	118.62
Total	......	...	106.80	....	57.97	....	389.84	....	2,574.60

An Ideal Ration of Liquid Food (Mrs. E. H. Richards)

Material.	Amount.	Proteid.	Fat.	Carbohydrates.	Calories.
		Grammes.	*Grammes.*	*Grammes.*	
Beef broth or *consommé*	1 pint.	20.5	0.5	.....	88.70
To which has been added one large egg, minus shell	2 oz.	7.1	6.8	.....	91.67
Dried fruit soup	1 quart.	....	....	100.0	410.00
Lemon jelly	½ pint.	6.5	....	12.5	77.90
Whole milk	1 quart.	34.0	36.0	44.0	651.00
Rice or arrowroot	3 oz. (dry).	6.3	0.3	67.2	304.11
Grape sugar, or some one of the prepared foods (dry)	4 oz. (dry).	2.5	....	100.0	420.25
Total	2.5 quarts to 3.0 quarts.*	76.9	43.6	323.7	2,043.63

* According to how the rice is given.

A Common Invalid Ration too Low in Proteid (Mrs. E. H. Richards)

	Proteid.	Fat.	Carbohydrates.	Calories.
	Grammes.	*Grammes.*	*Grammes.*	
1 pint of beef broth or *consommé*	20.5	0.5	....	88.7
1 pint of dried fruit soup	....	....	50	205.0
1 pint of lemon whey	....	21.5	79	521.7
1 pint of Imperial Granum, containing 3 oz.	6.8	0.4	64	294.0
2 quarts of liquid. Total	27.3	22.4	193	1,109.4

A Ration Rich in Proteid—after Acute Disease (Mrs. E. H. Richards)

Material.	Amount.		Proteid.	Fat.	Carbohydrates.	Calories.
	Grms.	*Oz.*	*Grammes.*	*Grammes.*	*Grammes.*	
Bread	453.6	16	31.75	2.26	257.28	1,205.81
Meat	453.6	16	64.04	22.68	......	487.62
Milk without cream	453.6	16	29.02	18.00	39.00	444.48
Coffee or tea with cream	453.6	16	4.60	3.25	1.14	53.43
Butter	14.17	½	0.14	12.27	......	118.62
Sugar	56.7	2	.....	.....	54.72	224.35
	....		129.55	58.46	352.14	2,746.12
Less 10 per cent for indigestibility	......	...	12.95	5.84	35.21	274.61
Total	....		116.60	52.62	316.93	2,534.31

Table compiled by Mrs. E. H. Richards and Miss Marion Talbot

One day's food, at the University of Chicago, calculated to determine the amounts and proportions of the various constituents and their comparison with the general average.

Pounds.		Per cent proteid.	Per cent fat.	Per cent carbo-hydrate.	Pounds protein net.	Pounds fat net.	Pounds carbo-hydrate net.	Calo-ries.
50.0	Stew and cold meat.	21.0	8.0	......	10.5	4.0	....	.....
90.0	White potatoes.....	1.8	0.2	19.1	1.6	0.18	17.2	.....
45.0	Sweet potatoes.....	1.5	0.4	26.0	0.7	0.2	11.7	.....
4.0	Dried beef.........	34.0	7.5	......	1.4	0.3	....	.....
77.0	Flour and grain....	11.5	1.8	70.0	8.9	1.4	53.9	.....
3.0	Tapioca...........	1.3	......	83.0	....	....	2.5	.....
192.0	Milk..............	3.5	3.7	4.7	6.8	7.1	9.0	.....
13.0	Cream.............	3.0	12.0	3.0	0.4	1.6	0.4	.....
15.0	Butter............	2.0	83.0	0.5	0.3	12.5	....	.....
15.0	Sugar.............	.....	......	96.5	....	....	14.5	.....
6.0	Prunes............	3.5	......	65.0	0.2	....	4.0	.....
9.0	Oranges, less 20 per cent waste........	1.0	......	11.0	....	....	0.8	.....
50.0	Bananas, less 50 per cent waste........	4.85	......	19.7	1.3	....	5.0	.....
7.2	Eggs..............	12.5	12.0	......	0.9	0.8	....	.....
41.0	Lamb..............	20.0	15.0	......	8.2	6.2	....	.....
26.0	Turkey............	19.0	5.0	......	5.0	1.3	....	.....
14.0	Steak.............	15.0	22.0	......	2.1	3.1	....	.....
657.2	....	......	......	......	48.3	38.68	119.0	.....
76.0	(Less turkey, lamb, and bread left over)	......	......	......	7.9	2.06	23.6	.....
581.2	Divided by 130.....	......	......	......	40.4	36.62	95.4	.....
4.4	Per person, nutrients.	......	......	......	0.310 *Grammes.* 126.5	0.281 *Grammes.* 114.7	0.733 *Grammes.* 332.0	.....
......	....	......	......	......	....	....	....	2,946
	Daily average for the 6 months, nutrients	......	......	......	108.0	102.0	381.0	2,953

Average Daily Dietary for an Adult Man (Dujardin-Beaumetz)

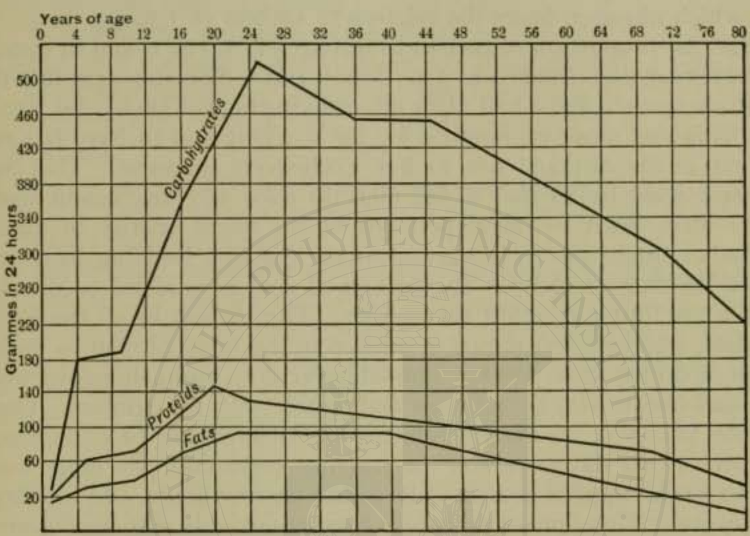
Albuminates..	124 grammes.
Carbohydrates..	430 "
Fat..	55 "

This would correspond with a bread-and-meat ration of—

White bread............................	819 grammes (about 28 oz.).
Meat...................................	259 " (about 9 oz.).

As a fair average for computation it may be said that 300 grains of nitrogen and 4,800 grains of carbon are daily required.

In order to obtain the nitrogen necessary for the system from a diet composed exclusively of starchy food—as, for example, potatoes—it would be necessary to eat ten pounds. If bread alone is eaten, four pounds would be required, and this contains more than twice the amount of carbon needed. About fifteen pounds of cabbage would have to be eaten for the same purpose. On the other hand, to obtain sufficient carbon from an exclusive meat diet at least six pounds of beef must be consumed. If eggs were used exclusively, about twenty-three pounds would have to be eaten. An ordinary lump of sugar is the food equivalent of an ounce of potato. A quart of milk, three fourths of a pound of beef, and five ounces of bread are all approximately equal in nutrient value.



Approximate quantity, in grammes, of different classes of foods consumed in twenty-four hours, computed according to age. (Mrs. E. H. Richards.)

The following table from Landois and Stirling is arranged to show the total quantity of each single food which it would be necessary to eat in order to obtain the requisite protein on the one hand (column A) and the requisite carbohydrates on the other (column B). For the purpose of comparison these authors estimate the necessary daily amount of carbohydrates at 448 grammes and the necessary proteids at 130 grammes:

	A.	B.
Rice	2,562 grammes.	572 grammes.
Wheat bread	1,444 "	625 "
Lentils	491 "	806 "
Peas	582 "	819 "
Eggs	968 "	902 "
Rye bread	2,875 "	930 "
Cheese	388 "	2,011 "
Potatoes	10,000 "	2,039 "
Beef	614 "	2,261 "

If a man doing hard labour were to attempt to live upon milk alone he would require fully ten pints a day to obtain the carbon necessary. Either of these quantities of food greatly overtaxes the digestive system. In fact, it would be wholly impossible for most people to eat meals of this character. The food would be too heavy; it would take too long a time to consume it, and it would be too monotonous. It becomes absolutely essential, therefore, for man to so regulate the composition of his diet as to properly balance its necessary chemical elements. This balance is best secured by a diet in which nitrogen bears the relation to carbon of 1 to 3.5 or 4. In bread the proportion of carbon to nitrogen is 3.0 to 1, and in meat it is reversed, and stands 1 to 3.5. Munk and Ufflemann state that the ratio between animal and plant albumin in the diet should be 3 to 7.

It is also more economical for the workingman to have fats and sugar in his diet and not to live exclusively on meat. The contractor soon learns that ill-fed men do poor and insufficient work. The force must be developed out of the latent energy of matter whether bricks are to be carried to the top of a building by a man or a hoisting machine. The carbon of coal is oxidised to develop force for lifting through the engine. The carbon in all the forms of fats, starches, and sugars is utilised in the body of man to enable him to do the same work. The labourer does right therefore when he eats bacon with his cabbage and treacle with his oatmeal. There is one fallacy in the above comparison that must not be overlooked, which is that the more fuel the machine consumes, the more work it does; this applies to man only within narrow limits, and too large a quantity of food promptly brings him into trouble with his digestive organs. (See Overeating.)

The amount of nutrient material required per diem by a healthy adult male doing moderate manual labour is summed up as follows:

	Voit.	Atwater.
Protein	118 grammes.	125 grammes.
Fat	56 "	125 "
Carbohydrates	500 "	450 "

This proportion is represented by Billings as follows:

Lean meat	20 ounces.
Bread	22 "
Potatoes	10 "
Three or four cups of coffee.	

According to Chambers, the average adult at ordinary labour obtains enough food in a day if he eats one pound of meat and two pounds of bread or its equivalent, provided no peculiarities of size, health, or climate are to be accounted for.

The average percentage of water in bread is 37 per cent; in cooked meat, 54 per cent; in vegetables, 70 per cent or more (Letheby).

"Assuming the food average as 23 water-free ounces daily and the mean body weight 150 pounds, the body receives $\frac{1}{105}$ of its own weight in water-free solids. The range in different persons is $\frac{1}{80}$ to $\frac{1}{120}$ of the body weight" (Parkes).

This problem may be differently stated, reckoning in the water with the solid food as follows:

A robust man weighing 144 pounds may consume $\frac{1}{24}$ of his body weight, or 6 pounds, in nourishment per diem, divided as follows:

Inorganic food—i. e., water and salts—3.5 pounds.

Organic food (animal food, 1 pound; vegetable food, 1.5 pound), 2.5 pounds.

It is usually better, unless active exercise is being taken, to eat a little less meat and more vegetable food, as previously stated, and to drink a little more fluid.

The average amount of dry food by weight required for breakfast may be put at 8 ounces, for luncheon 6 ounces, for dinner 9 ounces. The "middle diet" at Guy's Hospital, which is supplied to the majority of the patients, furnishes 29.5 ounces of solid food per diem in addition to liquids. Of course such persons are taking no active exercise. This is equivalent to 17 ounces of dry or water-free food. It consists of 4 ounces of meat (cooked), 12 ounces of bread, 8 ounces of potatoes, 1 ounce of butter, 0.75 ounce of sugar, 0.25 ounce of tea, and 2.5 ounces of milk.

Nitrogenous material should constitute "one fifth of the water-free food, or from 4 to 5 ounces for active life. The ordinary meat rations for soldiers is 12 ounces per diem, of which 20 per cent, or 2.4 ounces, is deducted for waste of bone, tendon, etc. For inactive life, from 3 to 3.5 ounces" (Pavy). This diet will completely replace the nitrogen eliminated from the body. "Two pounds of bread and three fourths of a pound of uncooked beef contain as nearly as possible the right proportion of carbon and nitrogen." This makes 44 ounces of solid food. Water-free meat contains about 0.20 per cent nitrogen.

Fat added to the daily diet in the proportion of about one ounce of butter not only supplies necessary force and tissue elements, but acts favourably in promoting the proper assimilation of the other classes of food and diminishing to a great extent the wear and tear of the tissues. With active work, especially in a cold atmosphere, more than double this amount is consumed with advantage, and even 2.5 ounces form an average allowance for many classes of workmen.

The carbohydrates are required in quantities between 14 and 22 ounces, their main use being to convey energy for heat and mechanical work.

The quantity of salts required for daily use varies from 0.5 to 1 $\frac{1}{12}$ ounce. This quantity is less affected by conditions of temperature and exercise than are other food constituents. Chaumont estimates that a man of 150 pounds can do an average day's work upon a diet of albuminoids, 4.5 ounces; fats, 3.75 ounces; carbohydrates, 18 ounces; and salts, 1$\frac{1}{12}$ ounce. These estimates are of water-free constituents.

Water.—The amount of water drunk per diem is usually less than should be taken. Many persons believe that it is injurious to drink much fluid with their meals and forget to take any between, and as a result not enough water is consumed to thoroughly dissolve and eliminate the waste matter of the system. The average quantity of urine voided is 52 ounces, 10 ounces more are lost from the surface of the lungs, and 18 ounces from the skin. This total of 80 ounces must be daily replaced to maintain the equilibrium of the body. The solid food of a mixed diet has been shown above to contain on the average 50 or 60 per cent of water, so that about 25 ounces of water are taken into the system daily as an integral part of the food. In addition, at least 55 ounces or more should be drunk either as plain water or in various beverages.

Another way of stating the above facts is that the average quantity of solid food (not water-free) which is required by adults is between 40 and 45 ounces per diem, and the total amount of food, including all fluids, should be from 95 to 120 ounces, of which three fifths or four fifths is composed of water, and the remaining one or two fifths of water-free substance. These estimates are only intended for general application, and there are necessarily many exceptions.

The ratio of solid to liquid food varies in health with the greater or less preponderance of fluids, the solid being more constant. It is commonly nearly 1 to 2, but many persons reduce it to 1 to 1.5, or even 1 to 1.

Muscular exertion demands an increase in both solid and fluid food, but the former is more essential than the latter, if the exertion be prolonged.

When a man does increasing work, unless his food be proportionately increased, he begins to consume his own tissues until their loss so weakens him that he is obliged to desist from a part, at least, of his labour. Should the disproportion between output and income continue, he becomes so enfeebled as to be liable to the inroads of hardship in various forms—especially those of cold and zymotic diseases.

It is estimated that in each twenty-four hours a man of normal health and physique absorbs, including the respiratory oxygen and water, about 7.25 pounds of material, which he eliminates in a corresponding quantity of waste, about three fifths of which is water.

One of the best means of determining the proper amount of food to sustain a man in good health is derived from a study of the experiences of arctic explorers. Their men are subjected to great hardships and feats of endurance, as well as to intense cold. From the nature of the expeditions no superfluous food can be carried, and yet the chief factor in success is the maintenance of good bodily vigour. For these reasons the rations for arctic travellers have been most carefully established, and a brief review of them will throw much light upon this interesting subject.

The Peary expedition to the north pole in 1887 used 19 ounces of solid food as the ration for the sledging expedition, but this soon proved to be inadequate in the cold of the arctic regions. Dr. Ray used 29 ounces, which also proved insufficient, and later 34 ounces of solid food. Various other expeditions have used 32 ounces of solid food, consisting wholly of pemmican, which has been sufficient.

Molintock, another arctic sledge traveller, used 40 to 48 ounces of food daily. Captain Neary's expedition used 38 ounces of solid food, proportioned as follows: Meat, 20 ounces; biscuits, 14 ounces; potatoes, 2 ounces; sugar, 2 ounces. To this were added chocolate, 1 ounce; rum, 2 ounces; and 1.5 ounce each of tea and tobacco with condiments, making in all 44 ounces of supplies.

De Long quotes from the physician to his arctic expedition that "alcohol proves a great advantage, keeps off the craving for food, preventing gnawing at the stomach, and has kept up the strength of the men as given—3 ounces per day." (This was during starvation, but, as stated on p. 236, alcohol is injurious to the maintenance of robust health in cold climates.)

While performing active exercise in the cold a diet of 1.5 pound of stewed deer's meat did not prevent hunger, but 1.5 pound of pemmican per diem, with one half ounce of tea and one half ounce of Liebig's extract of meat, supported life for some time. On leaving the ship and starting on their long sledge expedition, the following daily ration was allowed each man by Lieutenant De Long:

BREAKFAST

Pemmican	4 ounces.
Ham	1 ounce.
Bread	3 "pieces."
Coffee	2 ounces.
Sugar	$\frac{3}{8}$ ounce.

DINNER

Pemmican	8 ounces.
Liebig's extract	1 ounce.
Tea	$\frac{1}{2}$ "
Sugar	$\frac{3}{8}$ "

SUPPER

Pemmican	4 ounces.
Tongue	1 ounce.
Tea	$\frac{1}{2}$ "
Sugar	$\frac{3}{8}$ "
Lime juice	1 "
Bread	4 ounces.

While held fast in the ice, and still on the steamer, the average allowance of food per day was about four pounds, but some complained of being hungry on this ration. Several men suffered severely from lead poisoning from the solder used in canning tomatoes, traces of lead being found on examining the contents of the can. The acid of the tomato acts upon the solder, forming a soluble lead salt. The cans, however, had been kept for a period of two years before their contents were eaten (De Long). (See Canning, p. 284.)

In the voyage of the Jeannette to the arctic zone in the polar expedition of 1879–'81 a very liberal diet was allowed the sailors on entering the arctic regions, the average quantity of food allotted per man per diem being a ration of 5.5 pounds. Meat was furnished three times a day. Fat was supplied in the form of pork and butter, and bread and potatoes made the bulk of the starchy diet, constituting about two thirds of the whole amount of food. The diet at first included large quantities of condensed milk, butter, eggs, oatmeal, cheese, and macaroni, together with a great variety of canned fruits and vegetables and dried fruits, such as apples, peaches, dates, figs, prunes, and raisins.

In Lieutenant A. W. Greely's account of the expedition (Three Years of Arctic Service) he says: "The amount of food per man each day actually eaten in over two years at Fort Conger was as follows:

Meat	26.8 ounces.
Canned vegetables	10.0 "
Sugar and sirup	5.3 "
Farinaceous articles	13.6 "
Canned fruits	4.7 "
Dried fruits, preserves, fruit, butter, and pickles	2.9 "

"This aggregate of 64.3 ounces would doubtless be increased by coffee, chocolate, tea, spices, condiments, etc., to nearly seventy ounces. This amount may reasonably be assumed as the quantity of food necessary for the maintenance of a man's health in a latitude such as Conger (81° 44′ N.), where the actual temperature is 4° F. (20° C.)." He adds that tomatoes proved to be the most serviceable vegetable, and apples and peaches the best fruits. The beverages consisted of coffee, tea, chocolate, cider, and a small quantity of rum, the latter averaging two gills weekly for each man, which he regarded as beneficial from the effect it had upon the cheerfulness and good humour of the men. Meat in the above table included fat, in the shape of pemmican (four ounces), butter, lard, pork, and bacon.

The hours for meals were as follows: Breakfast, 7 A. M. Dinner, 4 P. M., and two lunches. The latter consisted of hard bread and butter, tea and coffee. The typical *menu* was as follows:

Breakfast.—Corn beef, oatmeal, fresh bread, chocolate, or coffee.

Dinner.—Vegetable soup, baked pork and beans, corn bread, stewed peaches, and coffee.

On sledging expeditions it was important to reduce the weight and bulk of the food to a minimum; accordingly in the Greely expedition of 1882 the daily allowance for sledging expeditions was thirty-nine ounces, to which was added an ounce of lime juice. The lime juice was carried solidified in the form of small squares, in which form it proved refreshing and invigorating to the exhausted men. This constituted the ration of the first year, 1882. Greely writes:

"On the above ration of 1882 parties kept the field for forty days in a mean temperature below zero 17.8° C., and returned in health and strength."

In 1883 the experience of the previous year led him to modify the ration by replacing part of the bread with butter and meat. This modified ration consisted of—

Meat	22 ounces.
Butter	2 "
Vegetables	4 "
Bread	10 "
Sugar	2 "
Milk	½ ounce.
Tea or chocolate	1 "
Salt	¼ "
Pepper	$\frac{1}{16}$ "

with an allowance of six ounces of alcohol for cooking the food of a party of three or four people; therefore the ration contained 40.5 ounces besides beverages. Greely says again: "Three fourths of the ration were about equal quantities of pemmican, bacon, and frozen musk-ox meat, while the balance was made up of canned sausages and corned beef in about equal quantities" (Three Years of Arctic Service, vol. i, pp. 202, 203). He suggests as a still further improvement that the vegetable ration should consist of three ounces of preserved potatoes, the remaining ounce being replaced by half an ounce each of milk and extract of beef tea, which is the best drink for the arctic regions. It should be chiefly used in the field in the form of an extract. A little coffee is preferable to chocolate.

The latter was found to induce thirst during the day. Tea should be compressed or used as an extract. Curry paste and other powerful condiments were also found serviceable. Alcohol was not considered necessary as a food.

During the third winter of his arctic expedition, from November 1, 1883, to June 23, 1884, Greely's per capita ration for his entire party was:

Meat	4.0 ounces.	Butter	0.5 ounce.
Beef extract	0.26 ounce.	Lard	0.26 "
Evaporated potato	0.4 "	Rice	0.1 "
Soup	0.6 "	Raisins	0.16 "
Tomatoes	0.3 "	Tea, compressed	0.3 "
Peas	0.2 "	Extract of coffee	0.44 "
Corn	0.2 "	Extract of chocolate	0.3 "
Carrots	0.1 "	Milk	0.2 "
Bread	6.0 ounces.	Mulberries	0.2 "
Dog biscuit	0.8 ounce.		

It is noticeable that alcohol is omitted from this ration. C. E. Borchgrevink (First on the Antarctic Continent, 1898–1900) made extensive use of dried vegetables, and such articles as ham, bacon, curry and rice, cheese, dried fish, sardines, jam, marmalade, and cocoa.

The usual estimate for the total quantity of all food material, including solids, water, and respiratory oxygen as well, which is consumed by a healthy adult male per annum is one and a half ton.

Following is the estimate of total food supply for eighteen months for one man in the Yukon region. The total weight, about one ton, is considerably less than that of food ordinarily eaten, owing to the fact that fruit and vegetables must be carried in an evaporated condition.

"The chief items are 600 pounds of flour, 300 pounds of bacon, 150 pounds each of beans and sugar, 75 pounds each of rolled oats or other mush material and cornmeal, 50 pounds of rice, six dozen cans of condensed milk, 35 pounds of butter in sealed cans, 150 pounds of evaporated vegetables, 100 pounds of evaporated fruit, 50 pounds of prunes and raisins, 30 pounds of dried fish, 40 pounds of coffee, with baking powder, soda, salt, pepper, ginger, mustard, yeast cakes, tea, soap, matches, lime juice (very important), dried beef, extract of beef, soups in tins, sausage, tobacco, etc., as desired, bearing in mind always that variety of food promotes health. There has been more or less said in the newspapers about various concentrated foods, but, with the exception of evaporated vegetables and fruit, condensed preserves, condensed milk, and beef extract, nothing yet has been brought forward which has been proved desirable. One cannot afford to experiment with his stomach in Alaska." (New York Evening Post, July 6, 1898.)

Men eat about two thirds of all the meat, and women one third. Men consume about four fifths of all the alcoholic beverages, and women one fifth. The latter consume much more tea than men.

Soyer has computed tables of the total quantity of foods consumed by a man during his lifetime. He estimates that a man during sixty years of life after early childhood eats 33¾ tons of meat, vegetables, and farinaceous food, and that an ordinary man by the time he has attained to seventy years has consumed 30 oxen, 200 sheep, 100 calves, 200 lambs, 50 pigs, 1,200 fowls, 300 turkeys, 24,000 eggs, 4.5 tons of bread, and 3,000 gallons of tea and coffee.

Starvation and Inanition

Starvation, or asitia, is a term which technically applies rather to the lack of sufficient food for the maintenance of the body, while inanition means the lack of assimilation of food by the tissues. Where there is defective absorption, food may be furnished to the system in abundant quantity, but inanition results from lack of ability to absorb and develop force and nutriment from it. The interval through which different persons can subsist without food depends upon: 1, External conditions of temperature and moisture; 2, the amount of work being performed; and 3, the existing condition of the body.

1. The maintenance of a uniform warm external temperature prolongs the period through which man can endure abstinence from food. Exposure to cold accelerates starvation symptoms by reducing the vitality of the body and the resistance of the system. Moisture in the air, by preventing evaporation from the surface of the body, prolongs the period of starvation which can be endured.

2. Persons who refrain completely from exercise can live far longer without food than when undergoing active work. Self-forgetfulness in times of famine, by diverting the mind from the sufferings of the body, tends to prolong life.

3. Well-nourished persons can endure longer intervals of abstinence from food than the weak or diseased. The distress of delirious or apparently insensible persons may be augmented by lack of sufficient food. Sex has no influence with the effects of starvation, but they are most keenly felt at the extremes of age, by young children, and senile subjects.

Those who have the most fat stored in their tissues call upon this supply to maintain the energy of the body in the absence of food, and, having a larger supply than thin or emaciated persons, they can endure starvation much longer, although they may complain more bitterly of the pangs of hunger than invalids, who are accustomed to a low diet. Chossat's experiments with starving animals proved that while they lost 40 per cent of body weight, the loss of fat alone reached 90 per cent, being greatly in excess of that of any other substance. Anselmier fed starved dogs upon their own blood, and succeeded in thus prolonging their lives for three or four days beyond the usual limit, and life lasted until 60 instead of 40 per cent of their body weight had been lost.

When food is wholly withheld, life cannot be prolonged beyond six to ten days in the majority of instances. During the winter of 1876–'77 an accident occurred in a colliery in South Wales by which four men and a boy became imprisoned for ten days without food. At the expiration of this period they were found alive, and, although very feeble, they were able to walk when released. They had had a supply of water, and the atmosphere in which they were confined was moist. At another colliery accident in Wales a number of men were confined in a mine for six days without food, and, although their sufferings were extreme, nearly all were able to walk out on being rescued. As a result of an earthquake in Calabria, Sicily, in 1783, several persons were imprisoned in falling ruins. A girl of eleven years survived, having been six days without food, and another girl of sixteen years survived after eleven days of starvation.

The lack of food may be endured with far less torture if water is applied in abundance to the system. When water is withheld in addition the body loses weight much more rapidly, the tissues become dry, the thirst excessive, the secretions are suppressed, and the suffering is greatly intensified.

VOLUNTARY FASTING

Of late years several persons have attempted prolonged feats of starvation, tempted by love of notoriety or desire of gain, by exhibiting themselves for the gratification of public curiosity. In several instances they have been carefully watched by medical experts and there is every reason to believe that the fast has been conducted with honesty. In at least two of these authenticated instances, those of Tanner and Succi, the complete starvation period has been prolonged for over forty days. In both cases fluids were allowed, and one of the men relieved intense epigastric pain and food craving by condensed medication.

Succi was an Italian who, in 1890, undertook an absolute fast of forty-five days, during which period he lost 42½ pounds and drank 1,154 ounces of water, or an average of about 25½ ounces per diem. This he took in the forms of plain water, mineral water, and ice. He became alarmingly emaciated during the fast, but even on the last day had strength to walk about the room. He resumed eating by first taking cocoa, and subsequently bouillon and other light articles, and made a complete recovery. His mind remained clear throughout. He took occasional doses of a few drops of an elixir supposed to contain opium.

There have been a number of cases from time to time recorded of " fasting girls." They are usually of nervous hysterical temperament. On reaching the age of puberty they become dyspeptic and grow shy and disinclined to eat what is good for them, although they may gratify abnormal cravings surreptitiously. They are very apt to be at the same time strongly impressed by religious beliefs, and in their disordered mental condition to acquire the delusion that it is sinful to eat. This delusion becomes fixed, and they then are regarded as " freaks " and achieve much newspaper advertising. They should be treated as ordinary cases of hysteria simply, and be removed from oversympathetic friends and dealt with kindly but firmly. Hydrotherapy yields excellent results, and even a good spanking may not be amiss in awaking the patient to a realising sense of her errors. The claim sometimes made in such cases as those just described, that they lose no weight, is nonsensical, for the body must diminish in weight continually by evaporation of water from the lungs and skin and its passage from the kidneys and by the exhalation of carbon. Edward Smith estimates that the quantity of carbon exhaled in one day of fasting is equivalent to that contained in twenty ounces of bread.

When either voluntary or forced starvation takes place very gradually, especially in elderly people, their systems become slowly accustomed to very small quantities of food.

Luigi Cornaro was a Venetian gentleman who advocated a very abstemious diet, and whose own case is often cited in illustration of the smallest quantity of food which may support life. He was born in 1463; after a reckless and intemperate youth he reformed, and by careful dieting prolonged his life to one hundred and three years. He published a Treatise on a Temperate Life, and for the last forty-eight years of his own existence he subsisted on a daily allowance of twelve ounces of vegetable food with fourteen ounces of light wine. He occasionally ate eggs, but rarely took any other form of animal food.

There is much wisdom in some of his doctrines, but, unfortunately, no one else who has attempted to practise his rules has met with similar success in prolonging life. The majority of mankind would undoubtedly prefer to live fewer years for the pleasure of being less abstemious.

Periods of voluntary fasting of greater or less duration are recommended and practised by devotees of many religious sects. Such fasting was formerly carried to a greater extent by ascetics than at the present time. As a means of mental discipline or cultivation of will power, fasting may in some instances be defended, but fasting " to be useful must be voluntary " (Chambers), otherwise it is apt to cause irritability of temper, and it may even lead to deception to obtain food. Such fasting may be carried to an excessive and injurious degree unless it be definitely limited and supervised. It is more powerful in its effect, moreover, if it is but seldom undertaken. If a man so reduces himself by fasting that he cannot use his intellectual faculties with accustomed vigour he may be sure that he is doing himself injury. Better than complete fasting for purposes of mental discipline or religious motives is the temporary elimination from the diet of accustomed luxuries, or giving up such articles of daily use as butter, sugar, salt, wine, tobacco, etc. This, in fact, is a custom practised by many persons during the Lenten season.

The day has long since passed when fasting can be regarded as favouring either clearness of intellect, muscular strength, or endurance, and, as Gerland has said, "the ethnologist can trace the physical and mental decay of whole nations to a long course of insufficient food."

Dr. Denis, of Brussels University, presented an interesting report at the International Congress of Anthropology for 1892, showing striking parallelism in the curves of famine and crime, and of marriages as inversely related to the price of wheat.

Symptoms.—The symptoms which result from complete starvation are characteristic. If food is suddenly withheld, the sensation of hunger gradually increases at first, becomes extreme, lasts for two or three days, and slowly disappears. It is accompanied by a gnawing pain in the epigastrium, which is relieved on pressure. The pain may disappear with the hunger, but it is followed by a sensation of extreme weakness or faintness, which is both local in the stomach and general throughout the body. The sensation of thirst, on the contrary, when all fluid is withheld, persists until death or until the subject becomes insane or unconscious.

When food is gradually withheld, urgent hunger may not be felt at all, but the longer and more severe the fast, the more difficult does digestion become. The circulation grows feeble, the heart action rapid, the respiration shallow and possibly slow and irregular. There is apt to be some thirst, even though water be supplied. If it be withheld, the torture becomes unbearable. Constipation may be succeeded by diarrhœa, but it more often remains complete. The facies are typical, the expression is anxious and staring, the orbital fat disappears, and the eyes are greatly sunken and finally become glassy. Corneal ulceration may be present. General bodily emaciation ensues, the muscles are soft and reduced in size by more than one half, and the abdominal viscera to a similar degree, the skin becomes pale, loose, and, from change in the secretion of perspiration, emits a peculiar fœtor and acquires a clay-like colour. The feet and ankles may swell, owing to the enfeebled circulation.

The victims become so ravenous that all sense of taste gives place to the intense hunger. Upon one of the recent unfortunate arctic expeditions, on one occasion, the tea being accidentally omitted from the kettle, dirty water was drunk by the starving men without recognising the difference. The secretions are altered, and become inactive. The urea excretion falls to one fourth the normal. The total volume of blood is diminished, and anæmia is extreme.

The body temperature begins to fall in the first day of the period of starvation, and continues falling, so that a loss of ten or more degrees below the normal of 98.6° F. may occur.

In extreme cases muscular action is no longer possible; there are vertigo and faintness on raising the head, the voice is lost, and gradually the nervous system succumbs to languor and general prostration; the mind becomes more and more dull, listless, and even idiotic, the victim being unable to describe his condition or express his wants. He may have hallucinations, insomnia, and dreams, in which are often pictured scenes of plenty.

The sufferings produced by slow starvation distract the mind and render connected thought difficult. If long continued, the mind becomes unbalanced, and men who have been shipwrecked and left to wander in the open sea in rowboats for a long time without food usually become delirious, or even maniacal, within four or five days.

In 1874 three men and two boys were castaway for twenty-two days in an open boat. They had at first ten days' provisions, and subsequently nothing but old boots and jellyfish, and they fought violently with each other in the delirium which ensued (Chambers).

During prolonged starvation the most important organs of the body are nourished at the expense of others, especially of the skeletal muscles. For example, in an animal starved for thirteen consecutive days it was found that while the muscles lost 30 per cent in weight, the brain lost but 3 per cent and the heart but 2.5 per cent.

The ultimate effects of starvation are identical whether the process be gradual or rapid, occupying days or years, and death results when the body has lost six tenths of its weight. It may occur while the victim is in stupor or coma from cardiac failure or, possibly, in convulsion. The actual cause of death has by many been attributed to the loss of body heat. While this is undoubtedly a contributing factor, it is more reasonable to suppose that it is due to the general inanition of the muscles and nerves and the progressive enfeeblement of the heart action. The heart muscle not infrequently will be found to have undergone fatty degeneration. It is, however, true that in animals kept warm by artificial means the advent of death from starvation may be considerably postponed.

While undergoing starvation the blood is reduced in volume proportionately with the loss in body weight, but it nevertheless maintains the balance of its normal average composition (Panum and Voit).

Hunger is not always a reliable guide as to the need of the system for food. Some dyspeptics are always hungry and eat more than they can digest. Hunger begets a habit of too rapid eating, and more food may be taken than is necessary, because it has not had time to be absorbed and reach the tissues before the meal is over. Moreover, hunger may be temporarily appeased by eating other substances than food, like bits of old leather, for example, which appear to act mechanically in the stomach. For this purpose men rendered insane by hunger will sometimes swallow all manner of useless and harmful substances, such as buttons, pieces of metal, pebbles, etc.

No more graphic and pathetic account of the miseries of starvation exists than is found in the journal of Lieutenant De Long, commanding the expedition of the Jeannette, which visited the arctic regions in 1879–'81 (The Voyage of the Jeannette, Journals of George W. De Long, 1883). After leaving their sinking vessel the members of the expedition were exposed, at first in open boats, and later in their long sledge journey, to the most exhausting work and to intense suffering from cold and wet. They frequently dragged their sleds in severe storms for ten or twelve miles a day, while subsisting solely upon half a pound of stewed deer meat, with a little tea three times a day. This food being exhausted, they were obliged to consume the meat of their last remaining dog, which they ate fried. They subsisted upon this food exclusively for four days longer, having an allowance of but half a pound a day, and finally their last journey of twenty-five miles was performed with no other nourishment than a few ounces of alcohol and an infusion made from some old tea leaves. During this time their intense suffering from hunger was partially alleviated by chewing scraps of deer skin, which, from its bulk in the stomach, seemed to afford slight relief.

The alcohol being exhausted, they lived for another day upon a teaspoonful of olive oil, with a breakfast composed of an infusion made from the arctic willow (containing really no nourishment) and "two old boots." After this the men, becoming weaker and weaker, were unable to proceed farther on their journey, being driven back by intense cold and the difficulty of crossing the partially unfrozen rivers. Their feebleness gradually overcame them, until one by one they died of inanition. Four men survived for sixteen days upon absolutely no food whatever, and possibly their sufferings were even further prolonged, but the journal of their gallant and heroic commander ceased at this point, for he, too, died.

In the starvation which overtook the members of the Greely party on the Lady Franklin Bay Expedition, and caused the death of a large number of the company, attempts were made, as in the case of the Jeannette expedition, to relieve the agonies of hunger by filling the stomach with indigestible material of various kinds. The skin sleeping bags were roasted or boiled and eaten, and even oil-tanned skin was consumed, while the sufferings of the men were aggravated by the presence of game in sight but out of reach. A few shrimp and lichens were obtained and stewed with seal skin. At this time, although it was summer, the temperature was occasionally below the freezing point, but during part of the two years spent in the vicinity of Fort Conger it was sometimes $-40°$ or even $-60°$ F.

During the siege of Paris in 1871, when thousands of the inhabitants were reduced to starvation, it was found that a diet which was barely sufficient to support life consisted of ten ounces of bread with one ounce of meat.

In prisons the diet limit has often been reduced too low. It may be sufficient to maintain life, but if hard labour be inflicted, weakness, sickness, and death will inevitably follow. In an overcrowded prison a daily ration of twenty-eight ounces of unbolted meal and five ounces of bacon has been known to cause death by slow starvation. As a means of discipline a starvation diet is sometimes enforced in penal institutions for a few days, and it is usually quite as efficacious as corporal punishment. A diet which is designed to effect its aim by monotony as well as reduction in quantity, but without reaching the limit of cruelty, is the following, which has been used at the United States military prison at Fort Leavenworth:

Breakfast.—Hash or stew, 8 ounces; bread, 7.5 ounces.

Dinner.—Soup, 8 ounces; bread, 7.5 ounces.

After twenty continuous days of this diet eight ounces of bread are allowed for supper. This diet has been found to make the most refractory men soon manageable. (See Diet in Prisons.)

Treatment.—The treatment of persons rescued from starvation must be conducted with the utmost care. The digestive system is so enfeebled that to allow them to yield to the cravings of returning appetite is to insure immediate death by overburdening the stomach and circulation. The body should be kept warm and in absolute rest, and warm fluid nourishment in minute quantities—half teaspoonful doses of beef peptones or meat juice—may be given at intervals of fifteen minutes or half an hour. If no vomiting or evil symptom results, small quantities of peptonised milk may be tried at half-hour intervals. Alcoholic stimulants in any quantity are to be avoided, but a few drops of brandy or whisky may be given from time to time in water. If the stomach is irritable, nutrient enemata should be employed. The following day the quantity of food may be slightly increased, but if emaciation is extreme and enfeeblement is pronounced, the patient must be kept upon a fluid diet for ten days or more. Easily digested forms of starchy food may then be added, such as dry bread, arrowroot, gruel, and the like.

FAMINE

When starvation occurs upon a large scale, affecting a community with famine, pestilence is sure to accompany it. Disease has always been rampant in Ireland when the potato crops have failed, and in India when the grain supply has given out. Much of the illness which occurred in the early history of the Crimea was due to insufficient food, and in the Middle Ages the ravages of pestilential diseases, such as typhus, smallpox, the plague, etc., were always worst in times of general starvation. The history of epochs of famine in siege or otherwise is always accompanied by outbreaks of violence, for hunger begets ill-temper, vice, and crime. This has occurred of late years, notably in Athens, Florence, and London, and in Paris during the Commune.

Nothing predisposes man so much to all forms of infectious disease as starvation and inanition. This is so well known that physicians and nurses in charge of contagious cases are particularly cautioned to eat well and not expose themselves to infection while suffering from fatigue and lack of food.

Improperly Balanced Ingredients of Diet

Improper diet is often quite as injurious as slow starvation, for a person who eats a large bulk of food of one class, to the exclusion of other classes, may delude himself by thinking that he is taking nourishment enough on account of the degree of satiety which he derives from his diet. " The outward appearance of such persons is to a certain extent characteristic, marked generally by a pale and puffy aspect, due partly to a general excess of water in the tissues and partly to an abnormal deposition of fat " (Bauer). The evil result of such diet is very apparent among infants and growing children who have been fed upon a large bulk of farinaceous food to the exclusion of milk, meat juice, etc., and in them the foundation may be laid for the development of scurvy, or scrofula, or tuberculosis, and sometimes also the stomach and bowels become permanently distended. (See Diet for Infants and Children.)

The effects above described are commonly produced by excessive ingestion of starchy and saccharine foods to the exclusion of protein, and, on account of the cheaper cost, the children of the poor are more apt to be injured in this manner than the rich, among whom the opposite diet—an excess of nitrogenous aliments—is more common. The latter sometimes gives rise to circulatory disturbances, overworks the kidneys, and produces nervous irritability.

It has often been observed by dietists that proportionately more fat is consumed in the United States than in Europe, and some are inclined to attribute to this form of food some influence upon the greater activity which characterises Americans. It is extremely doubtful whether this has as much to do with it as climatic and other conditions of environment.

Taken by themselves, carbohydrates have little or no effect in deferring death from starvation, but with albuminates they act as tissue sparers. (See Force-producing Value of Foods, p. 21.)

Mrs. Richards gives the following useful comparisons of food composition, showing particularly the inefficiency of fluid diets other than milk to support life:

	Proteid.	Fat.	Carbo-hydrate.	Calories.
Three quarts of milk	102.0	108.0	132.0	1,953.0
Three quarts of beef broth or *consommé*	123.0	3.0	.....	532.0
Soup of Munich Hospital	21.6	21.6	108.0	730.0
Rations recommended in certain invalid receipt books	24.5	28.5	65.6	631.0
Rations recommended in another receipt book	66.5	23.5	83.5	831.0
Prausnitz's estimate of normal ration for man	110.0	50.0	350–400	2,350.0
Prausnitz's estimate of normal ration for woman	100.0	50.0	300–350	2,100.0
Estimated life ration	75.0	40.0	325.0	2,000.0
Maximum work ration	125.0	125.0	450.0	3,500.0
Minimum work ration	110.0	90.0	420.0	3,000.0
Common invalid ration too low in protein :				
1 pint beef juice, containing 7 per cent	31.5	.....	......	129.0
1 pint whole milk	17.0	18.0	22.0	325.5
1 quart flour gruel, made with whole milk.	18.2	18.2	38.0	397.9
2 quarts of liquid. Total	66.7	36.2	60.0	852.4

PART IV

FOODS REQUIRED FOR SPECIAL CONDITIONS

AGE AND FOOD.
INDIVIDUAL SIZE AND FOOD.
BODY WEIGHT AND FOOD.
SEX AND FOOD.
DIET AND HEREDITY.
DIET AND RACE.
CLIMATE AND SEASON AND FOOD.

AGE AND FOOD

FOOD IN CHILDHOOD

A CHILD at three or four years of age actually consumes nearly one fourth as much food as it requires at adult life, for during this process tissue growth is very rapid, and if the child be in health, the bodily activity is relatively very great. An active child at twelve or fifteen years of age who is growing fast and who is freely exercising may require and assimilate as much food as a man past middle age, and insufficient food and food of defective quality and composition work proportionately far more harm during the growing age.

Inquiries made in this country in regard to the diet of older children and young adults demonstrate that it contains a proportionately large quantity of fatty food—much more than is customarily consumed in European countries. This is in great part owing to the habit of eating considerable butter, which, generally speaking, the better circumstances of Americans enable them to obtain.

The following table from the investigations of the Munich School gives:

The Minimum Amount of Food Necessary for Different Ages

AGE.	Nitrogenous substances.	Fats.	Carbohydrates.
	Grammes.	*Grammes.*	*Grammes.*
Infant until one and a half year	20–36	30–45	60–90
Child from six to fifteen years	70–80	37–50	250–400
Man (moderate work)	118	56	500
Woman	92	44	400
Aged man	100	68	350
Aged woman	80	50	260

The special diet regulations for infancy and childhood are described at length under the headings Diet in Infancy and Diet in Childhood.

Food in Adult Life

The nature and quality of the diet appropriate for adults must depend somewhat upon individual constitution, occupation, habits of life, and to some extent upon the climate in which they live.

The full adult weight is not usually attained before the twenty-fifth year, although in some cases it is reached earlier. In many instances adults after the age of forty or forty-five years increase considerably in weight. In men the bones continue to solidify until about the thirtieth year; in women this condition is usually reached a few years earlier. When the final growth of the body and development of the vital organs is completed the use of food consists simply in maintaining the proper equilibrium of the tissues by replacing waste with new material and in furnishing fuel for the development of force, the food being no longer required for growth. Many persons eat more than is required for these purposes.

As men advance in life, become prosperous, and acquire more and more luxurious habits of living or become absorbed in various occupations, they are apt to take less exercise, while the number of luxuries of the table which their means enable them to command constantly tempt them to indulge in food which is not needed and which is imperfectly consumed in the body.

Sir H. Thompson writes (Diet in Relation to Age and Activity): "More than one half of the disease which embitters the middle and latter part of life among the middle and upper classes of the population is due to avoidable errors in diet."

It is often difficult for a man between the ages of twenty and thirty years who has led an exceptionally active and vigorous or perhaps even an athletic life to realise, as he grows older and passes on towards forty-five or fifty years of age, that he requires less food to maintain his organic equilibrium than formerly, and his habits of eating acquired at a more impressionable period of life cling with great pertinacity. It may prove an advantage sometimes in such cases to lessen the appetite for dinner by a late lunch, or to try other simple means of restriction.

These observations fail of application to the poor, whose means do not allow them to gratify their appetites, and in the case of those whose diet is established for them. There is quite as much, if not more, ill arising from deficient feeding as from overfeeding; in either case the difficulty is only made serious by long continuance, and occasional great indulgence in overeating as in overdrinking is less productive of harm than habitual indiscretions of a lesser degree. So much is due to habit in the different organs of the body in relation to food that the stomach and intestine will usually reject undigested the contents of an occasional excessive meal, whereas with habitual overeating they become accustomed to appropriating very large quantities of food, which are absorbed, but which are not eliminated without straining the excretory organs, or which may be stored in the body in the form of incompletely oxidised material, which accumulates until the system rebels and a violent bilious attack by vomiting and purging relieves the overburdened body. There are persons who have so little restraint over their appetites that they persistently indulge themselves in this way.

Food in Old Age

In old age there are inevitable changes which slowly occur in the circulatory and digestive organs of the body. Although the general health may still be unimpaired, the circulation is less vigorous, and the nervous system less active to external stimulation. There are degenerations in the secreting organs with a tendency to deposition in the tissues of phosphate and carbonate of lime, derived from the food. Absorption is less active, and there is diminished adaptability of the whole system to alterations in environment, and much less ability to meet the requirements of emergencies, such as sudden calls for the use of muscles or mental strain. The muscular tone of the intestine is apt to deteriorate and produce constipation and a relaxed condition resulting in its dilatation. The circulation through the mesenteric vessels and those of the portal system becomes inactive, with a consequent reduction in the rate of absorption, and a diminished and altered gland secretion in the liver, pancreas, etc.

For these reasons the digestive powers are less vigorous, but, on the other hand, there is not so much demand for fuel in the body as in earlier years. The vital processes conducted by the circulation, respiration, and metabolic changes in the tissues are very inactive, and there is a correspondingly restricted expenditure of energy.

Persons of very advanced age—those who are past eighty years or more—can sometimes live comfortably on an astonishingly small quantity of food. J. Forster examined the food of the inmates of an institution for elderly widows and found that many of the old women subsisted very comfortably upon a diet containing, in grammes, albumin, 67; fat, 38; and carbohydrates, 266.

Much depends, however, upon the rapidity with which the changes above described have developed, and dietetic rules for such cases are not to be based upon a definite period of years so much as upon the degree of senility which is present in individual cases.

Sir Henry Thompson (Diet in Relation to Age and Activity), in commenting upon the progressing diminution with advancing years of physical energy and of the power to eliminate waste material from the body, and the consequent harm of overeating, says that if a man past his half century of life "continues to consume the same abundant breakfasts, substantial lunches, and heavy dinners which at the summit of his power he could dispose of almost with impunity, he will in time either certainly accumulate fat or become acquainted with gout or rheumatism, or show signs of unhealthy deposit of some kind in some part of the body—processes which must inevitably empoison, undermine, or shorten his remaining term of life. . . . The typical man of eighty or ninety years is lean and spare, and lives on slender rations."

In the dietetic treatment of cases of extreme old age the rules which are naturally suggested are:

1. To diminish the total quantity of food ingested.
2. To give food at frequent intervals in small amount.
3. To give only easily digestible food, which does not produce too large a residue of waste matter, either in the intestinal canal or in the form of excrementitious material in the blood.

It is an undoubted fact that, having reached an advanced age, a man may often prolong his life and greatly add to the comfort of his remaining years by adhering to these rules. Yet there are many instances of those whose constitutional vigour is so great and whose appetite for the good things of the table remains so keen that they are unable or unwilling to listen to the dictates of reason. I recollect an instance of a gentleman who, in the enjoyment of almost perfect health at the advanced age of ninety-four, suddenly terminated his life by an uncontrollable indulgence in lobster salad. The idea is prevalent with some people that the quantity of food and stimulants should be increased *pari passu* with age, but this is as wrong in theory as it is pernicious in practice, and the simple fact that an article of particularly rich or hearty food has been enjoyed with impunity for many years is no argument that it can be indefinitely taken in the same degree, although this reasoning is very often encountered.

In commenting upon Professor Humphrey's report upon centenarians, made for the British Medical Association, Dr. Yeo observes: "Their habits in eating and drinking tended, as a rule, to great moderation in both. . . . Of animal food the majority took but little. . . . The exact quantity is mentioned in nine instances: One took 12 ounces, one 6, one 5, and six 4 ounces daily. In the use of alcoholic drinks we also find evidence of great moderation."

Some more recent investigations of the dietetic habits of men over one hundred years of age show considerable diversity; thus, for example, some were found who ate but one meal a day, while others ate four or five; some drank but little fluid, others took a great deal; some were total abstainers from alcohol, and others were not.

Persons who attain to very advanced age are almost invariably of spare habit, and the universal testimony in regard to centenarians is that they have never abused food or drink, and that in the latter years of life, at least, they have been very abstemious in the use of meat. In fact, Nature usually furnishes a hint in this direction by depriving them of their teeth, making it practically impossible to eat animal food, which requires mastication, and, as Yeo suggests, "if artificial teeth are used for the purpose of continuing a diet composed of animal flesh, they will not prove an unqualified advantage."

Next in importance to diminishing the quantity of food in the diet of the aged (especially the proportion of fats and proteid material) should be considered the necessity of regularity in diet, both in regard to the general character of the food taken and the times of eating.

If the teeth are absent, tough vegetables and meats must be avoided, yet the food should not be wholly fluid, for some mastication should be performed in order to maintain the salivary flow. Plenty of time should be allowed for this purpose.

Any sudden changes in diet should be avoided, and the intervals between the ingestion of food should not exceed six or eight hours.

It is very common for elderly people to awaken early in the morning at three or four o'clock and to be unable to drop off to sleep again, but if they have some light form of nourishment at the bedside, such as a glass of milk or a little gruel, which they can take at that time, they will often continue their sleep.

Malt liquors are very good for the aged, and a moderate amount of alcohol acts as a tonic and supplies them with needed energy for digestion and other functions.

Yeo gives the following suggestions in regard to the diet of the aged, which are so useful that they will be quoted in full:

"Of animal foods best suited for this time of life the following may be mentioned. When the organs of mastication are altogether inefficient these foods should be minced or pounded into a paste or otherwise finely subdivided:

"Young and tender chicken and game and other tender meats.

"Potted chicken, game, and other meats, sweetbread.

"White fish, as soles, whiting, smelts, flounders, etc. Best when boiled.

"Bacon, grilled; eggs lightly cooked or beaten up with milk.

"Nutritious soups, such as chicken or fish, *purées*, beef tea, mutton and chicken broths.

"Milk in all forms, when easily digested.

"Beef tea and milk supply the needed mineral substances, and the former is an excellent stimulant.

"The addition to milk of an equal quantity of Vichy water, warm, or of warm water, will often help to make it agree.

"Of vegetable foods the following are all suitable:

"Bread and milk made with the crumb of stale bread and without any lumps.

"Porridge and oatmeal gruel.

"Puddings of ground rice, tapioca, arrowroot, sago, macaroni with milk or eggs and flavoured with some warm spices, or served with fruit juice or jelly; bread and butter, at least a day old; rusks for soaking in tea, or milk, or water.

"Artificial foods, consisting of predigested starches. The digestive ferments are scantily provided by the digestive organs at this age, and soluble carbohydrates are valuable for maintaining the body heat.

"All farinaceous foods should be submitted to a high temperature for some time, so as to render the starch granules more easy of digestion.

"Vegetable *purées* of all kinds may be taken in moderation—e. g., potatoes, carrots, spinach, and other succulent vegetables.

"It is important that the use of potatoes and fresh vegetables should not be neglected; otherwise a scorbutic state of the body may be engendered.

"Stewed celery and stewed Spanish or Portugal onions.

"Stewed or baked fruits and fruit jellies and the pulp of perfectly ripe raw fruits in small quantity.

"The acidity of certain stewed fruits may be advantageously neutralised by the addition of a little bicarbonate of soda so as to avoid the use of a large quantity of cane sugar to sweeten it, as this is apt to cause gastric fermentation and acidity. In stewing fruit, about as much soda as will cover a shilling should be added to each pound of fruit.

"Aged persons often require their foods to be accompanied with some kind of condiment, which promotes their digestion and prevents flatulence.

"Caviare and the roes of smoked and salted herrings are of this nature.

"For sweetening food, milk sugar is much less prone to excite acid fermentation than cane sugar.

"A very digestible form of fat—when it is needed—is cream, mixed with an equal quantity of hot water and about ten drops of sal volatile to each fluid ounce."

INDIVIDUAL SIZE AND FOOD

The size of the body has more influence than its weight upon the quantity of food consumed. In infant feeding the relationship is made the subject of careful study (see Infant Feeding), but in adults there is more variation. As a general rule, persons of large frame eat in proportion to their size, and vice versa, but there are many exceptions familiar to all, and some very corpulent persons are very abstemious at the table. Because most persons eat more than they really need, a man of large frame can often eat less than one of small size, and yet have plenty.

Attempts have been made to demonstrate that a preponderance of animal or vegetable food respectively, or of some particular system of diet, influences the stature of men. Of course, children who receive insufficient food or food poor in quality may be half grown, but beyond that fact theories as to the specific influence of different classes of food upon the development of the body are founded upon ignorance of the natural history of the different races of man. The diet of Bushmen, Australians, and Fuegians presents instructive examples of tribes with large or small bodies, demonstrating that "it is not quality or monotony of food, but its quantity that affects development" (Gerland).

BODY WEIGHT AND FOOD

The question as to how far gain or loss in the body weight may be taken as an indication of the appropriateness of diet is important. In prescribing systems of diet for many diseases, such as dyspepsia, obesity, diabetes, phthisis, etc., it is very desirable to have the patient weighed systematically at least once a week, and good scales are very useful in the physician's office. Care should, of course, be observed that changes in clothing are not allowed to interfere with the accuracy of the observations. Loss of weight, under some conditions, may be much more rapid than gain ever is. The latter at best does not usually proceed at a rate of more than two or three pounds in a week, even during convalescence from such an illness as typhoid fever; but in diseases like cholera, for example, in which emaciation is extremely rapid, the loss of weight may amount to two or three pounds a day, or possibly more.

In some diseases a fallacy arises in comparing food consumption with body weight. In fevers there is usually loss of weight, but this is not always the case. Sometimes in aseptic fevers the weight may remain uniform; and in phthisis there is sometimes uninterrupted gain during a moderate hectic. Leyden has found that in fever, while the albuminous ingredients of the body are diminishing, there may be more water stored in the tissues, and in cases of anasarca and dropsical accumulations of rapid development it is quite possible for the weight to increase, while in reality the body is rapidly wasting away, and it would be a very grave mistake to deduce any conclusions for feeding the patient from the weight alone. Another important consideration is the rapidity of loss of waste food products from the body.

The normal weight of fæces which should be voided each day is five or six ounces—about one fourth of which is solid matter, the rest water. Many persons do not pass over half this quantity for days together, and thus go on accumulating waste material, which adds to their weight. The same disproportion between food ingestion and the elimination of urea and different salts in the urine may exist. Moreover, the loss of weight by excessive perspiration may reach a pound or two a day. Athletes subjected to violent physical strain and stokers working in great heat—sometimes of 120° F.—may lose two pounds in an hour in this manner. The night sweats of phthisis cause considerable actual loss in weight, besides the exhaustion which they occasion. The loss of weight through the aqueous vapour and carbon dioxide in the lungs may vary somewhat, although it is less changeable than might be supposed.

For all these reasons it is necessary to be somewhat cautious in accepting conclusions from the scales for application in ordering more or less food, or altering its character.

The weighing of infants immediately before and after nursing at the breast is an excellent and fairly accurate method of determining how much food they are getting, and infants whose nutrition gives any cause for anxiety should be frequently weighed, for in them, for obvious reasons, the record of slight variations in weight can be much more accurately utilised in regulating feeding.

SEX AND FOOD

The relation of sex in regard to food affects the quantity rather than the quality, excepting among a few rude tribes where superstition is allowed full sway. The northern Eskimos, for instance, have a belief that if women eat eggs they cannot become pregnant, which is in curious contrast to the reputation for aphrodisiac effects which this food has among civilised people! Women eat less food than men relatively because their average size is smaller, and also absolutely because they do less work and lead a more indoor life. The difference is slight, and when other conditions are equalised the question of sex has very little influence upon the quantity of food consumed.

Generally speaking, women's digestive processes are somewhat less active than men's, and they have greater tendency to constipation. The accepted standards for woman as compared with man are as follows: The meal of a woman equals 0.8 of the meal of a man; a woman with little muscular work demands 80 grammes protein, and a total food value of 2,400 calories; at moderate muscular work woman requires 90 grammes protein and 2,800 calories; man with little muscular work requires 112 grammes protein and

3,000 calories, and at moderate muscular work 125 grammes protein and 3,500 calories.

About the only way in which sex affects the quality of food consumed is in the somewhat greater fondness for sweets and confectionery exhibited by females, but this can be shown to be due more to other considerations of habit and custom than to sex. The use of tobacco and alcohol by many men, for instance, makes them care less for such foods.

DIET AND HEREDITY

The influence of heredity upon diet is not very striking. Children are sometimes supposed to inherit likes and dislikes for particular foods, whereas they are merely acquired tastes from the circumstance that they have certain foods offered them at home to the exclusion of others. The functions of the stomach and intestines appear to be somewhat hereditary. Violent seasickness and a tendency to biliousness and constipation in some persons and the prompt vomiting of the contents of an overloaded stomach in others is sometimes a family trait, running through three or four generations. So is occasionally the inability to digest special foods, such as crustaceans, strawberries, etc., but such instances are rare.

Unfortunately, the abuse of alcohol is very strongly hereditary—so much so that the children of inebriate parents should be protected as long as possible from learning the taste of either beer, wine, or spirits.

Heredity has some influence in disorders of food assimilation, like gout and diabetes, and in such cases improper diet and careless habits of eating may develop latent disease.

DIET AND RACE

The food of prehistoric man necessarily consisted of the simplest elements, represented by fruits, berries, nuts, insects, and an occasional piece of raw fish or meat. Such food is, in fact, the diet of primitive tribes to-day. The Fuegian lives chiefly upon shellfish and seaweeds, and the Central African dwarf upon plantains and insects (see p. 33). The name "Eskimo" was first applied by natives of eastern Canada in opprobrium, to signify "raw-fish eater."

The history of the development of diets and of food cultivation and preparation is practically a history of the progress of culture, and most of our present foods were quite unknown to our earliest progenitors. The discovery of the uses of fire greatly increased the variety of available foods for man, for all the cereals which are cultivated require its use to fit them for digestion. As Gerland has said, men obtain their food from natural products, by cultivation, or by barter and commercial exchange, according as nomadic or fixed habits predominate, and "no mere hunting or fishing tribe can be large and remain in one place," for it is estimated that in the temperate zone to support one man by these means at least sixteen square miles of territory are necessary.

Many a tribal, and even national war has been the more or less direct outcome of the necessities of obtaining food supply from distant sources, and the economic, commercial, and social development of all matters pertaining to food among civilised people to-day far exceeds in importance all other practical questions. As man advanced in culture and began to live in communities where division of labour became an important factor in development, preference to some extent superseded necessity in the selection of diet, and as food acquired a commercial value, more and more labour was bestowed upon its preparation and preservation, until at the present time the rich are able to select their diet with almost total disregard of season or climate, and even the common labourer finds it economical to eat some foods which, like sugar or tea, may have been transported many thousands of miles.

Following is a synopsis of an exceedingly interesting report kindly written for me by Dr. Frederick A. Cook, the physician to the Peary expedition to northwestern Greenland in 1891–'92, which is appended to illustrate the dietetic habits of a race which, for nearly a thousand years, are believed to have been practically isolated from commercial or social relations with any of their neighbours. There is so little scientific information existing in regard to the dietetic habits of the tribe of Eskimos which he studied, who live the farthest north of any people in the world, that his statements will be found of exceptional value. One cannot peruse the account without being impressed with the fact that generalisations in regard to the influences of diet upon the system should be made with great caution when applied to different races of man. For example, both scurvy and rheumatism are sometimes attributed to an excessive meat diet, yet the Eskimo has no starchy food at all and does not suffer from these diseases, and, moreover, his bodily vigour and power of endurance compare favourably with that of any other race or class of men, and in some respects it is greater than that possessed by others.

Dr. Cook says in regard to the Eskimos of northwestern Greenland: "They usually eat but one meal a day, which they take at irregular times, being people without restrictions of any kind. They can be seen eating and drinking whenever able to procure sustenance. Their diet consists almost exclusively of meat, composed principally of the muscular tissues of the following animals, in the order of their importance to the natives: Seal, walrus, norwhale, white whale, polar bear, reindeer, arctic hare, and sea fowls, such as guillemots, gulls, eider ducks, etc. When food is scarce they eat every part of the animal, including the stomach and intestines; indeed, the only vegetable food that the most northern Eskimo can obtain consists of the contents of the stomach of the reindeer (lichens), which he is only occasionally able to secure. The women and children sometimes eat flowers of the arctic poppies and the so-called scurvy grass, but never to any great extent. In times of famine, in order to prevent wholesale starvation, the aged are turned out to starve to death, and their bodies are then devoured by the more vigorous members of the tribe. Occasionally, when the old people are shrewd and active, the younger children are sacrificed for this purpose. As a rule, the Eskimo will not eat dogs, but when food is scarce dogs are first added to their larder, and when the last dog has been eaten, human beings come next in order.

"One of the greatest delicacies is old seal. A native never wastes the carcass of an animal; if he should kill the seal fifty or a hundred miles from home he will bring it to shore and *cache* it in such a way that the foxes, bears, and birds cannot attack it. He then leaves it, and may not return for two or three years, when he comes back in anticipation of a great feast, for the old seal seems to him like old cheese to us, and he enjoys it immensely, although a white man could not endure the odour. I have known twenty individuals to eat a seal of this character in less than two hours, leaving only shreds of the skin after them. I have never been able to verify the statement, so commonly quoted, 'that Eskimos can eat twenty pounds of meat or blubber.'

"Fully two thirds of the Eskimo food is eaten raw, and one half is consumed while in the frozen state. When an Eskimo woman starts her blubber lamp and places over it a *conlipsie* (the name applied to their primitive stew pot) she does so principally to obtain the warm drink which the cooked meat affords. It cannot be said that Eskimos cook their meat because they prefer it cooked, but because when the meat is heated slowly, as it can only be heated by their primitive method, the blood and fat ooze from the muscular tissues and form a thick soup, which, aside from water, is almost their only drink, and a cupful of this beverage is offered to every guest. The natives may consume three or four hours in eating one meal, and when they have thoroughly gorged themselves they will lie down and sleep; as they do this, however, they place before themselves a dish full of cooked meat, and those who awake from their sleep will finish their meal, but on rising no breakfast is served, for the Eskimo who has a day's journey before him would not think of eating before starting. He claims that this would prevent his ability to travel, and this rule the Eskimos apply to their dogs as well, who are often only fed every two days. These

Eskimos are as irregular in their habits of sleep as they are in regard to their meals. During the four months of constant sunshine they usually arise when the sun is in the south, but the Eskimo never thinks of going to bed until he is sleepy, so that in time of excitement, when there is a new arrival or in the pursuit of game, he will often remain awake for forty-eight or seventy-two hours, and then he will sleep 'until the spirit of sleep has left him,' as he expresses it.

"The Eskimos endure fasting very well, and after a good, full meal they can fast for two or three days, apparently without serious inconvenience. Indeed, when food is scarce—which usually happens during the period of darkness—some thrive on about one meal a week, but they appreciate the fact that he who is not well fed cannot encounter fierce storms, and no one who has not had full rations would think of venturing out in severe weather. During the tedious night of four months these Eskimos appear to undergo a state of hibernation, eating very little and sleeping a great deal; their otherwise lively spirits are more or less subdued, and while they try to keep cheerful they are apt to become depressed and debilitated, and they are not capable of great muscular exercise during this time. When the sun returns their skins are somewhat jaundiced, and they are very anæmic. This peculiar effect was also produced in the members of our party in a more exaggerated form, although we tried many methods of overcoming the depression, and though we had no trace of scurvy our will powers were lessened, and our ambition was, to some extent, lost, and our muscular power as well was much reduced, so that a walk of a mile produced exhaustion. All of the secretions were diminished, particularly those of the digestive tract, and to stimulate these taxed my mental skill for the greater part of the winter of 1891–'92, but with us, as with the Eskimo, as soon as the sun returned our strength and ambition came back, and we felt as if we had gained a new lease of life and were ready to encounter any hardship.

"The Eskimo drinks very little while eating. He usually defers that for some time afterwards, or perhaps until he arises next morning, when he drinks a great deal, and while I have not measured the quantity of water consumed by any definite number of inches in twenty-four hours, I have often given Eskimo men three pints of water at one time, and nursing women two quarts. Before starting upon a journey a native will fill up with water. It should be remembered that these people use no free salt or condiments.

"I am not prepared to say that the food of these people bears any relation to their stature, as other factors may influence their height, but their large abdominal development is undoubtedly due to the immense quantity of food and drink which they consume at one time. Variation in diet does not seem to be a necessity to the

Eskimo unless he is feeling ill, when he recognises the importance of a change of food and surroundings. He will always hail with pleasure the first bird, deer, or walrus of the season.

"The Eskimo's clothing is such a perfect non-conductor that the temperature does not vary much around his body, and in summer it is practically the same as in the coldest day of winter. For this reason, the extreme cold of winter does not call for a large quantity of food, but a native knows that his food is fuel for his body, and that he must take it in sufficient quantity to develop muscular power and animal heat.

"The Eskimo mother nurses her child until the next is born or shortly before it, a period which varies in from one to eight or nine years, but the average time is four years. Long before the mother weans her child she masticates the food, opens the baby's mouth, and transfers the food from her own mouth to the baby's, very much as a pigeon does, and the child thus brought up would not think of taking up pieces of meat or toys or anything else to put into its mouth, for it will take nothing except from its mother.

"The members of our expedition took very few forced marches in low temperatures. The one over the interior of Greenland was undertaken at the time of year when the thermometer ranges from 5° F. below zero to 40° above.

"The quantity of food consumed per man every twenty-four hours upon this expedition was as follows:

Pemmican	1½ pound.
Bacon, fat	6 ounces.
Powdered pea soup	2 "
Dry ship biscuits	12 "
Condensed milk	3 "

"A quart of tea with perhaps a pint of water was our only drink, but we had no drink through the day while on the march, and often were unable to secure more fluid than two cups each morning and night. The pemmican was composed of dried beef and beef tallow, half and half, a few currants, and a little sugar, but no salt. On several expeditions during the spring of 1892, while the thermometer ranged from 20° to 40° F. below zero, the members of the party always consumed large quantities of food. This was not, however, until they had been out two or three days, when the amount of food which they could devour seemed almost unlimited. There was no time that we craved for fat. We enjoyed the pemmican immensely, but that was because we had nothing else. During the extreme cold weather, while in the field, we took more kindly to fats, but never in preference to other foods. Canned meats, for some unexplained reason, were soon in disfavour, for the variety and character of the food seemed to be of very little consequence;

indeed, our appetites were such that we were ready to eat anything and everything placed before us. We were, however, always liberally supplied with hydrocarbons, and I believe had this not been the case, a demand for them would soon have arisen, for the most valuable food for a polar expedition is composed largely of hydrocarbons.

"The most important articles of diet for a polar expedition we found to be pemmican, cranberry sauce, tea, coffee, chocolate, preserved milk, sugar, ham, cheese, bacon, oleomargarine, lard, pickles, lime juice, dried fish, beef-soup tablets, wheat, corn, rye flour, rice, hominy, oatmeal, dried vegetables, and a liberal supply of all kinds of canned vegetables, particularly canned tomatoes, peas, beans, corn, canned soups, and dried fruits. Lime juice was not served regularly to the members of the expedition, and I think nothing is to be gained by so doing. For some of the members of the party it was decidedly injurious, but others called for it occasionally as a refreshing drink.

"The average weight of these northern Eskimo men is one hundred and thirty-five pounds, but that of the women one hundred and eighty-eight pounds. Obesity is foreign to the Eskimo, and leanness is equally rare."

Studies of negro diet have been made for the United States Department of Agriculture (Bulletin No. 71, 1899) by H. B. Frissell and Isabel Bevier, with the following result:

Cost, Nutrients, and Fuel Value of Food per Man per Day in Dietary Studies in Virginia and Elsewhere

	Cost.	Protein.	Fats.	Carbo-hydrates.	Fuel value.
DIETARIES OF NEGROES IN ALABAMA	*Cents.*	*Grms.*	*Grms.*	*Grms.*	*Calories.*
Dietary with minimum protein	4	26	83	225	1,800
Dietary with maximum protein	11	99	252	666	5,480
Dietary with minimum energy	5	31	27	304	1,625
Dietary with maximum energy	12	93	283	649	5,670
Average of 20 negro families in Alabama	8	62	132	436	3,270
Average of 19 negro families in Virginia	11	109	159	444	3,745
AVERAGES OF OTHER DIETARIES					
Average of 4 Mexican families in New Mexico.	8	94	71	610	3,550
Average of 14 mechanics' families	19	103	150	402	3,465
Average of 10 farmers' families	..	97	130	467	3,515
Average of 14 professional men's families	28	104	125	423	3,325
Tentative standard for man at moderate work.	..	125	...	...	3,500

The preponderance of protein in the diet of Virginia negroes as compared with those investigated in Alabama is due to residence nearer the sea and large consumption of fish, especially salt herring.

Arthur Goss (Nutrition Investigations in New Mexico, U. S. Department of Agriculture, Bulletin No. 54) gives the following dietary of a Mexican living in New Mexico and an Alabama negro:

	Nutrients in grammes.			Fuel value in calories.
	Protein.	Fats.	Carbohydrates.	
Mexican	68	73	572	3,320
Negro	62	132	436	3,270

In this dietary the Mexican subsists upon but little more than half of the standard requirement of protein, and the negro upon less than one half. The Mexican eats chiefly flour and frijoles, with little meat, and the negro subsists upon bacon, fish, and cornmeal.

CLIMATE AND SEASON AND FOOD

Much has been written about the need of man changing his diet when he removes from one climate to another, in the belief that the natives always eat the kind of food best adapted to the climate in which they live. This is superficial reasoning, and too much importance is attached to the relations of climate to diet *per se*. As a matter of fact, the natives of a country eat what they can obtain easiest, or what their habits and mode of life have accustomed them to in the struggle for the survival of the fittest. "Climate affects diet mainly by the supply it affords" (Chambers).

"The national dietary is determined largely by the climate and nature of the available soil, and among civilised communities it is largely modified as facilities for commerce and interchange of food products are increased.

"Maritime people naturally derive much nitrogenous food from the sea, as fish, molluscs, crustaceans, etc. Among the residents of the far North albuminous and fatty diet predominates, and the coarser cereals—barley, rye, oats, etc.—being more hardy, predominate in their food. Barley grows the farthest north of all the cereals" (Clark).

The Hindu subsists mainly upon rice, one of the simplest types of farinaceous food, and he derives his nitrogen from corn and lentils. He must consequently eat a large bulk of food in order to obtain sufficient nitrogen for the needs of the system; his digestive organs enlarge, and he finds the means of stimulating them by the free use of condiments of various sorts. Bulky and fibrous vegetable food distends the alimentary canal. The natives of very hot countries live mainly upon vegetable and starchy foods, eating cereals, green vegetables, and pulpy fruits which contain water, salts, and acids in abundance, which are cooling and refreshing. As a rule, they eat less animal food than do the natives of temperate and arctic regions, nor do they require fats in excess, although they take some fats and oils.

While these statements apply to a majority of mankind, they are by no means without exception, and it must not be argued that because a tribe eats the only food which Nature has provided, they could not live equally well in their own climate upon other food, if they could obtain it. Far from depending solely upon vegetable food, most savage tribes living in the torrid zone eat meat ravenously when they can get it, and often prefer it in an advanced stage of decomposition.

The New Zealander and South Sea Islander choose a varied diet of fish, eggs, roots, seeds, berries, seaweeds, and meat if obtainable (see p. 32).

As pointed out by Chambers, the Pampas, who eat flesh and drink water only, thrive on hot arid plains, and so do the Nubian Arabs, while the peasants of northern Norway and southern Spain live alike almost wholly on breadstuffs without meat. He says that "the immediate transition from a purely animal to a purely vegetable diet, though borne by the individual, is fatal to the race," and "the best diet in the abstract is a mixed diet, and mixed in the proportion selected by the experience of most civilised nations, and it is also best for the individual who is accustomed to it to adhere to under whatever sky he may be wandering." In changing residence from one extreme of climate to another it is not advisable to alter the diet too suddenly, and more must depend upon the previous habits and occupation of the individual than upon external temperature. Meat eaters find it easier to adopt quickly another form of diet than vegetarians. The Dominican friars deteriorated so much in health in the British climate that they were obliged while resident in England to obtain special dispensation allowing them to eat meat four times a week.

The English soldiers transported to India or Africa are not required to become exclusive vegetarians; and the French in Africa or Panama have done best upon a mixed diet. In the United States Surgeon General's report for 1900 the statement is made that "experience in the Philippines has shown that though it is undoubtedly true that while leading quiet lives men eat less in a tropical climate than in a temperate or cold climate, and particularly of meat or fatty substances, our soldiers during the active operations of last year have shown no marked tendency to lessen the quantity of fresh meat eaten. Exhausting labours and fatigues with corresponding wear and tear of the muscular system require a liberal meat issue, which the soldier uses with satisfaction and advantage."

"Well-clad and sheltered soldiers require less rations than poorly clad men exposed to the weather—a good thing to know in times of great privation" (Woodruff).

Men often become involuntary vegetarians while travelling in hot climates from inability to procure meat, and may partially starve themselves from lack of appetite for monotonous food, variety being unobtainable. This leads them to resort to strong condiments, spices, curry, etc., to stimulate the appetite.

Many persons, especially those past middle life and people with a tendency to corpulency, find that during the heat of the summer season, and especially during the prevalence of "heat waves," they are in much better health when they abstain from hot soups, fat, and meat, and take but little animal food of any kind. The total quantity of food eaten may advantageously be reduced at this time of the year as much as one sixth, or even one fourth. Most persons find this out as a matter of individual experience; but there are others who should be especially directed in the matter, and the rule applies to infants as well as adults. The diet in winter should comprise both more nitrogen and more carbon than in summer.

The breakfast hour is often made half an hour or an hour earlier in summer than in winter to advantage.

The thirst engendered by living in hot climates is conducive to excessive drinking, and as the water is often bad, an additional excuse is often made for drinking too much liquor. By these means the foundations for hepatic and renal troubles, cirrhosis, and Bright's disease are often laid. On this account, in very hot climates strong alcoholic drinks ought especially to be avoided. In India they uniformly disagree, and lighter beverages, such as beer and wines, must be taken very sparingly; but there is no objection to tea, coffee, and chocolate.

PART V

FOOD DIGESTION.—CONDITIONS WHICH ESPECIALLY AFFECT DIGESTION

DIGESTIBILITY OF FOODS

In the previous part of this work the writer has incorporated a number of tables of the so-called "nutrient values" of foods as computed by physiological chemists. Such analyses are of unquestioned scientific interest, but it is necessary to caution against their too rigorous application in practical feeding, either in health or disease. For example, as pointed out by Halliburton, pork is the most highly nitrogenous of meats by analysis, yet its muscular fibres are so associated with fat that much of this food fails to be acted upon by the digestive agents of the body, and passes out as waste. Similarly whole wheat bread is chemically more nutritious than the bread of refined flour, yet so much of the proteid-bearing bran is undigested, that bulk for bulk, the whole-wheat breads are much less nutritious. As Halliburton states, "a common error, which it seems impossible to dislodge from the medical mind, is that 'nutritive' and 'nitrogenous' are synonymous terms."

Another example is found in the application of analyses of red versus white meats to the feeding of patients with enfeebled digestion. The differences in proteid content and extractives may be very slight, yet the variation in toughness of fibre and consequent digestibility may be considerable.

For these reasons it is wholly impracticable to prescribe an invalid dietary on a basis of "calories" as representing energy, or heat, or a matter of storage of body substance, as one would definitely prescribe a medicine. Moreover, for obvious reasons, nearly all the calorifacient food experiments made with man have been conducted upon those in health, not in disease. Even a healthy man inclosed in a calorimeter for a few days' experimentation is in reality under highly artificial conditions as compared with a healthy man under stress of mental work, physical labour out of doors, or subjected to any of the manifold changing conditions of daily life.

In the ensuing chapters, therefore, the conditions especially affecting food digestion and the true nutrient value of food in disease will be considered from practical and clinical standards, without placing undue emphasis upon analyses and "calories."

Patients often conceive erroneous ideas regarding the digestibility of special foods. The food supposed to "disagree" may have done so because it has been improperly prepared or cooked, or because it has been eaten with other foods forming improper combinations. For example, a simple milk diet may be well tolerated when the milk taken with other foods may produce dyspepsia or biliousness. Moreover, it is quite possible that a food which at one time proved indigestible, may have done so because of transient abnormal conditions in the digestive apparatus, rather than from any injurious quality in the food itself.

HOURS FOR MEALS AND ORDER OF TAKING FOOD

The hours for taking meals which are commonly selected are those which are best adapted to the varying needs of the system at different times in the day, and experience teaches that they must be varied considerably with occupation. In the larger American cities where commerce is active, and many men are subjected during the day to excitement, hurry, and strain, an evening dinner hour often best meets the needs of the system as well as the requirements of personal convenience. In the rural districts, however, and in many countries where life is less hurried and active than under the conditions of the extraordinarily rapid growth and development of the United States, it is found that taking the heaviest meal at noon agrees better with the wants of most persons. The hours for infant feeding are described under the heading Infant Feeding.

Children should always dine early in the day. There are in general three systems for adults in regard to the number of meals and hours for taking them which are in common use, in which two, three, and four meals, respectively, are eaten in the twenty-four hours.

The first system, which is in vogue in France and, to a less extent, elsewhere, is that of eating but two substantial meals a day. On first rising in the morning, a cup of hot coffee or chocolate is taken with a roll or some other simple form of bread. This enables two or three hours of moderate work to be accomplished before the first real meal, which is a breakfast eaten in the late morning, usually at or before twelve o'clock. This meal is substantial, consisting of several courses of solid food. The second meal, which is the dinner, is usually eaten between six and seven o'clock. This system is in use among workingmen as well as with the leisure classes, and is found well adapted to their habits of life. Americans travelling abroad, who are accustomed to eat a heavier meal for breakfast, often find some difficulty in adapting themselves to the French custom, but many learn to like it, and as the travelling public are commonly for the time being, a leisure class, it is less difficult to adapt themselves to new customs abroad than to introduce them at home.

The Germans also usually take a cup of coffee or other light beverage and a roll or *Butter-brod* soon after rising, but they dine very early, often at half-past twelve, taking a heavy, deliberate meal at this hour, which they are apt to follow with beer and tobacco. Their offices and banks open early, and are often closed from noon until three o'clock, when they are reopened until five, whereas in most cities in this country the most active business hours are in the middle of the day, and it would be practically impossible for many men to give up two or three hours at this time to eating and social converse. The Germans usually take a supper with meat at a somewhat late hour—between half-past seven and eight o'clock. In many German towns it is customary to open the theatres as early as six o'clock, so that the performance is closed in time for a supper at nine. The habit of eating between meals and of taking occasional light lunches in the afternoon seems to be more prevalent there than elsewhere.

In England it is a very common custom for the better classes to breakfast at eight or nine o'clock, lunch or dine between one and two, take a cup of tea and perhaps a biscuit at four or five, and dine or sup at eight o'clock.

In the United States, where there are theoretically no class distinctions, they practically do exist very strikingly in regard to the hours for taking meals, and the hard-working labouring class, whether employed in the city or country, almost universally dine at noon. It is mainly the mercantile and professional classes in large cities who dine between 6 and 7 P. M., while the more fashionable or leisure classes dine even later—sometimes at eight o'clock. Most of the latter, however, on going to the country for a summer holiday, are accustomed to reverse their habits and dine at the usual country hour—at one o'clock, taking supper at half-past six or seven. In the Southern cities it is quite common to dine in the neighbourhood of half-past two or three o'clock. Many persons in cities who habitually dine late on week days from long-continued custom, on Sundays dine shortly after noon, taking supper in the evening. This is an old custom handed down from days in which less exacting occupations favoured noon dining throughout the week, but due in part also to economical reasons, and a desire to make the work for servants as light as possible on Sunday afternoon. While those in good health with active digestion suffer no inconvenience from thus changing the hour for meals on one day in the week, there are others who find that it disagrees with them and disturbs their digestion. A hearty meal at noon following a very light breakfast, consisting of a roll and cup of coffee or tea, may be perfectly digested for years, yet reversing the order of the meals may entirely disorder the digestion.

For professional and other classes of men in the United States who are not occupied in physical labour or outdoor pursuits the following system is found to possess decided advantages: A breakfast is taken soon after rising, at half-past seven to half-past eight, which consists of fresh fruit, porridge or oatmeal, or other varieties of cereals, poached eggs or omelet, and a little bacon or fresh or salt fish, bread and butter, tea or coffee. The lunch, eaten between one and two o'clock, may consist of a lean chop, or a piece of cold ham, or a slice of rare beef with some stewed or baked potatoes, with a simple lettuce salad, or perhaps a little cheese for dessert. If a heavy meal is taken at this hour by persons unaccustomed to it, and who have had a breakfast of solid food, they often feel dull and sleepy for an hour or two thereafter, and are consequently incapacitated from active mental exercise. The dinner should be from half-past six to half-past seven, after the principal labours of the day are over, and at an hour early enough to allow of the complete digestion of the heaviest meal of the day before retiring. This may consist of several courses, which are conventionally arranged in the order which appears to be most rational and physiological—namely, soup, fish or an *entrée*, a steak or joint with potatoes and one or two fresh vegetables, a salad, and a light pudding or cooked fruit.

A clear soup at the commencement of a meal does not interfere with digestion, but favours it. The fluid, if taken in a quantity not exceeding eight or ten ounces, is, for the greater part, promptly absorbed in the stomach, and its warmth and the sustenance it contains act favourably upon the circulation, stimulate the secretion of gastric juice, and satisfy temporarily the cravings of hunger which are not met by the taking of solid food until after it has been digested for some time. The fish or *entrée* is then eaten in the earlier stage of gastric secretion when the gastric juice has not yet attained its full strength and quantity. This is followed by the eating of meat, which is destined to remain in the stomach for several hours, and requires all the energies of its digestive processes. The saccharine or farinaceous food, which does not undergo digestion in the stomach, is taken towards the end of the meal, when it remains a less time in the stomach than animal food.

The discussion of more elaborate dinners, consisting, as they do very often, of a dozen or more separate courses, would be out of place in this volume. Such dinners can only be indulged in for any length of time by those whose digestion is robust and whose leisure and comparative freedom from care and anxiety allow them to devote abundant time and physical energy to their meals and to secure sufficient holidays and trips to noted spas to enable them to periodically relieve the digestive system of the strain put upon it. Persons who rise late and dine early should eat but a small breakfast and a hearty supper. If the noon dinner is replaced by a light luncheon, a substantial breakfast should be eaten.

Undoubtedly it is usually best to so order one's occupation that neither severe mental nor physical labour need be undertaken immediately after eating. Yet much depends upon the age and strength of the individual.

At one of the largest colleges for girls in New England the pupils dine at one o'clock, and many of them commence to study immediately thereafter, or at 2 P.M.; yet cases of indigestion are comparatively infrequent among them; and the ordinary day labourer begins his work again without detriment almost immediately after a hearty noon meal, and continues it while gastric and intestinal digestion are still necessarily incompleted.

Invalids often require modification in the accustomed hours for meals, and Balfour says that "all invalids should have their important meal in the middle of the day."

Between four and five hours, on the average, must be regarded as necessary for complete digestion of a mixed meal.

The intervals between meals should be regulated with reference to individual peculiarities. As a general rule, convalescents or persons with feeble digestive powers and poor appetites, who are unable to eat a sufficient quantity of food at any one meal, should be fed more frequently, perhaps four or five times—that is, in addition to three ordinary meals, they should have light lunches in the middle of the forenoon and afternoon, or possibly just before retiring. The latter is particularly to be recommended, for if the food be light and nutritious, such as a bowl of gruel and a glass of hot milk, or a cup of cocoa with a biscuit, and possibly a glass of beer, sleep is not interfered with, but is promoted, and the system is saved from too long an interval of starvation between the hours of dinner or supper and breakfast. On the other hand, dyspeptics and patients with gastric catarrh may find it desirable to allow an interval of fully seven hours between their meals, in order to give abundant time for the digestion of one meal before that of the next is undertaken, and they should stop eating short of repletion.

There are others whose digestion is good, but constitutionally slow, and they are better with intervals of at least six hours between their meals; and there are some people who keep in better health on only two meals a day, and occasionally, although it must be regarded as an eccentricity, except in the case of some savages and the Eskimos (see p. 319), there are persons who thrive upon but one meal a day.

The monks of La Trappe eat but one meal daily, as a religious custom, at which they consume so much food that they become dull and lethargic for several hours afterwards (Combe).

Many savages, like the Hottentots, have no regular times for eating, but, like the carnivores, take their food whenever and however they can best obtain it.

The business or professional man when overworked sometimes forms the habit of omitting his noon luncheon; but this custom, although it may benefit some forms of dyspepsia, is a pernicious one in the majority of instances if long continued.

APPETITE

The term "appetite" in relation to dietetics usually means a pleasurable desire for food or drink, whereas hunger and thirst imply a craving for food and drink respectively, which has become disagreeable or positively painful. There is, however, no distinct line of demarcation to be drawn between these terms.

The appetite for food is a most capricious sensation, subject to all manner of disturbing influences. It is to some extent apparently under control of the will, in that it can be trained to recur at certain intervals before taking food. In a normal state it is, therefore, rhythmical, and it may then be taken as an index of the need of food, but when it becomes abnormal it is a very unreliable guide.

"As a general rule, though by no means without exception, substances pleasing to the palate are useful and not injurious to the organism" (Brunton).

The appetite often appears with great suddenness, either independently or as the result of directing the attention to matters of food and eating. It may depart as suddenly, even without gratification, or it may vanish after the first few mouthfuls of food are eaten, although it was apparently vigorous a moment before.

The appetite is aroused by a variety of circumstances and conditions, both physical and mental. Such are the smell, taste, and sight of food, good hygienic surroundings, exercise, bathing, cold or stimulating air, agreeable companionship, pleasurable mental emotions, and the proper preparation and serving of food. It may be stimulated by bitters, condiments, such salt foods as caviare or herring, and in some cases by alcohol. Wine drunk between meals is apt to spoil the appetite, but taken in moderation with meals it may increase it. A substance known as orexine, in the form either of a hydrochlorate, tannate, or simple basic condition, has been recommended as having the special function of exciting the appetite in convalescents. It does not, however, give uniform results, and I have seen little or no benefit from its use.

To obtain the most complete satisfaction from the sense of taste one should swallow the food, and not merely take it into the mouth.

The appetite is usually somewhat more keen in winter than in summer, but many persons observe no difference. It is depressed or destroyed by mental emotion, especially grief, anxiety, and worry; by the sight, smell, or taste of ill-prepared or improperly cooked or badly served food; foul air and poor hygienic surroundings; fatigue and exhaustion; many diseases, more particularly febrile diseases and most gastric disorders; nausea; the abuse of strong condiments, and of many drugs, notably opium and those which, like potassium iodide, produce a continual offensive taste in the mouth; the abuse of alcohol; eating irregularly and at too short intervals. In old age the appetite, especially for meats, usually becomes less keen, and the absence of teeth contributes to the loss of desire for such food. A voracious appetite sometimes occurs in children.

Bulimia, which means excessive craving for food, is by no means an indication of vigour, and is often due to an irritable condition of the nerves of the stomach, and may be brought about by eating at irregular intervals, which results in disturbance of the gastric secretion. Such children are usually thin, and are encouraged by ill-advised parents or attendants to gorge themselves with food which they do not digest.

The appetite is very dependent upon habit and upon the usual order and arrangement of the meal. An attempt to eat a lump of butter alone usually fails, but it is easily consumed if spread upon bread. Reversing the customary order of the different foods served at a dinner usually produces disgust, and may even excite nausea.

Pawlow has shown by a series of elaborate digestion experiments, made at the St. Petersburg Institute of Physiology, that there are two " tides " of gastric-juice secretion. The first, " appetite juice," is induced by hunger and the pleasurable sight or smell of food, or the sounds associated with its preparation, and is psychic; this secretion is abundant and actively digestant. The second is excited by the mechanical and chemical action of food in the stomach. Of the two the former often proves the more important, for food which is unappetising, or food which for any reason is eaten without relish or while the mind is strained in other channels, may remain for hours undigested. Hence the failure oftentimes to secure hydrochloric acid after an unappetising " test meal " of bread and water.

Abnormal Cravings

Instances of abnormal cravings for food are familiar to every one. They sometimes take the form merely of an inordinate desire for food which is in itself wholesome but which is poorly adapted to an existing diseased condition. Such desire is apt to come in the course of any protracted illness in which a very restricted diet has been maintained for weeks. It is largely psychic, and does not necessarily indicate an increased appetite. The dysenteric patient may long for ham or pickles or vegetables, or the very obese will beg for sweets, preserves, or farinaceous food.

In other cases the craving may be an indication of a positive want in the system, as when a scorbutic patient hungers for fresh fruit and vegetable acids.

In no disease is the craving for food of every kind more pronounced than in convalescence from typhoid fever. In this case the hunger can hardly be considered abnormal, for it is an expression of the need of wasted and exhausted tissue throughout the body for nutriment.

Patients usually find it most difficult to give up the class of foods which they well know does them most harm. The subject of flatulent dyspepsia longs for saccharine, and perhaps amylaceous or fatty foods—confectionery, pastry, and the like—and the diabetic sometimes has an inordinate craving for bread, which so far possesses him as to cause a resort to any subterfuge to obtain it.

In disordered mental conditions, hysteria, hypochondriasis, melancholia, and in the peculiar periods of puberty, pregnancy, and the menopause, cravings for wholly injurious articles may occur. Such patients have been known to eat chalk, or sour food, or consume large quantities of salt, sodium bicarbonate, etc.

With the exception of chronic alcoholism—if alcohol be regarded as a food as well as a stimulant—there is no distinct food " habit," in the sense that any particular food is likely to be long eaten to an injurious excess. Those articles of diet which are oftenest abused are condiments and confectionery.

VARIETY IN DIET

Monotony of diet is not incompatible with maintenance of life, and even of health, when the food is restricted to two or three articles only, but for the reasons given in discussing the force value of different foods (p. 7) there is no single food, not even milk, which will support man in ordinary health and vigour for long. There are many primitive races and tribes of man who live comfortably upon a diet so restricted that it would soon prove unbearable for a European or an American. Much, therefore, depends upon custom, and no doubt upon heredity. The Hindu eats boiled rice and ghee, or melted butter, and the low-caste Chinese eats rice to the almost, but not complete, exclusion of other food; the Eskimo lives upon one or two kinds of meat or fish, and a little fat; and the Congo native subsists chiefly upon the plantain. The Central American Indian lives almost entirely upon maize, and some of the Polynesians eat bread-fruit alone for two thirds of the year. The roving Indian of the North American plains originally subsisted all winter upon a diet of salt meat, and the Scotch peasants formerly lived for six days in the week upon oatmeal porridge.

Such a monotony of diet is, however, usually a question of environment and not of choice. The carnivorous Eskimo enjoys canned vegetables when they are offered to him, and the vegetarian African native gorges himself with meat when he can obtain it. As a rule, the more civilised the tribe of man the greater is the variety of his diet, and once accustomed to variety, it is very difficult to subsist upon a too restricted regimen. It is the ability to subsist upon a variety of foods which makes it possible for man to adapt himself so well to his environment when he migrates from one extreme of climate to another.

This adaptation is also possible because the elementary foods possess general nutritive properties for all the organs of the body, rather than special value for individual structures; for example, there is no "brain food" in distinction from food which nourishes other organs as well.

An ideally perfect food combination if made upon purely theoretical considerations of the needs of the body for just so much albumin, fat, starch, sugar, salts, and water would be a compound which in a very short time would become too monotonous and wearisome to be eaten. Even the domestic animals are kept in better condition by occasional slight changes in diet—such, for instance, as are afforded by change of pasturage or the variety which the season of the year produces in their natural food; and it is well known that the flavour of the meat of fish and wild animals depends upon the nature of their diet. For example, canvasback and redhead ducks are much more palatable while feeding upon the wild celery plant than when eating other food, domestic turkeys and capons improve when fed upon grain, swine flesh is made better by feeding the animal with corn than with skimmed milk, and salmon and shad acquire a more delicate flavour when feeding in fresh-water rivers.

In a report of digestion experiments made for the United States Department of Agriculture (Bulletin No. 85, 1900) by Charles D. Woods and L. H. Merrill, the statement is made that "it is a matter of common observation that digestion experiments made with one kind of food material do not give on the whole as reliable results as those in which two or more food materials are used. In other words, it appears that with a mixed diet the same person will digest a larger proportion of nutrients than with a diet composed of a single food material."

Among some peoples the variety of food is considerably restricted by religious observances, custom, and associations. For instance, there is the Buddhist prohibition of meat and the Jewish prohibition of swine flesh. When a variety in food cannot be secured the desired effect in stimulating the appetite and digestive secretions may be obtained by altering the methods of cooking and by modifying the taste and odour of food. On the other hand, too great variety, as well as too elaborate cooking, becomes equally tiresome. Those who eat constantly at restaurants and large hotels, where the table is greatly diversified, often find that a change to a simpler home table agrees with them better.

Woodruff attributes the decrease in drunkenness in the past few years in the United States army to the advantages accruing from a much greater variety in diet since fresh vegetables were made a part of the ration, and since by a system of exchange the soldier has been enabled to barter an excess of common ration food for a few articles of luxury. He also says: " Variety is necessary in the army for another reason: When the diet is very simple there is apt to be constipation, and in the field this condition is sometimes quite marked. It is recognised by physicians that chronic constipation cannot be properly treated with drugs, and it must be rectified by diet. The field ration, if possible, should overcome this tendency to constipation. Sluggishness of the bowels quite commonly goes along with discontent, homesickness among soldiers, and in such conditions the soldier is not a reliable fighter—he is easily beaten."

THE NERVOUS SYSTEM AND DIGESTION

The influence of the nervous system on digestion is very complex. In a general way, the peripheral nerves may affect the digestive process (*a*) through the circulation, (*b*) through motion, (*c*) through glandular action. The nerves chiefly concerned in these processes are the branches of the sympathetic system and the vagus. The latter, through its association with the cardiac, vasomotor, and respiratory centres in the medulla oblongata, places the vital functions of the body in very intimate connection with food stimulation acting through the branches of the nerve in the alimentary canal.

(*a*) **Action through the Circulation.**—The nerves influence digestion through the circulation by their vasomotor control, regulating the calibre of the vessels and quantity of blood supplied to the walls of the alimentary canal, the local blood pressure, and the consequent rate of absorption.

(*b*) **Action through Motion.**—The nerves influence the movements of the entire alimentary canal, either accelerating or inhibiting them, thus controlling the propulsion of the food, its admixture with secretions, and its contact with absorbing surfaces.

(*c*) **Action through the Glands.**—The nerve supply of the digestive glands is distributed to their blood vessels, and also probably to some extent to the cells of the gland parenchyma. This latter distribution is not always demonstrable histologically in man, but the influence is unquestionable.

Under normal conditions, the nerves act mainly in connection with the digestion through reflex stimulation produced by mechanical irritation of food and by the chemical irritation of its different ingredients as they undergo absorption. But, in addition, nerve currents from the central nervous system or from a remote peripheral origin may interfere with the normal nerve functions. Every one is familiar with examples of acute indigestion produced by fatigue of the nervous system, undue mental excitement, emotion, etc. For any given phase of digestion, disturbance of normal nerve function will retard the process more in its earlier stages by checking or altering gland secretion. In its later stages the effect of the nervous system will be more pronounced in controlling or inhibiting absorption. Overstimulation of the local nerves of the alimentary tract may excite an increased watery secretion and exaggerate peristaltic movement of the intestines, thereby hastening the passage of the food through them before there is time for digestion or absorption, and giving rise to diarrhœa.

CIRCULATION AND DIGESTION

The influence of the circulatory system upon digestion appears in the composition of the blood and in its rate of supply to the digestive glands. Vigorous active circulation accompanies good digestion and maintains a normal local reaction and temperature, and feeble, sluggish circulation produces local congestion of the viscera and interferes with gland secretion and absorption. When the nerves of the salivary glands are experimentally stimulated in animals by an electric current the blood vessels are altered in calibre. If the chorda-tympani nerve is stimulated the vessels are dilated and the rapidity of the blood flow is accelerated so that the venous blood issuing from the gland is of a red arterial hue, it not having lingered long enough to undergo the ordinary changes in regard to its gases. The salivary secretion becomes watery and contains a smaller percentage of solids.

On the other hand, when the sympathetic nerves are stimulated exactly the reverse occurs. Hence the blood supply is shown to alter the digestive power of a secretion by modifying its composition.

Blood which is impoverished in composition, watery, anæmic, or deficient in albuminous ingredients, will furnish poor materials for the manufacture of the digestive secretions, and, further, the muscular walls of the alimentary canal will suffer from malnutrition and peristaltic action will be diminished.

TEMPERATURE AND DIGESTION

Both the external temperature and the internal body heat influence digestive processes. The effect upon the system of the temperature of food and drink is also a matter of important consideration.

Hot food and drinks in cold weather, cold food and beverages in hot weather, are instinctively resorted to by almost every one, although this is, no doubt, as much due to mental association and, perhaps, a temporary agreeable sensation of the temperature in swallowing as it is to any decided influence exerted over the body temperature.

Sudden modifications in the external temperature of either excessive heat or cold react upon the circulation, respiration, and the nervous system in a variety of ways and indirectly affect the digestive apparatus. The shock of sudden or, more particularly, of continued exposure to cold over the entire surface of the body tends to constrict the peripheral blood vessels and produce congestion of the visceral vessels, modifying secretion and absorption in consequence. A local application of heat and of cold over the abdominal wall during activity of the digestive organs has but limited influence. Patients wearing a Leiter coil over the abdomen through which ice water is continually passed for many hours do not necessarily suffer from retarded digestion, nor do those who are having poultices continuously applied to the abdomen. In a series of experiments which I have made to determine the extent of heat penetration through the abdominal wall it has been shown that the application of heat or of cold of such extremes as can be borne without discomfort has little or no influence on the circulation in the stomach or the intestines or upon the temperature of those organs so long as the subcutaneous circulation is vigorous. This is owing to the rapid neutralisation of the heat or cold applied externally by the constantly changing layer of blood flowing beneath the surface. In dogs, a poultice of 140° F. or an ice coil with water at 34° F. placed over one side of the abdominal wall does not raise the temperature of a long-stemmed thermometer more than a quarter of a degree when slipped beneath the abdominal wall through a perforation or held immediately below the poultice or coil. If, however, the animal be killed, circulation ceases, and the temperature of the thermometer will immediately be affected to the extent of fifteen or twenty degrees. It is doubtful, therefore, whether enfeebled digestion can be much influenced by the local application of warmth over the abdominal wall. Many persons, however, who have a tendency to intestinal indigestion find it both agreeable and salutary to wear continuously a broad flannel bandage about the abdomen to favour uniformity in temperature and prevent the liability of taking cold.

It is incompatible with life that the variations of body temperature between the highest fever and the lowest depression should exceed the limits of temperature at which digestion is known to proceed when artificially conducted, so that these alterations do not of themselves alone destroy digestive power in the stomach. The latter is usually diminished or lost during fever, but this may be owing more to disturbances of the circulatory and nervous systems than to increased warmth of the stomach.

Efforts to raise or lower the local temperature in the stomach during digestion by swallowing, respectively, hot water or pounded ice are not productive of very striking results.

It is customary, and no doubt best, to administer stimulants hot in collapse from any cause.

Wunderlich, Fothergill, and others have laid considerable stress upon the antipyretic value of giving all fluids very cold in fevers, but I have yet to see any effect upon genuine pyrexia, as, for example, in typhoid fever, depending upon whether milk or other fluids were administered very hot or iced. I often prescribe hot boiled milk in such cases if patients prefer it, because the quantity of heat units which can be thus conveyed into the body is too small to merit serious consideration.

It is a popular belief that rich wines and oils are "heating" foods, and, conversely, "cooling drinks" have long been used in fevers, but the use of *iced* fluids and of cracked ice itself for relief of thirst in fevers is of comparatively recent date. It followed the extended introduction of the clinical thermometer, and to this day one occasionally meets with opposition from mothers to giving a child with high fever anything really cold.

Hot fluids drunk also favour perspiration, and sometimes aid expectoration, but this is because they are promptly absorbed and added to the volume of the blood, not because they contribute many heat units to the body. Winternitz endeavoured to show by sphygmograms that the imbibition of cold fluids increases arterial tension, and that of hot fluids lessens it. This may be true, but the sphygmograph is not at all a reliable instrument, and certainly the clinical application of this rule is not capable of substantiation, although in giving hot-air baths to promote perspiration in Bright's disease hot drinks are of undoubted service.

With practice one may learn to swallow water which is uncomfortably hot to the touch—at a temperature of 115° or 120° F. It has been swallowed at even 132° F. The drinking of very hot water before meals aids in cleansing the mucous membrane in cases of gastric catarrh and acts as a diuretic. The rate of local digestion in the stomach is comparatively little influenced by swallowing either hot fluids, such as soups or broths, or hot solid foods, and similarly it is not much retarded by taking such substances very cold, provided in each case they are swallowed very slowly. Some food is more digestible when eaten hot than cold, but with other food the reverse is true. In either case it is not so much because of the warming or cooling of the stomach, but because of the physical condition of the food. For example, some persons who cannot digest hot mutton fat can take it cold because it becomes friable and mixes better with other food. Some persons with very sensitive stomachs cannot take the fat of cold butter spread upon bread, but can digest it if melted thoroughly into hot toast, which subdivides the fat particles and keeps them from fusion. Hot boiled ham is more indigestible than cold ham for many persons. Hot milk may be more digestible for invalids than iced milk, yet the latter may be better borne if vomiting be present. Much must depend upon habit and individual peculiarities. One may begin a dinner with iced raw oysters, then take hot soup, and later conclude the meal with ice cream, followed by hot coffee, and yet throughout, the temperature of the stomach contents does not vary so much as half a degree, because the warm blood circulating so rapidly and abundantly within its walls and those of the œsophagus maintains the necessary normal average most favourable to digestion. Hot food is cooled and cold food is warmed in swallowing, and it may be said the hotter or the colder it is, the less likely it is to modify the rate of gastric digestion, for these extremes of temperature necessitate slow swallowing. Swallowing several tumblerfuls of iced water in quick succession does cool the stomach and inhibit digestion by local reduction of temperature, and also by shock to the gastric nerves; but even this effect is less than is commonly supposed. There are about fourteen pounds of blood in the body, having an average temperature of very nearly 100° F., all of which in turn keeps circulating through the digestive organs, and a single tumblerful of iced water poured into such a volume of warm fluid would not lower the temperature of the whole very much. This is why swallowing pounded ice is of so little avail to control gastric hæmorrhage, and much less pulmonary hæmorrhage, although it may relieve nausea somewhat. In support of these statements are the results of many experiments which I have made upon patients undergoing treatment by lavage, to whom I have given fluids at different temperatures, which were immediately siphoned out of the stomach, and tested for heat loss or gain. Two tumblerfuls of ice water may be slowly swallowed, and if siphoned out again in five minutes the temperature of the fluid will be found to have risen to fully 95° F.

The question has often been raised as to whether the body temperature can be permanently affected by alterations in the quality of the diet. It may be definitely stated that so long as the diet is abundant and nutritious it makes no difference whether man is carnivorous, a vegetarian, or lives upon mixed diet. Insufficient food and starvation or inanition from improper food, it is well known, reduce the body temperature to from one to three or more degrees below normal. Excess of alcohol also reduces it.

Improper and indigestible food may cause temporary rise in temperature, but this is usually caused by more or less gastritis or gastro-enteritis, and is therefore independent of normal considerations. The total daily variation in body temperature normally produced by the ingestion of food does not commonly exceed $\frac{1}{2}°$ F., but it may reach 1° F. The vegetarian rabbit has as high a temperature as a dog fed upon animal food alone. The grass-eating cow has a temperature two or three degrees above man's and quite equal to that of many strictly carnivorous animals. The graminivorous pigeon has a temperature as high as that of the fish-eating gull. No deductions can therefore be made in regard to any permanent influence of diet upon normal body temperature in healthy animals or in man.

The loss of body heat consequent upon starvation and inanition will be discussed under those headings.

EXERCISE AND DIGESTION

The influence of muscular exercise upon digestion is practically exemplified by every one's personal experience. Violent exercise, even by those of robust constitution, taken immediately after the ingestion of food almost invariably retards the process if it does not produce acute dyspeptic symptoms, and even vomiting. This is due mainly to the modification in the distribution of the blood, which during active exercise passes in large amount to the periphery of the body, and in much less quantity to the abdominal organs. There are also increased products of waste matter formed during muscular activity which circulate in the blood, and it is possible, though it cannot be definitely asserted, that they may temporarily interfere with the digestive secretions. Young children between the ages of four or five and ten or twelve suffer much less from the influence upon digestion of violent exercise than do adults. It is a common experience to see children romping and playing violent games immediately after eating without necessarily provoking indigestion—a habit which would be very disastrous to adults. On the other hand, exercise has a very important relation to digestion when taken at proper times and in right amount. This influence is to be attributed rather to the combined effect upon the circulation and respiration and general functional activity of the tissues which promotes their nutrition than to any special local action on the stomach or intestines. Exercise of a certain kind compresses or shakes the liver in such a manner as to favour the elimination of bile from it and increase its functional activity. For this reason horseback riding is unquestionably the most useful form of exercise for many varieties of dyspepsia and so-called "biliousness." Muscular fatigue following activity retards digestion very much, probably for the reason above suggested in regard to accumulation of waste matter as a result of exercise.

Moderate exercise may often be advantageously taken in the morning on rising for ten or fifteen minutes in order to get into a good perspiration before taking a cold bath. Such exercise with dumb-bells, Indian clubs, or weights with pulleys does not harm the appetite, and for some persons it is invigorating and beneficial. Stronger exercise, such as bicycle riding or taking long walks before breakfast, is not to be recommended unless the individual has been greatly overfed the night before. In the early morning hours, with an empty stomach, exposure to the influence of cold and damp, or possibly to infectious diseases, is believed to be greater than at other hours in the day. Physicians visiting cases of infectious diseases do well to go only at a time of day when they have recently taken a full meal and when they are not suffering from extreme fatigue.

Men differ greatly in the amount of exercise which they find necessary to keep them in good health and maintain a normal appetite. To keep a really vigorous man in the best bodily condition he should take daily exercise amounting to one hundred and fifty foot tons of work, or an equivalent of a walk on a level of about nine miles; but very few are able to accomplish this excepting day labourers.

The influence of food upon muscular activity has been studied by Hodge, who constructed a movable cage so arranged that any movements of the animal which it contains are communicated to the cage itself, and through it to a recording tambour and kymographion. In this manner the restless activity of the hungry animal seeking for food about its cage is recorded, as well as the indolence produced by a satisfying fatty diet and the stimulating effect of nitrogenous food. For example, he demonstrated that a mouse well fed on cornmeal alone may be active but a few minutes in the day, whereas the same animal fed upon meat and cream alone will exercise for ten hours out of the twenty-four. This is no doubt due to combined effects of the influence of the feeling of satiety, exhilaration, varying functional activity of different organs of digestion, and of the circulation and nervous system. It is to be hoped that future investigations will differentiate more clearly between these factors.

REST AND SLEEP AND DIGESTION

The custom of spending half an hour in making a leisurely toilet for dinner is beneficial in giving the rest to mind and body which puts the latter into the most favourable conditions. Dyspeptics and persons subject to an irritable or feeble digestive system can often derive much benefit by observing the rule of not eating when suffering from bodily or mental fatigue. They should lie down from half an hour to one hour and quietly rest before each meal, which may then be digested in comfort. Muscular fatigue and overexertion demand food for the replenishment of waste material, but the immediate digestive process is much facilitated by an intervening period of rest. It is often advisable for them to rest (but not sleep) for a similar time after meals. The practice of sipping hot coffee after dinner and of smoking a cigar is conducive to the rest which should be taken, whenever possible, after the ingestion of a heavy meal.

Sleep is often affected by the amount of food taken. Overeating with lack of physical exercise combined with sedentary habits and brain work, is very apt to produce sleepiness.

Sleep in Relation to Meals.—During profound sleep the different functions of the body are all more or less reduced in activity, and the motility of the stomach is lessened. The rate of circulation and respiration becomes slower, and gland secretion and digestive processes are retarded. For this reason, after eating a heavy meal at night, it is unwise to retire for two or three hours until the stage of gastric digestion is in part completed. It is true that many of the lower animals, particularly the carnivorous, who eat very frequently, are accustomed to lie down and sleep immediately after taking their food, but their functions in so many ways differ from those of man that but little is to be gained by a comparison with them, and their sleep is usually light until digestion is accomplished. On the other hand, in man, if profound sleep follows the eating of a heavy meal, digestion is very apt to be disturbed. A large volume of blood is kept in the abdominal vessels during digestion, and the cerebral circulation must be modified in consequence. It is possible also that the various products of nutrition which are being absorbed into the blood may act in stimulating the central nervous system in peculiar ways. Such sleep is restless, and is disturbed by dreams and nightmares, and even feverishness.

On the other hand, a light doze, in cases of exhaustion and for the aged, taken for half an hour after dinner, does certainly no harm, and may promote digestion by allowing more blood to be diverted to the digestive organs, none being required for other activities.

Persons whose health is below the average on account of disorders of digestion and assimilation not infrequently find that they become very sleepy after eating, more particularly after eating a heavy meal at noon; this condition is sometimes very annoying, and always indicates a lack of balance between the income and output of energy, which must be regulated by proper attention to diet and exercise. Usually in such cases the difficulty consists in habitually eating more food than the system can appropriate, and cleansing the body through the emunctories, with a temporary reduction in the quantity of food eaten, will remove it. In other cases the trouble arises from the exhaustion of the nervous system, which is unable to properly conduct two functions at once—that is, to regulate digestion and at the same time exercise the mind. Obviously, in such cases, rest and tonic treatment are indicated. The food should be given more often, but in small amount.

In England the custom is very prevalent among some classes of people outside of the larger cities of taking four meals a day. A breakfast at about eight o'clock and dinner from one to two, and a heavy tea—that is, a lunch with tea and some solid food—between five and six, which is followed by supper from eight to nine. This practice is well adapted for some persons, especially young, growing children at school (see Diet in Schools), but older children are apt to overeat if they follow such a custom. An interval of from one and a half to two hours should elapse between eating supper and retiring, and from two to three hours between dinner and bedtime if the alimentary canal is too empty; sleep will be retarded on this account, and the earlier stages of hunger before great exhaustion has occurred may be accompanied by restlessness and insomnia. A very little food taken into the stomach under these conditions will often produce sleep promptly. The aged, whose systems are susceptible to slight changes in their condition or environment, are liable to become sleepy after their meals, and they find it to their advantage to take a brief nap after dinner; but this sleep is not usually profound, and if it is too prolonged it indicates exhaustion, which should be met by more careful attention to the diet and stimulation.

Hunger produces wakefulness and restlessness, and starvation may cause persistent insomnia. Going to bed late without dinner or supper results in restlessness and insomnia, which may often be cured by taking a glass of hot milk, or a cup of chocolate and some light farinaceous article, or a light sandwich and a bottle of beer. In all ordinary cases of insomnia it is well to see what help can be got from diet and regular habits before resorting to hypnotics. (See Insomnia.)

In some diseases, notably diphtheria, it becomes a grave question between nourishment and sleep as to which is the more important. Vigorous local measures may be needed to control the spread of the membrane in the throat, necessitating half-hourly applications day and night, which of course interrupt sleep; and yet the patient may need to be wakened for such applications, and the giving of nourishment and stimulants as well. Sleep is often more needful than food, and it is the duty of the physician to see that there is a proper balance between them. In general, in exhausting disease, protracted typhoid or other fevers, etc., nourishment must be given once in two hours day and night; but if the patient does not fall asleep readily at night after being aroused for food, the intervals may be made three-hourly, and as strength returns, four-hourly. In such cases it is sometimes well to relax the rule, and give the patient one good night's rest of five hours without awakening him for food; but the degree of exhaustion and need of cardiac stimulants must be the guide in each separate case.

MENTAL EMOTION AND DIGESTION

Strong mental emotion, such as fright, terror, or excessive excitement of almost any kind, inhibits the digestive functions, especially in the stomach, but also in the intestines. Such emotion may be accompanied by vascular disturbances which will react upon the digestive organs, and in addition there seems to be a diversion of nerve currents from their proper course. Pleasurable emotions, however, affect digestion favourably, and the expression " laugh and grow fat " is certainly not without physiological basis.

Hufeland wrote that " laughter is one of the greatest helps to digestion with which I am acquainted, and the custom prevalent among our forefathers of exciting it at table by jesters and buffoons was founded upon true medical principles."

Prolonged anxiety and worry, in almost every instance, result in more or less gastric indigestion and malassimilation, so that, although the appetite may remain good, nervous dyspepsia, constipation, and loss of weight result.

FOOD IN THE MOUTH

The proper care of the mouth in relation to diet is an important subject which is frequently overlooked. In patients who are unable, from weakness or the prostration of fever, to use solid food or to cleanse the mouth themselves, lack of movement in the tongue and buccal muscles prevents proper cleansing of the teeth, and particles of food accumulate about the gums. In extreme weakness of the facial muscles the jaw drops and mouth breathing results. The air passing through the mouth evaporates the moisture present and gives rise to dryness of the tongue, which may become so extreme as to interfere with deglutition and articulation.

In such cases the mouth should be frequently moistened by the nurse and swabbed out by some antiseptic, such as a saturated solution of boric acid or diluted Listerine. This topic will be more fully treated under the heading Dietetic Treatment of Typhoid Fever.

Food which is allowed to collect in the cavities of decayed teeth favours the development of bacteria, which on being swallowed may become a cause of dyspepsia by exciting malfermentation in the stomach, especially of milk. Much bacterial filth accumulates beneath artificial teeth which are not frequently cleansed.

Imperfect or painful teeth, or swollen gums, interfere with the proper mastication of food, and when such conditions are present care should be exercised that all food eaten be soft and bland. This applies particularly to young children, very old persons, and the insane, who are incompetent to take care of their own mouths.

The digestion of non-nitrogenous food begins in the mouth, and depends upon the activity of the salivary ferment ptyalin, which converts starches into dextrin and maltose. In health this action is prompt and vigorous, and much of the starchy food is digested in the mouth, in its transit along the œsophagus, and also in the stomach, until the gastric juice becomes so acid as to check the process, for ptyalin is most active upon the alkaline side of the neutral point, and strong acidity inhibits its power. Chittenden has demonstrated that after neutralising saliva, ptyalin fermentation proceeds well in the presence of 0.005 per cent of hydrochloric acid, but stops with 0.025 per cent. Dufresne is responsible for the statement that ptyalin recovers its activity in the alkaline intestine, but that diastase is completely destroyed by the gastric juice.

In feeble and ill-nourished persons the salivary digestion becomes much impaired, and consequently their farinaceous food should be partially dextrinised artificially by diastase or by prolonged cooking.

An acid reaction in the mouth may be present because of fermentation, not because the saliva itself is acid. In rheumatism the saliva is very often acid. This reaction causes a sensation of dryness, lessens the taste for food, and gives rise to thirst. Saliva which is rich in cells and mucus is too viscid, and does not moisten the food properly during mastication. When salivation is present the ptyalin becomes too dilute to have any digestive action upon starchy foods. If swallowed, the too abundant saliva carries much air into the stomach; and if it is alkaline, it neutralises the gastric juice. A dry diet (see Dry Diet) will sometimes improve this condition.

FOOD IN THE STOMACH

Much controversy has arisen over the question as to how far the stomach performs the essential work of digestion, and how far the intestine is responsible for it. Some writers argue that the stomach is a comparatively useless organ except as a receptacle, and that the small intestine, with the different juices which are poured into it, is abundantly capable of doing alone the entire digestive work. The entire stomach has been excised from man and in several cases a fair measure of digestion has been retained. In these operations the œsophagus is united to the duodenum.

The only really important action of the stomach consists in digesting a single class of foods—namely, proteids—and this process is not always finished, whereas the intestine digests not only proteids, but fats, starches, and sugars. The digestion of starch, inaugurated by ptyalin in the mouth, is continued for a varying length of time in the stomach, until the hydrochloric acid reaction of the gastric juice becomes sufficiently strong to inhibit it. The period of this amylolytic digestion may be prolonged in the stomach by administration of diastase. The period of the unaided digestion of starch is usually stated to be only 15 or 20 minutes, but according to the researches of Austin it is much longer—one or two hours, so that but little starch digestion may be left for the pancreatic juice to complete. The stomach warms and macerates all the food, so that it relieves the small intestine of much preliminary work. Gastric digestion is hindered by either acids or alkalies used in excess, by metallic salts, strong alcohol, and by regurgitation of bile from the intestine. Gillespie has found as many as twenty-four varieties of bacteria in the intestine, most of which are harmless.

Quantity of Gastric Juice and other Digestive Fluids

No reliable estimates of the exact quantity of gastric juice, or, in fact, of any of the digestive fluids, are obtainable. At best, such estimates vary greatly according to different authorities. An abundant secretion is not necessarily an active one in ferment or acid, and the constant reabsorption of the water makes it quite impossible to say how much fluid has been secreted, for if the digestive juices be drained off and measured, the natural conditions are disturbed. Bile or pancreatic fluid allowed to drain off constantly through a fistula soon becomes altered in quality and weakened in digestive power.

The estimates of the total quantity of the digestive fluids secreted per diem extend from three or four quarts to three gallons, and it is almost impossible to make exact measurements.

Secretion of the Gastric Juice

When food enters the stomach it immediately excites the secretion of the gastric juice. This it does at first through mechanical action, either upon the nerves or the cells of the gastric tubules themselves. The purely physical character of the food which is taken into the stomach will therefore, to some extent, affect the rate of secretion as well as the composition of the gastric juice, and foods are often spoken of as being either bland or irritating. The former are those which are soft or in a fine state of subdivision, such as well-cooked farinaceous articles. The latter are the coarser forms of food and condiments, especially pepper, mustard, curry, pickles, etc., which have a more specific influence in increasing the flow of juice. This is probably due to reflex action through the nerves of the gastric mucous membrane.

The gastric juice is secreted more abundantly in response to the chemical stimulus of some substances than others, as, for example, sodium chloride and carbonate and alcohol when taken in moderate dilution. If, however, they are taken to excess they cause derangement of the gastric function, and congestion ensues with secretion of a neutral or alkaline mucoid juice instead of the true acid secretion.

Haidenhain has observed that the mechanical pressure of food against the stomach wall may be comparatively local and circumscribed, whereas the chemical stimulation of the food as soon as it begins to be felt, causes abundant secretion from the whole surface of the stomach, which becomes red and turgescent from increased vascularity.

The flow of juice commences almost immediately after the food has entered the stomach, and it continues to be secreted in varying quantity for two or three hours. After this period the secretion gradually diminishes. If the food has not been properly digested within a limit of three and a half hours, it may fail to pass on into the intestine, and while remaining in the stomach it undergoes various processes of malfermentation which are wholly different from the normal. These processes will be more fully discussed under the headings of the several forms of dyspepsia. By examining the interior of the human stomach when a fistula has been made, it appears that if the organ is empty, merely irritating the mucous membrane by rubbing its surface gently with a glass rod provokes the secretion of juice, which first appears in little clear drops at the site of irritation. These gradually coalesce and form tiny rivulets which run over the mucous surface to the most dependent portion of the stomach. At the same time the mucous membrane becomes somewhat congested and of a pinkish hue, owing to the greater quantity of blood which circulates through it.

Hydrochloric Acid

Hydrochloric acid exists in the human gastric juice in the average proportion of 0.2 per cent. Experimentally it is found that the best proteolytic digestion results with 0.1 to 0.2 per cent of hydrochloric acid. The acidity is reduced upon a vegetable diet.

The acid is secreted during active digestion but not normally at other times. It is often diminished in quantity, and less often it may be abnormally increased. Its action upon proteid foods like egg albumin, blood fibrin, and meat, is to cause them to swell and become somewhat translucent. It contributes the necessary acid reaction in which the ferment pepsin causes solution of these and other proteids and converts them into albumoses.

The quantity of free acid obtainable from the stomach is not great when much proteid food has been eaten, although its secretion may have been considerable. The secretion of the acid begins shortly after the ingestion of food, and reaches a maximum within about an hour. After an hour or two longer, according to the nature and quantity of the food present, it lessens and finally ceases.

According to the views of some writers, the first acid formed in the stomach is lactic acid, which joins the alkali of chlorides in the blood, and liberates chlorine to form hydrochloric acid. Maly has advocated the theory that the hydrochloric acid was formed from the action of phosphates in the blood serum, splitting up the chlorides so that the highly diffusible hydrochloric acid passes readily out upon the free surface.

Roberts furnishes the following table illustrating the effect of varying quantities of hydrochloric acid on the speed of peptic digestion:

2 grammes beef-fibre; 1 c. c. glycerin extract of pepsin; varying proportions of hydrochloric acid; water to 100 c. c.

Proportion of dry HCl in the digesting mixture.	Time in which digestion was completed.
0.05 per cent	500 minutes, almost no digestion.
0.08 " "	200 "
0.1 " "	130 "
0.15 " "	115 "
0.2 " "	100 "
0.3 " "	115 "
0.4 " "	160 "
0.6 " "	350 minutes, embarrassed.

The acid has an antiseptic influence, preventing the decomposition of food, and even checking it if already begun. It is also believed to possess an influence over the formation of pepsin. Brücke claims, contrary to many observers, that the acid of the stomach makes starch more soluble, and that much of it is also converted by lactic-acid fermentation in the stomach into erythrodextrin.

Pepsin.—According to Chittenden, pepsin is a hydrolytic ferment which is found in the cells of the tubules of the gastric mucous membrane, chiefly near the cardiac portion. It exists in these cells in an antecedent form, or as a granular "proenzyme," which is called pepsinogen or propepsin, and the agent which is believed to convert the propepsin into true pepsin, the active ferment, is hydrochloric acid. This theory assigns a new function to this acid. Lactic and acetic acids derived from food possess the same power in lesser degree. Like the other digestive ferments, pepsin belongs to the class of colloid or non-crystallisable, indiffusible substances.

Pepsin digests coagulated egg albumin even better than fibrin, gluten, casein, myosin, and gelatin, and hence this substance is commonly employed in making quantitative tests of the relative digestive power of different preparations of the ferment. The standard of the United States Pharmacopœia requires that pepsin shall dissolve three thousand times its own weight of coagulated disintegrated egg albumin. The rapidity of digestion is augmented only up to a certain point by increase in the quantity of pepsin, but beyond this limit it has no accelerating influence—no influence at all, in fact.

Pepsin reaches its maximum activity at a temperature considerably higher than that of the body—namely, 130° F. Its action is suspended below 40° F., and destroyed between 160° and 170° F.

The secretion of both pepsin and the rennet ferment or rennin which is often associated with it seems to rise and fall with that of hydrochloric acid, but this is not always the case.

Rennin has been described on p. 72.

Albumoses, Peptones.—The final product of food digestion as accomplished by pepsin with the hydrochloric acid of the gastric juice is peptone. Kühne showed that peptone is seldom, if ever, pure in the stomach, but the substance produced is a mixture of true peptone with proteoses or albumoses, which have reactions that in many respects are similar. The albumoses are more highly diffusible than peptones. Undoubtedly both peptones and albumoses are formed during digestion, and both may be absorbed.

Albumoses, like peptone, give a violet colour when added to a dilute Fehling solution of copper sulphate, and on boiling with nitric acid they exhibit a yellow colour and a precipitate which alternately falls on cooling and disappears upon warming. The albumoses may be separated from peptones by complete precipitation by saturation in aqueous solution with sulphate of ammonium. Bauer states it as his belief (Dietary of the Sick) "that the peptones do fulfil in the organism all the functions of the albuminous bodies, since they are again turned into coagulable albumin"; but dissolved albuminates are not necessarily converted into peptones before they are capable of absorption (Voit and Bauer).

Politzer, Gerlach, and others have demonstrated experimentally that albumoses can support nutrition and even cause gain in weight when given alone and free from peptones, and Hildebrandt found that the nitrogen of albumoses artificially fed to animals was utilised in the nutrition of the body to an even greater degree than the peptones of meat.

An excess of proteids overworks the liver and produces, on reaching the general vascular system, various nervous disorders, and, it is believed by many, lithæmia and gout as well.

Peristalsis.—In addition to exciting secretion upon entering the stomach, the food, at first by mechanical action and subsequently possibly through chemical stimulation, excites more or less rhythmical peristaltic movement in the muscular coat of the stomach. The object of this movement is fourfold: 1. To mingle the contents of the food thoroughly with the gastric juice. 2. To cause moderate trituration of the particles of food which are made to move in currents that proceed along the greater curvature and pass back to the cardiac end along the lesser curvature. 3. To bring the food in contact successively with different portions of the mucous membrane, and to thus stimulate it and favour the absorption of such ingredients as this division of the alimentary canal is capable of taking up. 4. To favour the occasional emptying of a portion of the contents of the stomach into the duodenum, the movement at this time being accompanied by a relaxation of the pyloric orifice.

Peristaltic action is influenced by the nature and composition of the food ingested, and it may be also stimulated in other ways, which will be more fully described in connection with intestinal peristalsis (see Diarrhœa and Constipation), for it may be said in general that those stimuli which effect intestinal peristalsis also influence this peculiar movement in the stomach.

DURATION OF GASTRIC DIGESTION OF DIFFERENT FOODS

Bauer says: " By the digestibility of a food one can obviously understand nothing more or less than the sum of the resistances that it offers to the action of the gastric juice."

The time required for gastric digestion cannot be stated with absolute accuracy. In general, the period for the full digestion of a mixed meal consisting of bread, meat, and vegetables is three and a half hours, but because some kinds of food are thoroughly digested in the stomach, while others are acted upon but little if at all, the preponderance of one or other article of food in a mixed diet may affect somewhat the whole period of digestion. Tables are sometimes given in text-books of physiology in which the time required for digestion of various kinds of meat are stated in a very definite manner, but all such statements should be received with ample allowance for ordinary variations. If one considers for a moment the different elements concerned in the process of gastric digestion, it is obvious that the normal time required for complete digestion will vary constantly, even in the same individual in a state of health, for it depends upon the kind of food eaten as well as the following conditions: 1. Its state of subdivision, its solubility, complexity, and the process of its cooking. 2. The rapidity with which it is swallowed. 3. The thoroughness with which it is masticated. 4. The activity of the stomach at the time. 5. The interval which has elapsed since the previous meal. 6. The condition of the blood and nerve supply of the gastric glands. 7. The activity of peristaltic movement, which may either retard or hurry the rate of emptying the stomach. 8. The amount of fluid drunk with which the gastric juice is diluted. 9. The strength of the important ingredients of this juice, its volume, and the effect upon it of food itself, neutralising it or not. 10. The rate of absorption. 11. Habit. 12. Idiosyncrasy. 13. The presence of excess of fat or other materials incapable of digestion in the stomach. 14. The diversion of the nervous energy required for digestion to other functions, such as mental or muscular work.

Such statements are often definitely made in articles upon dietetics as that boiled mutton requires three hours for stomach digestion, while roasted mutton requires three hours and eighteen minutes; that raw oysters require two hours and fifty-five minutes and roasted oysters three hours and eleven minutes; that boiled carrots require three hours and sixteen minutes, and the like. These figures may impress the lay mind as being of interest and accuracy, but when the above considerations have been taken into account, it must be seen that they are far from reliable. It is important, however, to state, if possible, the approximate time required for the digestion of certain general classes of food, and the following estimates are probably as nearly correct as possible in view of the above statements.

The average time required for meats cooked by broiling, roasting, or boiling is fully three hours or three and a half hours for their complete digestion. Gigglberger found, as a result of feeding patients with test meals and withdrawing the stomach contents through a tube, that meat requires from two and a half to five and a half hours for digestion, according to its quality, method of cooking, etc. Stewed meats need less time than roasts. Pork and very fat meat may require four or five or more hours for digestion, and veal needs at least four hours. Fresh lamb may be digested in two and a half to three hours. Chicken, capon, and turkey may be digested in from two to two and a half hours, but the meat of many of the forms of wild birds, such as ducks, may require four hours. Some of the viscera of animals which are eaten as food, such as brains, tripe, liver, and kidneys, are digested in less time—approximately two hours. Fish and shellfish require from two and a half to three hours for their digestion. Raw eggs are usually digested in less time than cooked ones, and they may be ready for absorption in two hours, whereas hard-boiled eggs require at least three and a half hours. Milk is usually digested somewhat sooner when boiled than if raw. Milk whey is absorbed from the stomach, but the curds often pass on into the duodenum.

The majority of the heavier vegetables, such as peas, beans, corn, beets, turnips, etc., remain in the stomach between three and three and a half hours, but potatoes, if baked and mealy, may remain but two and a half hours. Raw vegetables, such as coleslaw or raw cabbage and lettuce, etc., may remain two and a half hours or more in the stomach, and the same is true of most raw fruits, such as berries, apples, pears, peaches, etc. The more digestible cereals—rice, sago, tapioca, etc.—should pass on from the stomach within two hours. Fats and oils taken alone may remain in the stomach only a few moments. Sugars may, to some extent at least, be absorbed from the stomach wall in the course of the first hour of digestion.

Since gastric juice is fairly constant in composition, its effect in health upon the duration of digestion of the same kind of food may not vary in the same individual; but persons differ from one another very much in the rapidity of their digestive processes. In some persons, even in health, stomach digestion may be uniformly an hour or more slower than it is in others. Variations from the usual period of digestion are almost always upon the side of its retardation. The quality, composition, and quantity of the food all affect the rate of gastric digestion.

Coarse food, badly cooked starchy food, excess of fats, tough-fibred meats, unripe fruits or vegetables, all retard digestion, and may prove very irritant.

Among articles of diet, substances are sometimes eaten which are purely refuse material, such as the skin of potatoes and of coarse fruits, grape seeds, shells, soft-shell crabs, etc.

They may pass on unaltered into the intestine and cause diarrhœa, or they may sometimes linger for several days and excite reflex irritation. I have known undigested capsules of cod-liver oil to be retained in the stomach for three or four days before being vomited. (See Cod-liver Oil, p. 205.)

The temperature of food and drink affecting gastric digestion is discussed under the heading Temperature and Digestion (p. 338).

DIGESTION OF PROTEIDS IN THE STOMACH

The various albuminous foods are digested best, each with a different degree of acidity, and it is probable that throughout a meal the intensity of reaction of the gastric juice varies considerably, becoming stronger as more food is absorbed or more juice is formed, or weaker as more of it passes with the chyme into the pylorus or as it is more diluted with additional food or drink. In this manner the different proteids are all certain of a fair opportunity for timely digestion.

The products of albuminoid digestion in the stomach have been carefully analysed by Kühne and Chittenden, and are found to succeed each other in the following order:

1. Albuminoids or proteids.
2. Syntonin or acid albumin.
3. Albumoses or proteoses—proto-albumose, hetero-albumose, deutero-albumose. The three latter form—
4. Peptones.

Raw meat in the stomach turns grey-brown and swells. It takes longer to digest meat raw than when cooked, for the fibres are penetrated less easily by the gastric juice. An exception to this occurs when the raw meat is first scraped or made into a pulp. In the digestion of meats Frerichs found that the connective tissue is first broken down by the gastric juice, then the sarcolemma, and finally the substance between the striæ of the muscle fibres.

Vegetable albumin is digested in the stomach in a manner quite similar to the digestion of animal proteids.

Gluten and *vegetable casein* are also dissolved by the gastric juice when strongly acid.

Gelatin is one of the substances most easily dissolved in and absorbed from the stomach. It is altered by the hydrochloric acid of the gastric juice, so that it can no longer be solidified by cold. It is finally converted into diffusible substances somewhat resembling peptones, but not identical with them.

ABNORMALITIES OF GASTRIC DIGESTION

(The clinical examination of the stomach contents is described under that heading.)

Hypersecretion.—Hypersecretion of gastric juice gives rise to thirst, sour eructations, more or less epigastric distress, and it often accompanies dilatation of the stomach. The secretion may digest proteids well, but carbohydrates are ill borne in this condition, which is believed to be chiefly caused by some form of neurosis. An excess of more or less acid gastric juice passes on with the chyme into the small intestine, and causes an acid reaction therein, requiring more of the intestinal digestive fluids—bile, pancreatic juice, etc.—to neutralise it. The saliva is often increased at the same time, and Roberts suggests that this may be a provision of Nature to neutralise the acid in the stomach.

Hyperacidity.—Hyperacidity, or increase in the hydrochloric acid of the gastric juice, does not necessarily imply hypersecretion of juice. Hypersecretion may be abundant, watery, and weak in acid, or more concentrated with stronger acid, or normal in quantity but with increased hydrochloric acid.

Hyperacidity is common, and is especially apt to be present in connection with gastric ulcer and certain forms of chronic dyspepsia.

Absence of Hydrochloric Acid.—The persistent absence of hydrochloric acid from the gastric contents does not absolutely indicate the presence of any one disease, but rather that a considerable extent of the gastric mucosa is diseased, or it may be absent in nervous dyspepsia without organic lesion. This condition may exist with carcinoma.

Pyrosis.—Pyrosis, or eructation of gas from the stomach, if it occurs very soon after ingestion of food, is usually due to lactic or other organic acid fermentation. Occurring later, during active digestion, it may be due to the same cause or to hyperacidity from excess of hydrochloric acid. The latter condition is less common when due to lactic acid; the giving of hydrochloric acid stops further fermentation, whereas sodium bicarbonate, although it momentarily neutralises the lactic acid, soon produces an alkaline reaction in which the further development of the acid rapidly proceeds. On the other hand, pyrosis due to hydrochloric acid must be checked by alkalies.

FOOD IN THE INTESTINE

After preliminary maceration under the conditions of the moisture, warmth, and motion in the stomach, and after partial digestion there, the food, mixed with gastric juice, passes in a pultaceous mass, known as chyme, into the duodenum. Here the physical conditions are almost identical with those found in the stomach, but the chemical composition of the new digestive fluids—namely, the bile and pancreatic and intestinal juices—is alkaline, and a number of new ferments complete the solution and digestion of the food.

The starches which were but partially digested by the saliva are converted into dextrin, maltose, and glucose by a diastatic ferment—amylopsin—contained in the pancreatic juice. Cane sugar is converted by the intestinal juice into glucose, any proteids which have been but partially digested in the stomach are completely converted into proteoses and peptones by the proteolytic ferment trypsin of the pancreatic juice, and the fats are emulsified and saponified by the combined action of the bile and a pancreatic ferment.

Pancreatic juice is the most active and comprehensive digesting fluid of the body. It is not only much stronger than the gastric juice in its action upon proteids, being able to form peptones with fewer intermediate products, but it possesses the distinct advantage that it also digests fats and carbohydrates by a ferment, called steapsin, which acts in either acid or alkaline media.

Its amylolytic power is stronger than that of the saliva, for it digests the raw starch and cellulose which is eaten in such vegetables as celery, lettuce, or radishes, and in fruits like the apple.

The ultimate products of trypsin digestion are antipeptones and hemipeptones. The ferment acts best in a fluid medium rendered alkaline by from 0.5 to 1 per cent sodium carbonate. It also digests proteids energetically in a neutral medium, but free acid soon destroys it. Chittenden has shown that combined acids do not necessarily put a stop to trypsin proteolysis.

The bile plays several rôles in intestinal digestion, but its chief action is in aiding the emulsion of fats, described below. It can accomplish the absorption of fats even in the absence of pancreatic juice. When bile is absent the fatty food may decompose in the intestine and develop gases and foul odours.

Voit says that the white colour of icteroid stools is dependent rather upon the presence of undigested fat than the absence of bile, for with a meat instead of a milk diet they may still be of a dark colour. When a biliary fistula is made in dogs and the bile is drained away, they emaciate and have a ravenous appetite if fed upon meats and fats, but not if fed upon carbohydrates (Voit).

The quantity of bile secreted is increased by a nitrogenous diet, and diminished upon an exclusive fat diet (Uffelmann). Vegetable foods colour the bile green; animal foods make it yellow or orange.

Bile is often said to prevent putrefactive changes in the food in the intestine. It is not, however, an antiseptic substance, for, unlike the gastric juice, it easily undergoes decomposition, and the influence attributed to it is due rather to its promotion of peristalsis, thereby keeping the intestinal contents moving and preventing stagnation and putrefaction.

The Digestion of Fats.—When fat is cooked in the food, a good deal of it is converted into rancid fat—i. e., fat containing free fatty acids. In the mouth the fatty food is unaltered, unless it be in the form of adipose tissue, when the process of mastication breaks it down and liberates some of the fat globules, which are melted by the natural warmth. If eaten in the form of oil or butter, with starchy or vegetable food, the fat coats the particles of food in the mouth. Bread thus mingled with butter is less likely to form a large and too tenacious bolus.

In the stomach the fat remains unaltered, and when the semifluid chyme begins to flow into the intestine it passes in with it. The connective-tissue elements of fatty meats, etc., are dissolved away and digested like other proteids by the gastric juice.

In the intestine the fat is subjected to a double process of emulsification and saponification, which is accomplished by the combined action of the bile and pancreatic juice. The latter splits fats into glycerin and fatty acid, and this action is favoured by the admixture with bile, which simultaneously occurs in the duodenum. According to Rachford, the fat-splitting power of pancreatic juice is more than quadrupled by bile, although the latter has no fat-splitting influence of its own. He also declares that the presence of hydrochloric acid which has just entered the upper duodenum with the chyle, like the bile, still further aids the pancreatic action upon fats, as four to one.

It is held by the majority of authorities that pancreatic juice also contains an emulsifying ferment, steapsin, and that the free fatty acid above described splits up the sodium bile salts and liberates their sodium, which unites with a portion of the free fatty acid, forming a soap. The soap coats the droplets of emulsified fat with a thin film (like a soap bubble) and prevents them from coalescing again. The emulsion is then absorbed by the lacteals.

It is, however, not a necessary part of the theory of digestion of fatty food that the fat must all be emulsified. No doubt a large part of it is absorbed more directly or as a soap without emulsification.

Extracts of both the liver and spleen have been said to favour the absorption of fats by emulsification.

Undigested food reaches the intestines under the following conditions: (*a*) When too much food is eaten, (*b*) when gastric digestion is imperfect, (*c*) when the food is improper.

Intestinal Gases.—During the digestion of certain foods in the intestine more or less gas is evolved. The gas, by distending the walls of the gut, serves the purpose of keeping them from agglutinating, and thereby facilitates the free movement and intermingling of the digestive fluids and food, and the absorption of the latter.

Ruge has published the following table of the percentage of gases evolved by several different kinds of foods:

Food.	Milk.		Meat.			Peas or Beans.		
	1.	2.	1.	2.	3.	1.	2.	3.
CO_2....	16.8	9.9	13.6	12.4	8.4	34.0	38.4	21.0
H......	43.3	54.2	3.0	2.1	0.7	2.3	1.5	4.0
CH_4....	0.9	....	37.4	27.5	26.4	44.5	49.3	55.9
N_2.....	38.3	36.7	45.9	57.8	64.4	19.1	10.6	18.9

ARTIFICIAL DIGESTION

To physiologists we are indebted for the discovery and development of the scientific preparation of digestive ferments or enzymes and the predigestion of food outside of the body. The composition of the various digestive ferments and their action in general have been understood for a long time, but it is only within the last two or three decades that the use of these organic bodies has been made practicable on a large scale for rendering food more digestible or assimilable by invalids, and the whole question of artificial digestion of foods is one which is receiving more and more careful attention and thorough study. The subject may be said to be yet in its infancy, and it is highly probable that the extensive researches which are being conducted by so many investigators at the present day will yield even more practical and important results than those already attained. The use of predigested food at present forms an indispensable adjunct to the treatment of a large number of serious diseases, both acute and chronic, especially those which concern the alimentary canal, and the methods of infant and invalid feeding have been practically reorganised by it.

The different ferments which can be used for increasing the activity of digestion within the body or for partially digested foods outside of the body are principally diastase, pepsin, and extracts of pancreatic juice, which are usually called " pancreatin," and which are compounds of several substances. Besides these there are several vegetable ferments, such as papain from the American papaw, and ferments are present in the juice of the pineapple, and the century plant or agave.

Predigestion of Starches

There are a variety of ferments and other materials which have the power of converting starch into dextrin and sugar. They are ptyalin in the saliva, amylopsin in the pancreatic juice, diastase, a ferment in the intestinal juice, and the substances inulin and lichenin. The latter is obtainable from various lichens, such as Iceland moss. Mucin and certain gums are also amylolytic.

Of these different ferments, the one which is found to be of most practical service for predigestion is diastase.

The action of the diastase of malt resembles that of the ptyalin of the saliva and the amylopsin of the pancreatic juice, which alter starches into dextrin and maltose. It is prepared in several ways, as, for example, in meal of malt, which may be added to farinaceous foods, and in the form of malt extracts, and various malted foods (malted milk, etc.) are sold for invalid use or for infant feeding.

Taka-diastase is a stable concentrated form of diastase, said to possess the power of converting 100 times its weight of starch into sugar in ten minutes. The dose is 2½ grains after eating.

In such preparations the predigestion of amylaceous foods is carried to the extent of more or less complete conversion of the starch into dextrin and maltose. The diastase has no action in the stomach provided the acid gastric juice is being secreted, for it only causes fermentation in a neutral or alkaline medium; in fact, the ferment is probably destroyed before reaching the intestine, but it may act in the stomach for half an hour or so before the reaction of the gastric juice becomes too strongly acid. The presence of alkaline carbonates retards the action of diastase. In early infancy the amylolytic ferments of the salivary and pancreatic fluids are not well developed and are very meagre in quantity. If a young child is unable to digest milk for any reason, malted food may be temporarily supplied in some cases, because in it the starch is already more or less completely digested and is ready for absorption. In general, the value of malted foods and malt extracts depends upon the predigested starch which they contain, which furnishes nutrition, rather than upon the action of the diastatic ferment within the alimentary canal.

Ground malt itself possesses even stronger digestive action upon starches than malt extracts. The latter contain the ferment diastase, dextrin, maltose, and a portion of the salt and some nitrogenous ingredients of barley. Both ground malt and malt extracts digest starches at a moderate heat, not exceeding 150° F. There are many varieties of malted foods, but Liebig's Infant Food is a good illustration of this type. It is prepared as follows (see also p. 151):

Mix a half ounce each of ground malt and wheat flour, seven and one fourth grains of potassium bicarbonate with one ounce of water and five ounces of sweet cow's milk. Warm slowly and stir until thick. Remove from fire, stirring for five minutes, replace over fire, and remove when quite thick. As the diastase continues to act the mass will become thin and sweet. Boil and strain. It contains gluten and albumin of flour and barley, besides dextrin and maltose. The food thus prepared is very nutritious, for it not only contains the proteid materials of the milk, but those also of the wheat flour and malted barley (gluten and albumin), as well as the predigested starch. The malted foods which are made with desiccated milk and malted flour are deficient in fats, salt, and proteid material, but the lack of these substances can be supplied by the addition to the food, when used, of cream and beef juice. The digestibility of bread may be increased by adding 5 grains of diastase to the pound of flour mixed in the dough.

For manufacturing malted foods the wheat or barley flour should be baked in order to rupture the starch granules and make them more soluble.

Predigestion of Proteids

The digestion of proteids may be accomplished either within the body by prescribing pepsin and hydrochloric acid, or without the body by use of the same agents, or, as it is more often done at present, by pancreatinisation.

Pepsin was the first among the digestive ferments to be isolated and employed for artificial fermentation.

This ferment differs from diastase in the fact that it is capable of continuing its digestive functional activity within the body, and it is therefore frequently prescribed in cases of deficient gastric secretion, to be taken with the meals, or immediately after, as a powder or in solution. The action of pepsin is confined to the conversion of albuminous food, and it requires an acid reaction. It is sometimes claimed that the continual administration of pepsin and dilute hydrochloric acid may weaken the stomach by doing the work of that organ while it rests; but it is difficult to see any true ground for the statement, for this action in no wise concerns the stomach wall or its secretion, but is limited to the conversion of food into more easily soluble material, which increases the general bodily nutrition, and therefore indirectly improves the stomach digestion.

Pepsin is destroyed by dilute solutions of sodium bicarbonate as well as by the alkaline pancreatic intestinal fluids and the bile. It is obtained in a number of forms for use in aiding gastric digestion, such as scales, dry powder, pills, and solution. There is considerable variation in the strength of the preparations, depending upon the care taken in their manufacture and differences in the processes of extracting the ferment; but all of them have some digestive action, and they are very serviceable remedies for gastric indigestion.

Peptones or amphopeptones are the ultimate products of stomach digestion. They are derived from primary and secondary proteoses by pepsin proteolysis through hydration and cleavage. In regard to the artificial digestion of proteid foods by pepsin, Chittenden says: "Peptones are truly formed, and many times in large amount, but never under any circumstances have I been able to effect a complete transformation of any proteid into true peptone by pepsin-proteolysis; there is always found a certain amount of proteoses more or less resistant to the further action of the ferment. Even with a large amount of active ferment, an abundance of free hydrochloric acid, a proper temperature, and a long-continued period of digestion, even five and six days, there is never found a complete conversion into peptone. Indeed, the largest yield of peptone I ever obtained in an artificial digestion is sixty per cent, while the average of a large number of results under most favourable circumstances is somewhat less than fifty per cent." Hence, artificial pepsin is not a complete digester, as often supposed, and too great reliance should not be placed upon it.

Pepsin should never be given in combination with an alkali, such as sodium bicarbonate, excepting in cases of hypersecretion of hydrochloric acid with scanty pepsin formation.

The pepsin-secreting cells predominate over the acid-forming cells in the stomach so largely that they are seldom destroyed to the same degree as the latter, and hence pepsin is of much less importance than hydrochloric acid in the treatment of both functional and organic disease of the stomach. It is a very common practice to prescribe it in tablet form without acid, but as a rule, to which there are almost no exceptions other than that of hyperacidity, in those cases in which the exhibition of pepsin is indicated hydrochloric acid is equally if not more important, and they should be prescribed together.

The pepsin is given in doses of three to five or ten grains immediately after meals when proteid food of any kind has been eaten. Ten grains may be added to a pint of milk, but if long continued in excess of twenty grains per diem, it may excite purgation.

Pancreatin is the name given to a complex fermentative body derived from extracting the pancreatic gland. It is obtained in the form of a dry powder, and also as a solution or liquor. Its introduction is mainly due to the researches of Dr. William Roberts, of England.

The extract made from the pancreatic gland is a powerful digestive agent and, on the whole, is more serviceable for the predigestion of food than any of the other ferments. It contains both trypsin and amylopsin. This extract also emulsifies fats, and it is as easy, if not easier, to obtain the pancreatic extract than pepsin, and since its action is so powerful and varied, the majority of the predigested food preparations—the so-called "peptonised foods"—are made with pancreatin instead of pepsin. Pancreatin is sometimes prescribed by physicians for internal use, but unless protected in a keratin-coated capsule the ferments are entirely destroyed in the stomach by the action of the gastric juice. Keratin is a horny substance derived from feathers which is not soluble in acid fluid, but is quite soluble in alkaline media. Hence a capsule containing five grains of pancreatin coated over with keratin may remain undissolved in the stomach until gastric digestion is completed, when it will pass into the intestine, where the coating is dissolved and the ferments act upon the chyle. It is customary to add some alkali, such as sodium bicarbonate, to the pancreatin in the process of artificial digestion, although it will also operate on protein in the presence of a neutral reaction. All the products of pancreatin digestion, as well as the ferment derived from the juice itself, decompose if exposed for any length of time to the air. Pure meat peptones, prepared either by pepsin and hydrochloric acid or by trypsin in alkaline solution, are ready for immediate absorption and are nutritive, but a very general objection to their use exists in the exceedingly disagreeable odour and taste which they possess, which to many persons are nauseating and disgusting. This difficulty is overcome when peptones are used for rectal injection, for which purpose they are most valuable. Efforts are often made to disguise the disagreeable taste and odour of beef peptones in various ways. When obtained in solution, wines and aromatic substances are added to them or they are sometimes evaporated to dryness, pulverised, and redissolved in sherry, but the taste is exceedingly persistent and it is often difficult or impossible to disguise it in any manner, so that patients will not sooner or later object to it. Among the principal peptones which are used are Koch's, Kemmerich's, Catillon's and Carnrick's, Savory and Moore's, and Benger's. Some of the pancreatinised foods are strengthened by the addition of predigested starches and sugars. Some of them constitute very good foods for cases of enfeebled digestion or diminished absorptive power. Among them may be mentioned Benger's Food, which is made with cooked wheat meal and pancreatic extract. The latter partially converts the starches into malt and diastase, and when added to milk at the proper temperature for fermentation, it acts upon the casein and converts it into a soluble peptone. Oat flour and lentil flour are similarly prepared. Carnrick's Infant Food is made on the same principle with Benger's Food, with wheat flour, pancreatin, and milk, to which is added a certain percentage of lactose. Savory and Moore prepare a concentrated predigested milk and milk with cocoa, which have an agreeable taste and considerable nutrient value. Another preparation is Loeflund's Peptonised Kindermilch.

All peptonised or pancreatinised foods are open to the objection that they are much more expensive if used for a long time than the preparations which can be easily made at the bedside by any intelligent person by the use of the simple pancreatin extracts. Among these extracts are Benger's Liquor Pancreaticus and Peptonising Powders and Fairchild's Zymine, which act upon lean meat as well as milk. If complete peptonisation is required, large quantities of the ferment must be used, and the process should be continued longer than for a lesser degree of peptonisation. One or two drachms of Benger's Liquor Pancreaticus with fifteen grains of sodium bicarbonate will completely peptonise half a pint of milk in a few minutes if the bottle be immersed in water which is heated, but which is not too hot for the hand to bear. Roberts's rule for pancreatinised milk gruel is quoted by Yeo as follows: "A good thick gruel made with oatmeal or other meal while still boiling hot is added to an equal quantity of cold milk. The temperature of the mixture will then be about 140° F. To a pint of this mixture two or three teaspoonfuls of Liquor Pancreaticus and twenty grains of bicarbonate of soda are added; it is kept at the same temperature for about two or three hours, and then boiled for a few minutes and strained. This mixture contains not only the casein of the milk peptonised, but the starch of the material is converted into sugar and its albuminates are peptonised. The bitterness of the peptonised milk is scarcely perceptible in this gruel."

Papoid is a vegetable ferment derived from the papaw tree (*Carica Papaya*) which is thus described by Chittenden:

"Extended study of the reactions of the vegetable ferment papoid shows that it is composed essentially of a mixture of vegetable globulin, albumoses and peptone, with which is associated the ferments characteristic of the preparation.

"Papoid, so far as my observations extend, has the power of digesting to a greater or less extent all forms of proteid or albuminous matter, both coagulated and uncoagulated. Furthermore, papoid is peculiar in that its digestive power is exercised in a neutral, acid, and alkaline medium.

"Papoid will act in dilute solutions, but the best and characteristic action is seen only when a small volume of fluid is present. In this respect it differs very markedly from the animal ferment pepsin, and for this reason any direct comparison of the two ferments is practically impossible, but blank experiments without papoid [with acid and alkali as used in these experiments] showed that these reagents have in themselves only a comparatively light solvent action on raw fibrin." After ingesting the ferment it is found in the stools, showing that it is not wholly destroyed in the alimentary canal. The dose is from one to three grains after each meal.

Caroid is a vegetable digestive ferment made, like papoid, from the papaw (*Carica Papaya*) in the form of a dry yellowish powder. According to Chittenden's analysis, it retains a strong proteolytic action in either acid, neutral, or alkaline media. It softens and disintegrates proteids, coagulates milk like rennet, and is also amylolytic. It is a solvent of gastric mucus.

FOOD ABSORPTION

The absorption of food takes place from the stomach to a limited extent, to a great degree from the small intestine, and to a lesser degree from the larger intestine. The rectum is capable of absorbing enough predigested food to sustain life for several weeks. (See Food Enemata.) The entire digestive process does not have to be completed before absorption begins. Usually those foods which are first digested, or which are administered in predigested form, are first absorbed.

The rate of absorption depends upon the degree of digestibility of the food, the extent of absorbing surface with which it is brought into contact by the peristaltic movement, the composition of the blood, the relative pressure in the intestine, blood vessels, and lymphatics, and, probably more than anything else, upon the functional activity of the cells covering the intestinal villi. The accompanying table shows the percentage of food swallowed which is actually absorbed:

Weight of Food.	Absorbed.	Residue.
Of 100 parts of solids of mixed diet	89.9	11.1
" " albumin	81.2	18.8
" " fats or carbohydrates	96.9	3.1

ELIMINATION OF FOOD WASTE

The data given below, which are derived from Bauer, exhibit the balance of income of food and output of waste of the body under different conditions of rest and activity.

Income of Food and Output of Waste (Bauer)

	Rest and abundant diet.	Work and abundant diet.	Small, ill-nourished man; rest and abundant diet.
Income	*Grammes.*	*Grammes.*	*Grammes.*
Meat	139.7	151.3	151.1
White of egg	41.5	48.1	61.8
Bread	450.0	450.0	450.0
Milk	500.0	500.0	509.6
Beer	1,025.0	1,065.9	1,012.7
Suet	70.0	60.2	58.8
Butter	30.0	30.0	30.0
Starch	70.0	70.0	70.0
Sugar	17.0	17.0	17.0
Salt	4.2	4.9	4.3
Water	286.3	489.1	41.4
Oxygen from air	709.0	1,006.1	600.7
Total	3,342.7	3,892.6	3,007.4
Output			
Urine	1,343.1	1,261.1	1,069.6
Fæces	114.5	129.0	137.1
Breath	1,739.7	2,545.5	1,597.8
Total	3,197.3	3,935.6	2,804.5
Balance	+145.4	−43.0	+202.9

The following data are quoted by Yeo:

"According to Dujardin-Beaumetz, a man loses, in connection with the processes of nutrition, nitrogen, carbon, water, and salts. In twenty-four hours these losses [for an adult man at moderate labour], on an average, amount to 20 grammes (300 grains) of nitrogen, 310 grammes (4,650 grains) of carbon, 30 grammes (450 grains) of salts, and 3 litres (about 6 pints) of water. The chief part of the nitrogen (14.5 grammes) passes away in the urine in the form of urea and uric acid, and the remainder (5.5 grammes) in the fæces, perspiration, and mucous discharges. Of the carbon, 350 grammes are consumed in the lungs, 45 grammes are eliminated by the kidneys, and 15 grammes in the other secretions. The water passes off by the skin, lungs, kidneys, and bowels. A man's food must contain the elements necessary to repair these incessant losses.

"The 20 grammes of nitrogen represent 124 grammes of dry proteid matters, and as these contain 64 grammes of carbon, on subtracting the 64 grammes from the 300 grammes necessary for nutrition there remain 236 of carbon to be derived from starch substances or from fats."

When waste matter has accumulated in the system its elimination may be assisted in various ways, as follows:

1. Through active exercise, which produces more complete oxidation and the formation of a larger proportion of water and carbon dioxide.

2. By diuretics, large draughts of saline waters, and occasional doses of saline cathartics.

3. By Turkish baths, which increase the elimination from the skin.

THE URINE AND FOOD

The relation of the composition of the urine to the quality and quantity of the food is highly important.

Independently of renal disease and of excessive perspiration, the occurrence of a scanty urine means that too little fluid is being ingested, and that the nitrogenous waste is accumulating faster than it is being removed.

The urine secretion is normally increased in quantity after meals, and is diminished during fasting and in sleep. The increased rate of secretion lasts for two or three hours, and then lessens. The increase usually begins within an hour after breakfast, but not for two or three hours after dinner. This may be owing to the slower absorption of fluid which occurs with the heavier meal—i. e., while solid food is retained in the alimentary canal, it holds back the fluid like a sponge. The maximum rate of secretion is also reached somewhat later after dinner, sometimes not for four hours.

After mixed meals the quantity of urea is more than doubled, and the phosphates and urates are increased in nearly the same ratio. Proteid foods always increase the output of urea, urates, or uric acid, while vegetable foods increase the phosphates and sulphates.

Klemperer has stated that in diseases characterised by nitrogenous tissue waste the latter is reduced by giving carbohydrates. In other words, the carbohydrates save the consumption of tissue and consequent production of urates or urea.

Meat and albuminous foods in general tend to make the urine more acid, whereas milk and vegetables make it more alkaline.

TOBACCO AND FOOD

The use of tobacco in its relation to digestion is a subject very closely allied to dietetics, but a brief mention of it only can be made here. Like alcohol, undoubtedly most persons are better without it, and its abuse is well known to disorder digestion through the action of nicotine upon the circulation, and especially upon the vagus nerve. No definite rules can be formulated for the use of tobacco in relation to meals beyond those suggested by the fact that the action of tobacco is always less likely to prove irritating if it is smoked while there is abundant food in the stomach. The after-dinner cigar in many persons promotes the secretion of gastric juice, and there are those in whom a mild cigar after breakfast favours peristalsis and the evacuation of the bowels. If there is any tendency to indigestion of starchy or saccharine foods, it is usually aggravated by the use of tobacco in any form.

As observed elsewhere, when food cannot be obtained after fatiguing exercise or a forced march, the moderate use of tobacco is often found to temporarily replace it, at least to the extent of lessening the feeling of weariness. (See Substitutes for Food, p. 286.) Smoking immediately before meals may destroy the appetite and interfere with the digestion of the food.

FOOD EQUIVALENTS

It is easy to compute the chemical equivalents of foods as analysed outside of the body. It is quite another matter to compute them with accuracy within the body. Most writers upon dietetics, however, make some attempt to do this, and the following data may be accepted as approximately correct: One pound of lean beef equals in nutrient value three eggs or two pints of milk. Roast beef contains about the same protein percentage as an egg, but much more fat. One pound of wheat equals 3.5 pounds of potatoes.

Of common cheese, Parkes estimated that "about half a pound contains as much nitrogenous substance as one pound of meat, and one third of a pound as much fat." It requires about 27 pounds of milk to make a pound of butter, and about 10 pounds to make a pound of cheese.

Van Noorden estimates that as a fat former seven grammes of fat equal 9.3 grammes of alcohol.

Oertel says that "one part of fat is iso-dynamic with 2.4 parts of carbohydrates, on an average," and one part of fat develops as much heat and force as 2.11 parts of albumin (Voit).

Church gives the following table of the estimated equivalents of foods which would yield the necessary daily supply of nitrogen if eaten alone:

	Pounds.	Ounces.
Oatmeal	1	10
Eggs	2	..
Lean beef	2	1
Wheat bread	3	13
Potatoes	24	..
White turnips	54	4
Cow's milk	6	8
Rice	3	7

To obtain the necessary daily supply of carbon:

	Pounds.	Ounces.
Bacon	1	..
Cow's milk	8	11
Wheat bread	2	8
Eggs	5	3
Rice	1	11
Turnips	20	..
Lean beef	6	6
Potatoes	6	6

PART VI

THE GENERAL RELATIONS OF FOOD TO SPECIAL DISEASES.—DISEASES WHICH ARE CAUSED BY DIETETIC ERRORS

THE GENERAL RELATIONS OF FOOD TO SPECIAL DISEASES

THERE are two methods of adapting diet for the sick: First, by giving one half, one third, or one fourth of the ordinary quantity of food for health; second, by altering the quality of the different classes of foods, and reducing the total amount simultaneously or not, as required. The former method is simpler and less troublesome, and for some few cases it may prove sufficient. It is to be regretted that it is a routine method adopted in many hospitals, for it is unscientific, besides being often wasteful and radically wrong. The second method presupposes a knowledge of the relations of diet to disease, and requires careful supervision. In speaking of this subject Parkes wrote: "It is certain that the physician can in this way wield a great power, which, if less striking than that obtained more rapidly by drugs, is yet of immense moment."

The same aliments which in health produce definite results in furnishing energy and repairing tissue loss may fail completely in disease. Such is the case in diabetes when starches become not only a useless but a harmful food, and in severe albuminuria, when meats only aggravate the albuminuric waste.

In the majority of severe diseases, and especially of acute and febrile diseases, the proteids and fats, aside from those of milk, become less assimilable than the carbohydrates. Beneke attributes this to the fact that carbohydrates are respiratory foods—i. e., their consumption results in the production of carbon-dioxide gas and water, and the elimination of carbon dioxide proceeds in disease very much as in health. If carbohydrates are not therefore furnished, inanition ensues, for the tissues begin to consume their own substance.

There are, on the other hand, some few diseases, such as tuberculosis, chlorosis, and secondary anæmia, in which proteids and fats may be distinctly required, and others again may temporarily demand a purely nitrogenous diet.

Food improper in quality or deficient in quantity is sure to be not only a direct source of disease, but indirectly, by lowering the vitality of the body, it leaves it an easy prey to epidemic and contagious diseases of every sort. This was strikingly shown during the ravages of the plague in the Middle Ages, and it has been apparent in the history of all recent famines. (See Starvation, p. 301, and Famine, p. 308.)

The important relation of food to disease in regard to its quantity and composition, as well as the frequency and method of its administration, are becoming more and more thoroughly appreciated. This is owing in great part to improved methods of diagnosis and to modern means of clinically discriminating between different kinds of gastric and intestinal indigestion. It is also due to an increasing knowledge of the chemistry of food, of food preparation by cooking, and of "artificial digestion."

There is still much difference of opinion in regard to the best dietaries for certain diseases, such, for example, as gout and obesity, but the general principles of dietetics are to-day well established and more widely understood and practised than ever before, and starvation in fevers, like excessive venesection and similar depleting measures, is no longer carried to the former injurious extreme. There remains much to be learned in regard to dietetics; and the great variations in digestive power which are encountered in individual cases of disease and in personal idiosyncrasy, together with the increasing varieties of foods and food preparations, make the relation of diet to disease a constantly broadening subject, the importance of which cannot be overrated. It is to be regretted that the study of dietetics is not more thoroughly taught as a necessary part of medical education, and that thorough systematic instruction in this practical branch of science is omitted from the curriculum of most medical schools. For many physicians it seems far easier to write a brief prescription for a "nerve tonic" or cathartic pill than to take the time and pains to state in writing for their patients a definite dietary which in very many cases will prove an invaluable adjunct to medicinal treatment, if not in itself a curative measure. Sometimes indeed they appear possessed with the idea that the minutiæ of dietetics are beneath consideration, whereas in reality, like the details of good nursing, they are most important, and a careful attention to them and a close interrogation into the ordinary habits of the patient in regard to his daily regimen is sure of appreciation and of beneficial results.

In all acute febrile diseases and in all so-called "wasting" diseases in which there is faulty assimilation of the food, the digestive functions are impaired, while the rapid tissue waste increases the need for nutriment to replace it. In such cases enfeebled digestive powers must be taken into account, and while endeavouring to supply the increased demand for food, every effort should be made to relieve the alimentary canal of unnecessary labour by supplying those preparations which will yield the necessary amount of nutrition and force with a minimum expenditure of energy. Moreover, the conditions of elimination of waste materials from the tissues must be studied in relation to the composition of different foods in order to prevent the overworking of the excretory organs.

It may be asserted that there is almost no disease of long duration and severity, and certainly no disease accompanied by grave constitutional disturbances, the course of which cannot in a measure be controlled or benefited by thorough study of the nature and uses of foods. There are many acute aliments in which undoubted benefit is derived from greatly diminishing or altogether withholding temporarily the consumption of food, while there are others in which forced feeding—that is, increasing the quantity of food to the utmost capacity of the digestive organs—is a necessity.

The general relations of food to the organism, as well as the nature of foods and the processes involved in their digestion, absorption, and assimilation, have received full consideration in the preceding pages. In the following chapters the principles briefly outlined above will be considered in their application to individual diseases. At the risk of some repetition, it has been thought best to make the dietetic treatment of each disease as comprehensive as possible under the different headings considered, and to emphasize its value by a brief synopsis of the more important symptoms which arise, and a discussion of the indications to be met by appropriate dieting.

DISEASES CAUSED BY DIETETIC ERRORS

While the course of the majority of all diseases is obviously influenced by the quantity and quality of the food eaten, there are particular diseases which are directly caused by improper diet. This causative relation concerns:

I. Insufficient food. II. Overeating and overdrinking. III. Food in itself wholesome, but which is injurious because the ingredients are not properly balanced. IV. Food containing parasites or their embryos. V. Food containing ptomaines. VI. Food containing other poisons, grain poisoning, etc. VII. Food containing adulterants. VIII. Food containing micro-organisms. IX. Food which is in itself wholesome, but against which personal idiosyncrasy exists. X. Alcohol as a food and poison.

I. Insufficient Food

The general effects of starvation have been described in the study of the proper quantity of food (p. 301). The effects of the deprivation of water are discussed on p. 43. Insufficient food may cause the condition of marasmus, and is an important agent in producing some forms of anæmia. (See Marasmus.)

II. Overeating and Overdrinking

Both overeating and overdrinking may be (1) temporary—that is, the result of an occasional debauch; or (2) chronic.

1. **Temporary overeating** may apply to the excessive consumption (*a*) of a mixed diet, or (*b*) of particular articles of food. The former (*a*) causes dyspepsia, or, in extreme cases, acute gastro-enteritis. The latter (*b*) may also cause dyspepsia and diarrhœa, or such affections may be produced as glycosuria, from excessive indulgence in candy and sweets; acne and other skin diseases, from the too liberal consumption of fats.

Temporary overeating at one or two meals may not produce any serious effect, but if the excess in feeding be long continued a variety of ills result, attributable directly to overloading of the alimentary canal and to the accumulation of waste matter in the tissues, and consequent imperfect oxidation processes.

The excess of food may be injurious in one of two ways:

First, if it is not absorbed, it ferments abnormally in the alimentary canal. There is a limit to the quantity of every food which can be digested in a given time; beyond this the food, whether starches, fats, sugars, or proteids, may decompose, or pass away unaltered.

Second, if the excess be absorbed the blood is overwhelmed, and the excretory organs are overworked.

The inability to sing with precision after a too hearty meal is often attributed to temporary congestion of the vocal cords. While this is observed in the thickened speech of alcoholism, the difficulty in singing caused by overeating is mainly due to inability to regulate the actions of the diaphragm and other respiratory muscles when the stomach is too greatly distended.

2. **Chronic overeating** may cause such diseases or diatheses as obesity, gout, lithæmia, oxaluria, and the formation of renal, vesical, and hepatic calculi. It is very certain to cause congestion of the liver and the condition known as "biliousness," in which the stomach and intestines are engorged, constipation results, the tongue is heavily coated, the bodily secretions are altered in composition, the urine especially becoming overloaded with salts, the liver becomes congested, and finally the nervous and muscular systems are affected,

with the result of the production of headache and feelings of fatigue, lassitude, drowsiness, and mental stupor.

For persons leading sedentary lives, excessive consumption of animal food is more injurious than that of vegetable food, for the reasons given above, although obesity is more favoured by excess in vegetable diet and sweets. The nitrogenous foods, requiring, as they do, a large consumption of oxygen for their complete combustion and reduction to urea and allied products, produce forms of waste matter in the system which are more deleterious than the carbohydrates that are converted into water and carbonic acid, and are more easily eliminated. It is for this reason that defective nitrogenous metabolism alters the composition of the blood and paves the way for disorders of nutrition, such as lithiasis.

Patients suffering from severe epilepsy and from certain forms of insanity, chiefly manias, and sometimes hypochondriacs, at times gorge themselves with food and drink.

The presence of intestinal roundworms and tapeworms may give rise to overeating, though this by no means always follows.

Overeating is apt to be carried to an injurious extent by the half-starved poor if they have sudden access to plenty, and by convalescents from typhoid fever.

Bulimia is a form of perverted sensation, causing inordinate craving for food. (See p. 333.)

Overeating not only taxes the digestive system, but, what is often more serious, it throws too great a strain upon the glandular and excretory organs, especially the liver and kidneys, and if the habit is long continued, disease of the nature above described inevitably results. In like manner the overfed boiler becomes sooner burned out, and its fires choked with ashes which accumulate faster than they can be removed. Overeating, especially among the well-to-do, is the commonest dietetic error, and looking at the question in its broadest aspects, it is quite certain that the foundation for more disease is laid by this habit than by overdrinking. (See Alcohol, p. 228.) The former, indeed, sometimes conduces to the latter, and there are some examples of alcoholism in which the desire for drink is only aroused and fostered by previous excesses in eating.

Overdrinking, except of alcohol (which is considered under the heading of Alcoholism), is not common, and is mainly confined to the excessive consumption of tea and coffee, which results in insomnia, cardiac palpitations, and various neuroses. Dilatation of the stomach has been attributed in some cases to overindulgence in mineral waters, but such instances are very unusual. Polyuria and diabetes insipidus have also been ascribed to the abnormal consumption of fluids, but without strong proof. Excessive use of milk as a beverage usually results in "biliousness" and constipation, but for the reason that it is really a solid food—that is, it becomes such immediately on entering the stomach. Thirst is often extreme in fevers, diabetes, and other conditions, but the drinking of exceptionally large quantities of water is by no means always harmful, and it is often desirable to recommend it as a diluent and diuretic. The propriety of restricting its use in dropsies, gastric disorders, etc., will be considered under the appropriate headings. (See Gastric Catarrh, Ascites, Diabetes.)

III. Food in itself Wholesome, but which is Injurious because the Ingredients are not Properly Balanced

Such diet may produce anæmia, from lack of meat or other animal food; scurvy, from preponderance of salt meat and fish and lack of fresh fruits and vegetables; rickets and marasmus, from errors in infant feeding, such as excess of amylaceous and lack of animal food, necessary salts, etc.; acne, or eczema, from food too rich in fats; constipation, from a too nutritious and concentrated diet; gout from various dietetic errors.

The belief is held by some authorities that a diet of coarse cereals and vegetables favours the development of chronic arteritis. (See Vegetarianism, p. 35.)

IV. Food containing Parasites or their Embryos

Food sometimes serves as the medium for the introduction of parasites or their embryos, such as the tapeworm, roundworm, echinococcus, and trichina.

In many cases the source of infection is found in the consumption of raw or very imperfectly cooked swine flesh and other meats used in the manufacture of sausages and similar preparations which are carelessly handled and come in contact with the viscera of the animals in which the parasites or embryos reside in some intermediate stage of development. Another possible source of infection, especially of intestinal worm larvæ, is in the excrement of animals, which is permitted to pollute raw vegetables growing upon the ground. Manure is freely spread about, and dogs infested with worms, or a casual pig allowed at large in a vegetable garden, may contaminate by their fæces such vegetables as grow low upon the ground and are usually eaten raw, as lettuce, celery, cabbage, etc. Fortunately, this is by no means a common source of infection, but it is well to remember that several diseases have been definitely traced to such a source, and this explains the occasional presence of tapeworms in people who never eat raw meats, ham, or sausage, or the flesh of swine in any form. No animal should ever be allowed to roam in a vegetable garden. Other varieties of parasites or their larvæ may occasionally be introduced with the food or water, such, for example, as the *Dracunculus medinensis*, which produces the Guinea-worm disease, or *Dracontiasis*, the larvæ of which are sometimes swallowed in drinking water by the natives of parts of Africa and the East Indies.

INTESTINAL WORMS

The presence of intestinal worms, such as the roundworm, *Ascaris lumbricoides*, and various species of cestodes or tapeworms, requires no special dietetic care beyond the preventive treatment of avoiding raw or imperfectly cooked flesh and submitting to a period of starvation for twenty-four hours, in order that the intestine may be completely emptied of food before an anthelmintic is given, so that it may more certainly reach the worms.

There are two principal varieties of tapeworm in man, besides four or five others, which are very rarely present in the intestine, being derived from the lower animals through habits of filth or carelessness in preparing food.

Of these two varieties, the commonest in this country is the *Tænia saginata*, or *mediocanellata*; the other, the pork tapeworm, or *Tænia solium*, is more often found in Europe and Asia. The larval stages of *Tænia solium* and *Tænia echinococcus* also are observed in man, and, according to C. W. Stiles, one half the persons affected by the latter die within five years. H. O. Sommer has collected 100 cases of echinococcus (hydatid) disease in this country. The larvæ are derived from the dog.

The *Tænia mediocanellata* is a segmented worm, having a large square head presenting four suckers, by which it maintains its hold upon the intestinal mucosa without the aid of hooklets. The segments increase very slowly in size behind the head, and finally attain a breadth of eight to ten millimetres and a length of seventeen to eighteen millimetres, while the whole animal may reach a length of twenty feet, or even become longer than the intestine. Fragments of the worm are constantly breaking off, compressed by the waste matter of the food, and with it are swept out of the gut. The larvæ live in swine.

The *Tænia solium* is not so long as the *mediocanellata*, measuring usually from six to twelve feet. The head, which is quite small, presents four suckers and several minute hooks, which enable the animal to secure a firm hold upon the mucous membrane. Behind the head are a series of segments, many hundred in number, constituting the body. They gradually increase in size, and the larger ones contain male and female organs of generation, each segment being supplied with both varieties. The larger segments attain a size of seven to eight millimetres by ten millimetres. Each mature segment contains an enormous number of ova—often several thousand—and in about three months, when the worm has reached its full size, the segments, which are narrower and smaller than those of *mediocanellata*, are continually breaking off and passing out with the fæces. Pigs eat the ova, and digest them. The ova consist of shells which contain minute embryos with six hooklets. The embryos make their way into the viscera or muscles of the animal, where they lodge and develop to form the larvæ or cysticerci, called also "measles." If the measled hog meat is eaten by man, and imperfectly cooked, the cysticerci develop with the intestinal worms above described.

The worms infest man at all ages, from early childhood up. They may cause no symptoms, but sometimes give rise to a ravenous appetite, as they interfere with intestinal digestion and absorption. They occasionally excite reflex nervous disturbances. Their presence is made certain by the finding of either the ova or the complete segments in various lengths in the stools.

Treatment.—The patient should be put upon very short rations for two days, during which time the bowels must be well emptied. The evening before giving the vermifuge the patient should take a light supper of bread and milk or a sandwich, and that night a brisk cathartic. It is best to give the medicine the next morning fasting. By this means the intestines become almost empty, and the head of the worm is left unprotected, so that whatever remedy is used to kill it will make it loosen its hold. Another laxative may be given a few hours later, and if the patient eats bulky food, such as bread and potatoes, for a day or two, and keeps the bowels active, the worm may be completely dislodged and crowded out. The stools must be floated in water and closely examined for the head, for if this is not obtained the worm is sure to grow again in three or four months. There are many tæniacides. One of the least disagreeable and most efficient when properly administered is pumpkin seed. The seeds should be husked, and three ounces may be pounded in a mortar, macerated, mixed with honey into a paste, and eaten spread like jam upon a thin slice of bread.

TRICHINOSIS

Etiology.—Trichinosis is a parasitic disease produced by the embryos of a worm, the *Trichina spiralis*, which work their way into the voluntary muscles and there become embedded. Among the parasites liable to be eaten with raw meats this one is by far the worst and most fatal in its effects. The habitat of the adult worm is the small intestine. During the emigration of the embryos into the voluntary muscles a group of characteristic symptoms is produced. The parasites have the following appearance: The adult male measures 1.5 millimetre in length; the female is from two to two and a half times as long. The embryo is 0.6 to 1.0 millimetre in length, and when at rest, encapsulated in the muscle, is coiled in a spiral. It has a blunt tail and a sharp head. The adult male has two small projections from the caudal end. The ovoid capsule first appears translucent, but later, from the deposition of salts of lime, it becomes opaque.

Infection in man is caused by the eating of ham and pork from hogs whose bodies contain the parasite. Among these animals it is of quite frequent occurrence. It is also spread through the agency of rats, which are eaten by hogs (Dock).

Natural History of the Parasite.—After eating flesh which contains the embryos the process of digestion dissolves their capsules, and they are liberated, passing into the small intestine, where, with the presence of the favourable conditions of warmth, moisture, and food, they reach their adult growth in from three to six days. Rapid reproduction takes place in the intestine, and the number of young produced by a single female worm varies up to at least a thousand. In a week or more after the ingestion of the parasites the newly developed embryos pass out through the intestinal wall and mesentery, seeking the muscles, which they enter; they then work their way through the connective tissue between the fasciculi or the separate muscle fibres, and finally enter the latter, where a fortnight's further development produces the complete muscle form.

The observations of Askanazy point to the conclusion that the adult female deposits the embryos within the walls of the intestinal villi, not setting them free in the intestine, as originally supposed. From the villi they penetrate the muscles, as above stated.

Thornbury reported at the Buffalo Academy of Medicine the results of analysis of 500 cases of infected swine. In these animals the parasite was found in the diaphragm 400 times, in the loin 290 times, and in the neck 170 times. "The point of predilection therefore appears to be the diaphragm. This is explained by its close proximity to the digestive tract, from which the trichinæ primarily bore." In three cases in man which he examined the trichinæ were found principally in the extremities, "one microscope slide from the biceps of an arm containing fifty of the parasites." They were also present in the diaphragm, intercostal and abdominal muscles.

The embryos, when lodged in the muscle fibres, act as foreign bodies or irritants and excite an interstitial myositis with the formation of a capsule around each embryo. One embryo may be lodged in a single capsule. Once within the muscle fibres, embryos remain without change until the capsule, the completion of which requires about six weeks, is in some way destroyed. After formation of the capsule a precipitation of lime salts occurs slowly within it for four or five months. The embryos, thus securely protected in a strong envelope, may retain their vitality for many years, and it is claimed that they have survived for at least two decades, but the worms themselves not infrequently become calcified. Other animals besides hogs may harbour this parasite, among which are the rat, cat, mouse, and fox, and it can be artificially inoculated.

Prophylaxis.—The prevention of trichinosis should consist in the more careful feeding of swine upon grain instead of offal, and for man the only absolute prevention is the extremely thorough cooking of all swine flesh, for a temperature of 140° F. is fatal to the embryos. Smoking and pickling is also preventive.

"In the usual curing solutions trichinæ are killed within six weeks in thin pieces of meat, but in thick pieces they can exist as long as four months" (Dock).

The presence of the parasites in countless numbers in the flesh of the hog may give rise to no symptoms of any kind in the animal, and it is this fact which makes the eating of raw ham, pork, and sausages particularly dangerous unless the meat of the animals killed has been subjected to a searching microscopic examination. It is the safest rule never to eat such meats. The difficulty of detecting the parasite in the hog is considerably increased by the fact that the calcification is very much slower than it is in man, so that the worms are more readily overlooked. The parasites fortunately are completely killed by boiling for some time the meat which contains them, but pickling or corning meat or smoking ham and bacon are not necessarily fatal to them.

Frequency.—Cases of trichinosis are occasionally reported in this country chiefly among the Germans, whose fondness for raw ham and a variety of sausages is well known. Osler reports the finding of 456 cases, including 122 deaths recorded in America. Many persons are often simultaneously affected from eating the meat of the same animal, thus giving the disease the false character of an epidemic.

Symptoms.—The symptoms vary with the number of parasites which have been eaten. If very few are ingested, the embryos are not reproduced in sufficient number to give rise to any symptoms. Usually, however, they are well marked, and embrace a stage of gastro-intestinal irritation followed by systemic infection. The patient, three or four days after eating raw pork or ham, suffers from more or less severe abdominal cramps, with anorexia, vomiting, and diarrhœa. The latter occasionally becomes severe. General muscular prostration is also present, and there may be chills. In a number of cases the gastro-intestinal symptoms may not be severe enough to attract attention, and the first symptoms are those of general infection, which develop at the commencement of the second week. There is an increase of temperature, amounting to 103° or 104° F., of an intermittent or remittent character. As soon as the embryos have extensively penetrated the muscles they give rise to great local pain and tenderness, accompanied by swelling and tension of all the muscles affected. The patient naturally assumes the position in which there will be the least strain upon the muscles.

These symptoms increase in intensity, and general œdema is apt to follow, which may appear first in the face. When certain muscles are implicated more serious symptoms may result. If the diaphragm is invaded or other muscles of respiration, there may be extreme or even fatal dyspnœa. If the parasites reach the muscles of the face, jaw, and pharynx, mastication and deglutition become difficult or impossible. There is more or less itching and burning of the skin and perspiration. Urticaria has been observed; anæmia and a marasmic condition eventually develop in a majority of cases, and marked eosinophilia amounting to 30 or 40 per cent is observed in the blood in this type as it is in other varieties of intestinal parasitic disease. There is comparatively little disturbance of the nervous system, and patients are usually conscious until the time of death, but in some instances a typhoid state supervenes with delirium. The other symptoms which have been reported as occasionally present are loss of tendon reflex, bronchitis, pneumonia, pleurisy, albuminuria, and polyuria.

Prognosis.—Mild cases may end in recovery within a fortnight. In severe cases in which there has been great prostration and emaciation convalescence is retarded for many weeks.

Children are more apt to recover than adults, but the outlook depends chiefly upon the number of parasites ingested. Cases presenting severe diarrhœa are more likely to end favourably, probably because some of the parasites are eliminated in this way.

Mortality.—The greatest mortality occurs between the fourth and sixth week. The causes of death may be exhaustion from choleraic discharges, dyspnœa, and inability to swallow. In protracted cases inanition results.

Autopsies show that but few organs aside from the muscles are affected by anatomical lesions. Cohnheim observed fatty degeneration of the liver and enlargement of the mesenteric glands. The muscles present the appearances of lesions of acute interstitial myositis around the capsules of the embryos.

Diagnosis.—The affection differs from acute rheumatism in the absence of swelling in the joints and the much greater local tenderness along the surface of the muscles. The latter are exceedingly painful both to pressure and voluntary movement. The disease in its protracted form has been mistaken for enteric fever, and undoubtedly it has many times escaped detection. The most valuable features in determining the diagnosis are the extreme tenderness to pressure of the muscles, their swollen condition, and the general œdema and dyspnœa. Under cocaine anæsthesia a small piece of muscle may be excised from the arm or thigh for microscopic examination. Osler advises searching the stools for the parasites, which may be found with a low-power lens as glistening threads.

Treatment.—The basis of treatment is to at once evacuate the alimentary canal, providing the fact of eating the infected meat is known within a day or two. Diarrhœa should not be checked. If constipation exists, a strong purgative of calomel and jalap or castor oil should be administered. When systemic symptoms develop, the treatment must be purely symptomatic, because there is no known remedy which will reach and destroy the trichinæ. Every effort must be made to support the strength of the patient until the embryos have become encysted, after which the acute symptoms will subside of themselves.

V. Food containing Ptomaines

Ptomaines are substances resembling alkaloids which are formed in the alimentary canal by the decomposition or putrefaction of nitrogenous foods. They may also form in such food outside of the body. This decomposition is the result of the action of certain micro-organisms simultaneously first described by Gautier in France and Selim in Bologna. It is at present believed that the constitutional symptoms observed in many infectious diseases are caused by similar poisons called toxins, which originate in the blood and other tissues of the body through the action of specific germs. The artificial cultivation of micro-organisms has proved that they are capable of forming substances which have distinct physiological actions that are sometimes highly poisonous. Many of these micro-organisms flourish in beef juice, milk, and various solutions of nitrogenous material; and in the alimentary canal, when such food is taken, all the most favourable conditions are present for the development of toxins. When the poisonous germs are ingested, their toxins are readily absorbed by the intestinal mucous membrane, and it is probable that ptomaine poisoning would occur very much oftener were it not that the liver, acting as it does as a gateway for the admission of nutritive matter for the body, is capable of destroying many poisons which enter it from the intestines through the branches of the portal vein. Corroboration of this statement is found in the fact that snake bites of the surface of the body may prove highly poisonous by immediate absorption of toxic material into the circulation, whereas snake poison may be swallowed with impunity, for if it is absorbed from the alimentary canal it is destroyed in the liver before reaching the nervous system.

The same is true of the action of putrefying meat, which in very small quantities may not produce severe gastro-intestinal symptoms or constitutional disturbances, and yet if inoculated through a cut in the finger may cause symptoms of a violent septic character.

Richard (Diseases of Modern Life) reports a fatal case of poisoning from eating tainted hare. The victim had had a small ulcer beneath the tongue for some time, which became gangrenous after eating the meat, and which was the undoubted source of inoculation.

Ptomaines may be developed from a variety of foods, but the principal ones from which poisoning from time to time occurs are spoiled meat, milk, shellfish, and fish.

POISONING BY MEAT OR GAME

When meat has been kept too long exposed to the air, or when it has become contaminated in any manner with putrefactive bacteria, it is unfit for food, yet if thoroughly cooked it may not be necessarily poisonous. This is the case with "high" game. The bacilli especially associated with meat poisoning are the *Bacillus enteritidis* of Gärtner, and the anaerobic *Bacillus butyricus* of van Ermenghem. Dangerous and even fatal cases of systemic poisoning by meat ptomaines have resulted from eating sausages, pork pie, ham, meat juice, beef, head-cheese, mutton, or veal. Two hundred and ninety-one severe cases of meat poisoning, one of which ended fatally, developed upon the U. S. transport City of Rio de Janeiro, in 1899, while proceeding from Honolulu to Manila. The putrefactive change may have already begun in the meat although it may not be apparent by an altered taste. Sausage poisoning is called botulism or allantiasis.

It is a curious fact that certain persons have great toleration for tainted meats. Among civilised races, and especially in England, the use of "high" game and mutton is much less in vogue at present than formerly, but the Eskimos and many savage tribes in Africa eat with relish, and digest well, decomposing meat the mere odour of which nauseates a white man. Bishop Colenso stated that among the Zulus of Natal the synonym for heaven is "*ubomi*," which means "maggoty meat." The natives of Siam and Cambodia prefer to keep their fish until it has begun to putrefy. In some parts of China foul eggs several months old are enjoyed as a delicacy.

Measly swine flesh rapidly decomposes, and the various processes of drying, smoking, and salting still leave it unfit for food. On the contrary, drying and smoking affect the superficial layers only, while the minor portion furnishes a culture medium for bacilli. Gluckmann has reported a case of poisoning by the *Bacillus proteus vulgaris* from eating cured ham.

The meat of very young animals should never be eaten, and the sale of young or "bob" veal two or three weeks old is prohibited by law. It is indigestible, innutritious, and it readily decomposes.

Symptoms.—The symptoms of meat poisoning from these various substances are substantially the same in each case, being those of severe gastro-intestinal irritation, but in bad cases they are accompanied by dangerous collapse. The symptoms may follow almost immediately or after an interval of four or five or more hours. The former is much better for the patient, for the sooner vomiting and diarrhœa relieve the alimentary canal of the toxigenic material, the greater the chance of recovery. The symptoms usually begin with suddenness and violence, but they may be preceded by malaise, nausea, lassitude, and mild abdominal cramps. The sudden onset is ushered in by rigours with vertigo or faintness, or violent headache. Exceptionally there is dyspnœa, and there may be cold perspiration and sudden severe pains in the epigastrium or in the thorax, especially between the shoulders. Intense thirst has also been observed. Soon after one or more of these symptoms have appeared there is violent colicky pain in the bowels, accompanied by retching and vomiting, sometimes hæmatemesis, and profuse watery diarrhœa. There is an extreme degree of muscular prostration which comes on suddenly and prevents the patient from standing. It may be due to the abdominal pain, but it also occurs independently. The tongue is dry and coated with a thick brownish-yellow fur on the dorsum, but the margins are of a bright red with distinct papillæ. Fever is usually present, and the temperature may rise to 103.5° or 104° F., although the skin may feel cold and moist. The pulse is somewhat accelerated and the rate may reach 130 or 140.

Occasional symptoms which have been noted by Ballard are severe cramps in the legs and arms, convulsive twitching of the muscles of the face and hands, stiffness in the joints, and various abnormalities of sensation, such as numbness, tingling, and flashes of heat and cold in the extremities. There may also be drowsiness, photophobia, and, in the worst cases, insomnia, nervous excitement, or mild delirium. If the poison results fatally, the prostration increases, the pulse grows rapid and feeble, the watery evacuations are uncontrollable, and rapid emaciation ensues. The patient becomes cyanotic and passes into a state of collapse resembling that of the last stage of cholera.

The poisoning presents all degrees of severity, depending on the amount of the tainted food which has been taken, the nature of the putrefactive process, and the condition of the alimentary canal at the time. In mild cases, more or less abdominal pain, vomiting, diarrhœa, and headache, with slight prostration, are the only symptoms. In the more severe cases, if convalescence follows the attack, it is prolonged, and the weakness of the patient may be fully as great as after some of the severe infectious fevers affecting the alimentary canal, such as cholera or yellow fever. In cases in which the symptoms develop very slowly, after an interval of a day or more the nervous symptoms are apt to predominate over those of the gastro-enteric system. There are painful muscular cramps, dyspnœa, aphonia, delirium, and palpitation. This variety of poisoning is extremely dangerous.

Diagnosis.—The diagnosis is almost always obtainable from the history of the case in connection with the symptoms above described, and when canned food has been eaten, the only difficulty consists in determining whether the poisoning is the result of eating tainted meat or of acute metallic poisoning from chloride of zinc, tin, or lead used in the process of tinning and soldering the cans (see p. 282).

POISONING BY MILK, CREAM, ICE CREAM, AND CHEESE

Poisoning by plain milk is less common than from certain varieties of cheese and from cream. When ice cream is made in large quantities, the cream is allowed to accumulate, and if a portion of it becomes infected with pathogenic organisms it will soon convert the whole mass into highly poisonous material. In a small town in Indiana, in 1900, over one hundred persons were seriously poisoned by ice cream from soiled cans. Many other such casualties have been observed of late years. Sixty-seven men, at the San Juan garrison in Porto Rico, were poisoned in 1900 by condensed milk. In the U. S. Surgeon-General's report for 1900, the symptoms are described as follows by Assistant Surgeon George M. Wells, U. S. A.:

"The symptoms were persistent vomiting, severe cramps in the stomach, purging, great prostration, dilatation of the pupils, headache, clammy perspiration, chilliness, and great thirst. The stomach in each case was washed out by means of the stomach tube. In some cases the stomach was empty, and nothing but water and mucus came away; in others the washings were tinged with bile, and in others again a moderate amount of food that had been eaten for breakfast was washed out, but in no case was the stomach overdistended or even full. The vomiting was controlled in several instances by the washing out of the stomach, but in many it persisted for several hours afterwards. The prostration was so great that some of the patients fainted before reaching the ward. A large number vomited blood in small clots, in most instances mixed with nothing but mucus, showing that the hæmorrhage had not taken place until after the contents of the stomach had been expelled. Purging began in most before the vomiting had ceased, and continued for twelve to fifteen hours. At first the stools were natural, soon watery, afterwards becoming mucous and blood tinged. Cramps in the voluntary muscles were mild in some, but other patients writhed in agony, their sufferings being relieved only after thorough kneading and massage by the hospital attendants. Forty were discharged from hospital on the following morning; the others from day to day until the fifth morning, when all were returned to duty."

Vaughan and Novy in this country have thoroughly studied the whole subject of ptomaine poisoning, and Vaughan has isolated from cheese and ice cream a toxin to which he has given the name of "tyrotoxicon," and in Michigan in 1883–'84 nearly three hundred instances of cheese poisoning were collected by him. In 1890 he isolated three proteid substances from germ cultures from the intestines of infants having milk infection. The symptoms of tyrotoxicon poisoning are substantially the same with those of meat poisoning, consisting of severe gastro-intestinal disturbance with collapse.

This toxin produces almost immediately after ingestion by a previously healthy infant violent symptoms of cholera morbus, which prove fatal in a few hours unless the poison can be eliminated. (See Cholera Morbus Treatment.) Of this poison Vaughan says: "Post-mortem examination shows but little change. [There is time for but little in fatal cases.] The mucous membrane of the small intestine is bleached and softened, and possibly deprived here and there of its superficial epithelium."

The poison apparently acts somewhat as the toxin of Asiatic cholera, by absorption from the intestinal wall, and by violently deranging the nervous and vascular systems, producing sudden and extreme loss of fluid from the body through osmosis into the intestine.

POISONING BY SHELLFISH AND FISH

Poisoning by shellfish and fish results from infection with ptomaines developed by micro-organisms, as in cases of milk and meat poisoning. In addition, it must be remembered that there are a number of persons who, from idiosyncrasy, possess an extreme degree of sensitiveness to the action of shellfish of all kinds. To such persons the eating of clam broth or raw oysters, crabs or lobsters, may give rise to violent outbreaks of urticaria or eczema, or produce severe headache, nausea, and vomiting. It is scarcely probable that these cases are due to the same source as those of true ptomaine poisoning, for they occur when the shellfish have been eaten in perfectly fresh condition; the symptoms, moreover, are usually less violent than those caused by ptomaines, and similar effects are produced in some people by certain vegetables and fruits, like the strawberry. Among shellfish the mussel furnishes the most violent poison. This substance Brieger has isolated under the name of "mytilotoxin." It develops particularly in the liver of the animal. The intensity of the poison depends somewhat upon the locality in which the animal has lived and fed. The same mussels may become non-toxic in different waters. The name ichthysmus is applied to fish poisoning in general, osteotoxismus to oyster poisoning.

Symptoms.—The symptoms of poisoning from eating raw fish or cooked mussels in which ptomaines have developed are somewhat different from those of meat and milk poisoning in that they concern the nervous system with less gastro-intestinal disorder. For this reason the poison is very much more dangerous, and cases have been known to result fatally two hours after eating mussels. In such instances there may be no nausea, vomiting, or fever, but there is sudden and extreme prostration, with numbness, faintness, coldness of surface, dilatation of the pupils, double vision, restlessness, nervousness, anxiety, and a feeble and very rapid pulse. In France hard-roed herrings have caused such symptoms. Decomposing oysters and fish may also produce symptoms of gastro-intestinal poisoning resembling those from the use of bad meat. The salted sturgeon which is eaten extensively as a food in parts of Russia has caused death from its decomposition, and a variety of fishes both in European and Eastern waters are capable of developing very active toxins. In Russia poisoning has been produced by eating the ova of the pike, barbel, and perch, and decomposed sturgeon roe (caviare). Portions of the porpoise, eaten in China, may prove poisonous unless thoroughly boiled. The mackerel family has three species which are poisonous, namely the jurel, bonito, and chicaro. They are found in the West Indies. Two species of herring are poisonous; one of them, the meletta, taken along the Atlantic coast from Florida to New York, has caused several fatal cases of poisoning.

Georgii reported in 1901 the poisoning of 24 men from eating a salad of canned lobster. The symptoms resembled fish poisoning. Urticaria was absent, but in one case there was glycosuria.

VI. Food containing other Poisons than Ptomaines—Grain Poisoning, etc.

Flesh may become poisonous from the animal having fed upon some noxious substance shortly before it was killed. The flesh of pigs fed on garbage may cause diarrhœa (Parkes). The flavour and digestibility of game, and even fish, varies much with the season of the year and the consequent nature of the food which the animal has had. Oysters are not wholesome food from May to September, or in "the months without an R." Cow's milk becomes unhealthful for infants when the animal eats improper food, and rare instances have been reported of illness of adults caused by eating meat poisoned during the animal's life, as in the case of a sick ox to which a large dose of tartar emetic was given. The animal died, and the meat contained enough of the substance to severely poison those who ate it.

Game sometimes disagrees on account of the nature of the food upon which the animal has previously been living. This is said to be particularly true of the grouse in various parts of the country at some seasons of the year. The laurel buds act in this manner. Hares fed upon rhododendron are poisonous (Letheby).

A curious instance of poisoning from eating turkey meat was reported by Seelye, of Amherst, Mass. Several young women at a boarding school showed symptoms of atropine poisoning after eating a bird which had fed upon the deadly nightshade berries.

GRAIN POISONING

Old unripe grain and mouldy flour develop poisons from decomposition of their gluten.

Ergotism.—The fungus known as ergot, or *Claviceps purpurea,* grows upon rye, and in Europe the careless admixture of this substance with grain in the preparation of flour has several times resulted in violent symptoms of poisoning. Collectively the symptoms are described as "ergotism," and they are commonly divided into two varieties, the gangrenous and the convulsive. The ergot-containing flour or meal must have been eaten for a considerable time, as a rule, in order to develop the symptoms.

Ergot is sometimes employed too freely in medicine. In appropriate cases it may be given in considerable quantity for a brief period without exciting toxic symptoms. When, however, its use is prolonged beyond a few days, serious poisoning results.

In the gangrenous form of ergotism the early symptoms are referable to local vasomotor disturbances, affecting principally the extremities. These symptoms are anæsthesia, numbness, prickling pain, and spasmodic twitching of the muscles, with an impeded blood flow due to vasoconstriction. In the convulsive variety the nervous system is profoundly disturbed. After a period of indefinite symptoms, such as lassitude, headache, and prickling sensations, spasms of the muscles with contractures begin. The spasms may be intermittent, or may assume a tetanic character, lasting sometimes through many days; the arms are strongly flexed and the legs and toes are extended. Spasmodic rigidity of the muscles may give place to violent convulsions, which become general and fatal. There is sometimes slight fever, and in the chronic cases melancholia or dementia results. Delirium also is sometimes present. In cases reported by Siemens and Tuzzek the posterior columns of the spinal cord were found sclerosed.

Lathyrism.—A grain called the chick-pea vetch is sometimes used for the adulteration of flour from various cereals. Several varieties are used which have a similar effect to ergot in producing a condition of spastic rigidity in the lower extremities. This form of poisoning has been observed in India by James Irving, and by others in Italy and France. It is, however, rare, and but little is known as to the exact nature of the lesions.

Pellagra.—Pellagra is a functional disturbance caused by eating fermented unripe maize or Indian corn, made into polenta. It is unknown in this country, but prevails in the south of Europe, in portions of Spain, France, and Italy. The first symptoms noticed are those of dyspepsia with more or less nervousness, insomnia, and debility. These symptoms are followed by an eruption, the pellagral erythema, which develops in the spring. After the eruption has lasted for some time, the skin becomes very dry and extensive desquamation ensues accompanied by burning pains, or, if neglected, the surface may become incrusted with areas of suppuration. With the appearance of the eruption the dyspeptic symptoms are increased, and there may be salivation and severe diarrhœa. The disease lasts in greater or less severity for several months and ends in slow convalescence, or else, in the worst forms, the nervous system is involved and emaciation, headache, convulsions, delirium, and paralysis of the legs may appear. The peasants who eat this spoiled food sometimes have severe attacks in successive years, and melancholia and suicidal mania have been observed among them. There are no definite lesions other than those of malnutrition, such as fatty degeneration of various organs (Arnold).

The disease is not contagious, and it is said to be preventable by adding salt to the cornmeal; but salt is a Government monopoly in Italy. The peasants resist the tax upon it, and, through prejudice as much as through ignorance and poverty, they fail to make use of it.

VII. Food Adulteration

Food adulteration consists of: 1. The addition of deleterious substances. 2. Fraudulent substitution of cheaper articles of food or the sale of food not as fresh or good as it is represented.

A. J. Wedderburn, in a report to the United States Department of Agriculture, makes the statement that of all food products sold in this country, 15 per cent is adulterated, but only 2 per cent is deleterious.

With the exception of milk and alcoholic beverages, the adulteration of foods in the United States is of comparatively little importance from any harmful influence it may have upon health. Its moral are often worse than its physical aspects.

In this country almost all food products are so abundant and cheap that adulteration would be too expensive, and it offers small temptation to unscrupulous dealers. There are, however, certain articles of diet which form exceptions to this statement, although the adulteration is more often merely fraudulent than a menace to health. These articles are included in the following table of examinations made in a single State (Kentucky) by the Agricultural Experiment Station. Forty per cent of all samples taken were found adulterated.

Kind and Number of Samples collected from June 13, 1898, to December 31, 1899

Articles Sampled.	Not found adulterated.	Adulterated.	Total.
Baking powder	11	45	56
Butter	118	29	147
Canned goods	6	..	6
Catsups, pickles, etc	12	45	57
Coffee	2	1	3
Cornstarch	1	..	1
Flour (wheat)	20	..	20
Jellies, preserves, etc	5	18	23
Lard	29	11	40
Milk (sweet and buttermilk)	115	35	150
Milk colour	1	..	1
Mince-meat	...	7	7
Oleomargarine	2	16	18
Olive oil	1	1	2
Pepper, spices, etc	3	11	14
Sweet cider and grape juice	...	3	3
Soda (cooking soda)	3	..	3
Sirups, honey, and sugar	41	9	50
Vinegar	67	59	126
Total	437	290	727

At the Connecticut Agricultural Experiment Station, 41½ per cent of 574 samples of spices were found adulterated, and over 25 per cent of coffee samples were adulterated (1899).

The object of adulteration of food—namely, to cheapen cost of production—is attained by (*a*) increasing the bulk, (*b*) altering the appearance, and (*c*) giving false strength.

In many States stringent laws have been enacted against all adulteration of food products, beverages, and drugs, but the ingenuity of manufacturers and dealers in evading them necessitates the constant vigilance of the experts of health boards.

Among the common adulterations may be mentioned the following: Isinglass adulterated with gelatin; wheat flour with bran or cowpeas; powdered sugar with barium sulphate; mustard with flour and turmeric or corn-meal to the extent of 90 per cent; "essences" of peppermint, cinnamon, etc., with poisonous wood alcohol; distilled coloured vinegar sold as cider vinegar; pickles adulterated with iron and copper (Massachusetts State Board of Health Reports); oleomargarine sold as butter; ground spices are adulterated with cocoanut shells, rice, flour and ashes (Ohio Dairy and Food Commission); water, sugar and tartaric acid are sold as lemonade.

Wines and liquors are sometimes adulterated with alum, baryta, caustic lime, salts of lead, salicylic acid, and hæmatoxylon.

Candies are adulterated with terra alba, kaolin, and various pigments, and the different chewing gums, gum drops, etc., are largely made with petroleum-paraffin products.

Most of the maple sugar sold is made from glucose, and maple sirup is also derived from other sugars and artificially flavoured with extract of hickory bark (Wiley).

Cotton-seed oil is often sold as olive oil.

Nearly half the liquid honey sold is adulterated with glucose.

Cocoa and chocolate are adulterated with both starch and sugar.

Coffee is very extensively adulterated with sugar, caramel, pea meal, chicory, and saccharin extracts. Coffee berries are artificially made in moulds out of mixtures of starch, molasses, or caramel, chicory, etc. Baking powder is often adulterated.

Prof. R. H. Chittenden, as a result of elaborate investigations made with a view to determine the effect upon digestion of borax and boric acid when added, as they often are, to preserve foods, concludes that " borax and boric acid, when present in moderate quantities, can have little or no deleterious effect upon the more important chemical processes of digestion. On the contrary, it would appear that the presence of these agents may, in some cases at least, even accelerate the normal digestive processes of the alimentary tract."

Pigments.—Artificial colouring matters are added to foods, both to intentionally deceive and also merely to make different substances, such as preserved green vegetables, candies, or confections, appear more attractive to the eye.

Formerly highly injurious copper or zinc salts were much used to colour canned peas and beans, and not infrequently they were found in poisonous quantities, but the green plant pigment chlorophyll is so much cheaper, and is so abundant and harmless, that it has superseded them almost entirely since its introduction for this purpose in 1877.

Ultramarine is much used to colour sirups; safranin, eosin, fuchsin, anilin violet, and many other anilins are employed in the manufacture of candies, as is also cochineal.

The pigments most in vogue to colour butter and cream are turmeric, saffron, an orange pigment from the stigmas of a flower, sulphonated anilin yellow, and annotto, a yellow pigment derived from the fruit of a South American tree. Annotto as used by dairymen to colour milk and cream is not harmful. To detect it, add a teaspoonful of baking soda to a quart of the milk, and immerse in it a strip of unglazed paper. In a few hours the latter becomes orange-coloured if annotto is present (Leffmann).

Salicylic Acid.—The French Commission of Public Hygiene made an exhaustive investigation of the subject of adulteration of bottled beer, cider, milk, grape juice, and other aliments with salicylic acid, which is mainly added to prevent decomposition. They reported that its daily use in the quantities employed for preservation is not harmful to healthy persons, but if renal or hepatic disease exists it may become so, for under these conditions it is not promptly eliminated. Used in any considerable quantity, it in time produces anæmia, as it does in rheumatism.

Wiley found salicylic acid in seven out of ten samples of canned tomatoes bought in markets. Formic aldehyde is extensively employed as a preservative of milk and other foods.

Vaseline is sometimes used to adulterate butter for making pastry and cakes. It does not become rancid, and is therefore difficult of detection. Fortunately, it is not especially harmful.

NATIONAL BUREAU OF MEDICINES AND FOODS

Efforts to establish a National Bureau of Medicines and Foods, designed especially to prevent adulteration and misrepresentation, are being made (1904) by the American Medical and the American Pharmaceutical Associations, and it is to be hoped that Congressional sanction of the plan may soon be obtained. If such a Bureau were established as a part of a broader Department of Public Hygiene, with representation in the Cabinet, it would contribute towards advancing this country in matters sanitary and hygienic to the standards of some of the continental countries which, in these respects, are at present far in the lead.

The importation of adulterated foods from foreign countries is well guarded against by existing customs regulations, but the various State laws against such adulteration are in great need of uniform codification, which can only be properly secured by national control. For example, adulterations and imitations of butter, which are prohibited in one State, may be legally sold in another, and the public suffers from lack of protection against food frauds.

TIN AND LEAD POISONING

Both tin and lead poisoning may arise from the prolonged use of preserved meats, vegetables, or fruits. In tin cans the lead is derived from the action of various organic acids upon the solder (which in this country is usually 50 per cent lead), and the tin used for coating the inside of the can eventually is dissolved in a similar manner. (See also Canning, p. 282.)

Of late years attention has been directed to this subject by chemists, and a number of cases are reported from time to time of serious metallic poisoning. As a general rule, if the canning is properly conducted and the meats or vegetables have not decomposed, there is no danger in their use provided they are thoroughly cooked, and provided also that the cans have not been kept too long. The amount of tin dissolved is directly proportionate to the age of the contents of the cans. The food in cans that have been unopened for two or three years is very apt to produce poisonous effects. Professor Bettink declares that malic acid is the solvent of the tin when fruits and vegetables are canned.

Hehner examined many canned foods, and found tin present, in most of them as a stannous hydrate, which existed in sufficient quantity to be fatal when given to guinea pigs.

Ungar and Bodländer have reported a number of cases of poison from canned asparagus. Tin present in such food in an insoluble form may be dissolved and absorbed during digestion.

Professor Beckurts reported that a sulphate of tin is formed by the action of vegetable albuminoids or of meat albumin on the can. This is very liable to take place with canned asparagus, and two cases of severe poisoning of this nature have come under my personal observation. Violent gastro-intestinal symptoms occurred, such as severe vomiting and diarrhœa, accompanied by faintness and vertigo. The symptoms came on two or three hours after eating the asparagus from cans which had been kept for a long time.

Johnson (in The Medico-Legal Journal, vol. iii, p. 53) reports cases of dangerous poisoning from eating tinned tomatoes which were accompanied by symptoms of violent gastritis, stupor, and coma.

Winckel reported the cases of 270 soldiers who had been made ill from eating lettuce and meat preserved in tins. In their cases it was estimated that the quantity of tin in solution was from 19 to 72 milligrammes per kilogramme. Roos advises the coating of such cans on the inside with insoluble varnish, which prevents the albuminoids or vegetable acids from coming in contact with the tinned surface and dissolving the metal. He found upon opening a can of asparagus preserved for thirty-one years that the inside tin coating was wholly dissolved in the liquid. A can of beef preserved for eight years, weighing 976 grammes, contained 77 milligrammes of oxide of tin, and a can of asparagus preserved only four months contained 11 milligrammes of oxide of tin and 6 of copper. Preserved apples, corn, apricots, meats, and soups have also all been found to possess the same solvent action upon tin cans. This is almost entirely prevented in those instances in which a coating of varnish has been put over the tinned surface.

Pears cooked in a tin stewpan have been known to cause severe poisoning.

One hundred and fifty cases of severe metallic poisoning occurred among the soldiers of a Tyrolese regiment who ate food from a tin-lined copper kettle.

In general, food cooked or allowed to stand for any length of time in either brass or copper vessels not kept absolutely clean is dangerous to life.

VIII. Food containing Micro-organisms

Recent developments in the study of micro-organisms conducted within the past decade have demonstrated very clearly the dangers of infection upon a large scale from consumption of meat, milk, and other foods contaminated by the germs of infectious diseases.

MILK INFECTION

Milk is an admirable culture medium for a great variety of germs, and some bacilli, like those of typhoid fever and tuberculosis, thrive particularly well in it. Moreover, its abundant and varied proteid material furnishes substance out of which to develop powerful toxins for absorption.

The following are the chief diseases whose germs are capable of being sometimes conveyed by milk: Tuberculosis, typhoid fever, cholera, diphtheria, scarlet fever.

Milk, and food in general, should never be kept standing in an ice box or cellar near an open or defective drain, as it becomes rapidly tainted in noxious air.

TUBERCULAR INFECTION THROUGH MILK AND MEAT

Tubercular Milk Infection.—This matter is of special importance in regard to the danger of conveying tuberculosis to infants through raw milk. That this may happen is generally accepted as proved (although Koch, at the Tuberculosis Congress held in London in 1901, made an emphatic statement to the contrary), and State boards of health in this country are everywhere endeavouring to secure proper legislative authority to inspect and condemn tuberculous cattle.

Milk infected with tubercle bacilli when fed to animals has been shown to produce primary intestinal and mesenteric tuberculosis, and this may occur in infants. H. C. Ernst produced tuberculosis in pigs by feeding them milk from tubercular cows when the latter had normal udders. Cow's milk may contain tubercle bacilli when the disease is located in the lungs of the animal (Ernst). It is possible that this is the case with the milk of tubercular mothers, although it is not yet an established fact. The danger to the infant is less in such cases, for the disease in the mother is usually recognised in time to discontinue breast nursing.

It has been estimated in regard to the Eastern States that 15 per cent of the common dairy stock is tubercular. Stall-fed animals who live in filthy barns and get but little exercise show the largest percentage of infection. In healthy adults the gastric juice may succeed in destroying tubercle bacilli swallowed with such food, and no doubt it often does so. Fortunately the milk of all tubercular cows does not contain the bacilli, but it is almost certain to do so when the udders become involved in the disease. In large dairies the cows should be given the tuberculin test once in six months, and if they respond should be condemned as milk producers. (Conference of State Boards of Health, 1898.)

In infants who live largely upon raw milk, and whose gastric digestion is less vigorous than that of adults, mesenteric tuberculosis is relatively more common.

Tubercular Meat Infection.—Tubercular meat usually proves less virulent than raw milk, probably because it is subjected to thorough heat in cooking, but all the bacilli are not invariably killed by imperfect cooking, and infected meat or milk should on no account be eaten. This fact is being gradually appreciated by the public, and meat inspection at abattoirs is now much better regulated by law and supervised by local health boards than formerly; but Billings says that "probably one half of one per cent of the beef sold in market comes from animals in whom tubercle existed at the time of death."

All slaughtering should be done in public abattoirs under competent inspection, and not only should the animals be examined before killing, but the meat should be inspected afterwards.

The *Bacillus tuberculosis* has been found not only in the meat or muscle of the animal butchered, but in the liver, kidneys, and other viscera. It has also been seen in peripheral caseous nodules growing upon fowls (Sibley), and barnyard fowls have been known to eat tuberculous sputum carelessly expectorated within their reach. The bacillus is not killed by salting meat nor always by its digestion in the stomach. Moreover, salt meat is not so thoroughly cooked as fresh meat, as a rule.

Theobald Smith (Annual Report, Massachusetts State Board of Cattle Commissioners, 1897) says it is doubtful whether the muscles of cattle ever contain bacilli, but the latter are liable to be smeared over the meat by the butcher's knife fresh from cutting into a tuberculous lymphatic gland or lung. According to this writer, there are several varieties of tubercle bacilli as found in different animals, which show decided differences in morphology and pathogenic activity, but their morbific processes appear to be substantially the same. He suggests that the bovine and human varieties may under some conditions pass into one another, but he denies that cattle are susceptible to human tuberculous sputum. He believes that the danger of infection of man through milk and meat is greatly exaggerated, for while human tuberculosis has been decreasing for a whole generation, that of cattle, at least until very recently, has been on the increase. One or two curious cases are recorded of fowls dead of tuberculosis acquired by pecking at human tuberculous sputum, and Peter Paterson, of Glasgow, reports a death from eating tuberculous poultry.

D. E. Salmon, Chief of the United States Bureau of Animal Industry, in a report covering the two years ending June 30, 1899, says:

"The number of condemnations per 10,000 animals slaughtered was:

	Cattle.	Sheep.	Swine.
Whole carcasses	22	7.5	24
Parts of carcasses	26	0.6	13
Total	48	8.1	37

"Of the whole carcasses of cattle condemned 26 per cent were affected with actinomycosis and 36 per cent with tuberculosis. Of the parts of carcasses of cattle condemned 13 per cent were affected with actinomycosis and 1 per cent with tuberculosis. Nevertheless these diseases are surprisingly rare, as only 8.1 carcasses per 10,000 animals were condemned for tuberculosis, and 9.2 per 10,000 for actinomycosis. Tuberculosis is one of the principal diseases of swine, but is found only in 1.3 carcasses per 10,000 animals. Tuberculosis in sheep is a rare disease. Including tuberculosis and pseudotuberculosis, which are given together in the reports, there are specified but 6 per 100,000 sheep inspected.

"The beef-cattle which come from large abattoirs are singularly free from tuberculosis, only 1 animal in 1,500 or 2,000 being affected to an extent to cause condemnation of any part of the carcass. Dairy cattle may be affected to the extent of 5 to 10 per cent! In Europe, the slaughter-house statistics show from 20 to 50 per cent of all cattle slaughtered to be affected with tuberculosis."

Other Infections.—Meat from animals dead of various acute diseases is sometimes eaten, and if well cooked it may be harmless, but it is not good food, and no part of any animal suffering from the foot-and-mouth disease (or cattle plague), rabies, glanders, actinomycosis, anthrax, septicæmia, swine plague, sheep or cow pox, pneumonia, trichinosis, or tuberculosis should ever be eaten.

TYPHOID AND CHOLERA INFECTION

Typhoid infection is undoubtedly conveyed through milk which has been diluted with water infected from a barnyard well or cesspool, or which has been placed in cans rinsed in such water. Hankin describes cases of this fever derived from eating *dahi*, a curdled milk made by East Indian confectioners. Fraenkel found that typhoid bacilli may live in acid buttermilk. The typhoid bacillus may live for several days in fresh milk without multiplying.

Three hundred and eighty-six cases from milk infection occurred at Stamford, Conn., in May, 1895. Another epidemic occurred in York, Pa., in 1899, and two extensive epidemics were traced to this source in Philadelphia in 1903, the milk dealers having been found to have cases of typhoid fever in their own families.

At Coseley, near Birmingham, England, five cases of typhoid fever were traced to infection from ice cream.

Typhoid infection through contaminated drinking water has been already mentioned (p. 39). Even brushing the teeth with such water or using it as ice may convey the bacilli into the body.

INFECTION WITH TYPHOID-FEVER GERMS THROUGH EATING OYSTERS

An epidemic of typhoid fever occurred at Wesleyan University in the latter part of November, 1894, which affected only certain students to the number of thirty, who had attended college-society suppers and eaten raw oysters. A very thorough investigation was made by Prof. H. W. Conn into the ætiology of the epidemic, and the following account of it was published in the New York Times on November 20, 1894:

"The investigators at first ascertained that neither the water of the college well nor the milk supply had been the agent of infection. Six college societies had given initiation suppers. All of the oysters eaten at these suppers had come from one dealer, who had obtained them from one oyster grower. At three of these suppers raw oysters were served, and all of the thirty victims had partaken of the oysters in this condition; no one of those present at the other three suppers, where only cooked oysters were served, was attacked by the disease. These facts indicated that the germs of typhoid had been conveyed in the water and other matter which accompanied the raw oysters. How had that water and other matter become infected?

"The oyster grower, who lives on the shore of the Quinnipiac River, a stream which flows into New Haven harbour, had been in the habit of laying down his oysters for a day or two in the river, after taking them from the deep salt waters of the Sound and before putting them on the market. At about the time when the first cases appeared at the university his wife died of typhoid fever. His daughter had been ill with the same disease. The oysters which were sold to the students had been bedded temporarily in the river at a point near the place where a short drain from his house discharges into the stream. The water became infected by the flow from the drain, and when the oysters were taken up the liquid and other matter which accompanies oysters so dislodged, either on the outside of the shell or inside of it, contained the germs of typhoid. Cooking killed these germs, but the raw oysters carried to those who ate them a dose of typhoid poison. It is reported that several recent cases of typhoid in New Haven have been traced to infection thus conveyed by oysters from the same river."

It has generally been believed heretofore that typhoid bacilli do not develop in salt water, but the circumstantial evidence points strongly to their having existed in the brackish water above described, and, according to Foote, of New Haven, the typhoid bacillus will live eight days in water from an oyster bed. The oyster juice also contains the bacilli, and the bacilli injected into oysters live a fortnight in abundance, and are known to have survived for thirty days.

Two fatal cases of typhoid fever have been reported in Berlin as due to infection from raw oysters. Sir William Broadbent reported in the British Medical Journal ten cases which he saw during November and December, 1894, and attributed to the same origin. A number of cases have been traced in Italy and France to the eating of raw oysters. Arthur Newsholme, of Brighton, England, studied 181 cases of typhoid fever occurring there from 1893 to 1896, of which nearly one third were attributed to eating raw shellfish—36 to oysters, and 20 to other varieties. All the shellfish were contaminated by sewage.

In 1903 an epidemic of typhoid fever in London was traced to the eating of shellfish contaminated by sewage, and in the same year 18 cases occurring in Glasgow were traced to the eating of cockles similarly contaminated. Typhoid bacilli were obtained from the cockles and gave the agglutination reaction. Eight other cases developed in one family in a neighbouring town, all of whom had eaten the cockles.

Sewage contamination of shellfish has thus been shown to explain the outbreaks of typhoid fever in which the water supply of towns or villages has been proved to be absolutely pure. Shellfish are scavengers of the sea, and as they have better sale when they are well fattened the oystermen are in the habit of replanting them near sewage drainage in shallow water for a few weeks before they are sold. The public, however, have been repeatedly warned of the danger of eating raw shellfish thus treated. Lean or unfattened deep sea shellfish may be eaten raw, without fear of infection, and thorough cooking renders shellfish innocuous, as it does all food from a bacteriological standpoint.

Oysters may also give rise to severe enteritis, and possibly cholera when derived from infected sewage beds. Frankland, however, has determined that cholera bacilli injected into oysters do not survive more than twenty-four hours.

It is possible, although it is not definitely proved, that typhoid bacilli may be conveyed upon raw vegetables and fruits which have been washed in contaminated water. It is known that cholera germs are conveyed in all of these ways. For this reason, as well as from the necessity of avoiding diarrhœa, it is customary to advise against the use of all raw fruits and vegetables during the prevalence of a cholera epidemic.

DIPHTHERIA AND SCARLATINA

Diphtheria germs, and even those of scarlatina, can be conveyed in milk should they have access to it. Several epidemics of both diseases have been traced among families employing in common a milkman whose children at home had one or the other disease. In Buffalo, N. Y., in 1899, an epidemic of 29 cases of scarlatina was definitely traced to consumption of milk delivered by one milkman, who obtained the supply from a farmer who had the disease at the time of milking.

FOOT-AND-MOUTH DISEASE

The foot-and-mouth disease may be propagated from the use of milk from an infected cow. Sometimes this milk is of a bad taste and odour, or it may even be mixed with blood or pus if the nipples are excoriated or if the udders are inflamed. In other cases the milk appears normal, but when boiled coagulates readily into small flocculi in a bluish whey. Such milk is rendered innocuous by the process of boiling. Children are more likely to contract the disease in this way than are adults, owing to their greater consumption of cow's milk.

The gums become swollen, red, and tender, aphthous ulcers appear on the lips and gums, the submaxillary glands and tonsils may be swollen, vesicles and pustules may appear on the tongue, lips, and extremities, and there is moderate fever with vomiting and diarrhœa. The disease promptly subsides on stopping the use of infected milk.

FOOD INFECTION THROUGH FLIES

The importance of preventing food infection through the agency of common house flies is just beginning to be appreciated. These insects are admirably adapted to convey infection from their great numbers and incessant activity, as well as their numerous feet, capacious intestines, their frequent evacuations, and disgusting habits of alighting and feeding upon sputum, manure heaps, and all animal discharges. When fed on tubercular sputum the bacilli have been discovered alive in their intestines, and cholera germs have been found adhering to their feet by which they are easily transported from a choleraic stool to a piece of bread or a raw fruit or vegetable, destined in turn to infect the first person who is unlucky enough to eat it. During the cholera epidemic in Hamburg Dr. Simmonds found comma bacilli in the intestines of flies in the post-mortem room where dead cholera patients were examined. The bacilli remained one and a half hour in the flies—time enough to be carried a long distance or to be widely distributed. When the matter is further investigated it will doubtless be shown that other kinds of infection are often spread by the medium of these vulgar pests. Ordinary pus infection is readily carried by flies. In the hastily constructed camps of our troops in the Spanish-American War, and in those of the British soldiers in the Boer War, many cases of typhoid fever were traced to infection by flies that had access to the latrines in which typhoid stools had been emptied.

IDIOSYNCRASIES IN REGARD TO FOOD

Idiosyncrasies are found to exist with some persons in regard to special articles of food, and these cannot be readily explained. As a rule, if marked, they extend throughout life, but it is not seldom the case that some people pass through periods when a particular article of food disagrees with them which they have been previously able to eat with impunity. Some are unable to digest milk and are immediately nauseated or made "bilious" by it, while others cannot eat eggs, and yet can drink milk, while some cannot take either. Some can eat the white and not the yolk of eggs. Others, again, cannot eat fat in any form or are unable to digest some one variety of fat, especially hot mutton fat. Some persons acquire a headache whenever they eat butcher's meat in excess. Among the commoner idiosyncrasies of diet are the revolt of the system which occurs from the use of shellfish of all kinds, but especially lobsters, and from strawberries. Fothergill reported the case of a lady who all her life was unable to drink coffee, of which she was very fond, without having diarrhœa from it within an hour or two. Temporary or functional visual disturbances may be produced by alcohol and by indulgence in "high" game or eating spoiled food. Casey A. Wood, of Chicago, has reported a case of recurrent amblyopia in a physician of fifty-four years of age, who invariably had an attack resulting from the eating of chocolate in any form.

Food idiosyncrasies are not infrequently hereditary, and may affect several members of one family. They are wholly independent of ordinary dyspeptic conditions, and may be present in those whose digestive organs are exceptionally robust.

X. Alcohol Poisoning—Alcoholism—Delirium Tremens

The position of alcohol as both a food and a stimulant has already been fully discussed in connection with its physiological and dietetic action (p. 231).

ALCOHOL POISONING

The effects of poisoning by alcohol differ according as they are acute or chronic, and according to the previous alcoholic habits of the patients. Habitual drinkers easily consume quantities of raw spirits which might prove fatal if drunk by one not inured to their use. Men have been known to drop dead a few moments after quickly drinking a pint or more of whisky on a wager. Although, according to Professor Atwater, two and a half ounces of alcohol may be daily oxidised by a person in health, the continued use of beverages containing this quantity is liable to produce alcoholism in any one.

When alcohol is used to excess as a stimulant its effects are manifested by the increased mental excitement of intoxication. There is a period of restlessness, insomnia, loss of memory, and irritability. The stage of insensibility and final stupor or coma develops later after long taking large quantities of alcohol. Patients suffering from alcoholic coma are always in danger of heart failure from paralysis of that organ, which forms no exception to the general rule that overstimulation of any muscle produces exhaustion and paresis. When in this condition, however, they are fortunately incapacitated from making any sudden or violent exertion, and in acute cases alcohol is eliminated with considerable rapidity from the various excretory organs of the body, especially the kidneys, in the form of waste matter, which it produces.

The continued use of strong spirits, as well as the occasional use of alcohol in excess, almost invariably results after some time in the establishment of chronic gastric catarrh, which is characterised by the formation of thick, ropy mucus, and thickening of the gastric mucous membrane, with atrophy of the gastric glands. There is always malfermentation with more or less acidity and heartburn and considerable nausea, especially in the morning, when the mucus or products of indigestion have accumulated overnight. There is also an increased production of connective tissue in the stomach wall. The effects of chronic alcoholism upon the alimentary canal are chiefly manifested in the stomach, although the intestine may share in the pathological changes. This is due to the fact that the alcohol reaches the stomach in a more concentrated form, and that being very diffusible it is absorbed in great part without entering the intestine.

In addition to the local gastric catarrh and inflammation which it may produce, alcohol gradually alters various viscera, causing cirrhosis of the liver, nephritis, chronic endarteritis, etc. Chronic alcoholism is one of the commonest causes of multiple neuritis, chronic pachymeningitis, and myelitis.

In chronic alcoholism the intense craving for alcohol in any form tends to weaken and overcome the will power and debase the moral nature of the individual, and those who are afflicted by this habit very often drink periodically—that is, the intervals between their excesses may be prolonged for one or several months, during which time they touch no alcohol in any form, and, indeed, in some cases they may have a positive loathing for it. The very sight of it nauseates them. The craving then returns and becomes so irresistible that if they cannot obtain liquor they have been known to drink raw alcohol from spirit lamps or in any shape in which they can obtain it. The craving consists partly of a special appetite for liquor in the stomach, and in part of the general irresistible desire of the system, which is somewhat akin in its effect to intense hunger, although the effect on the will power is more disastrous.

The evil results of excessive indulgence in alcohol are strikingly shown by its effect upon liquor dealers, the mortality among whom, from various diseases, as compared with that of other men, bears the ratio of 3 to 2. When a similar comparison is made in regard to the mortality of liquor dealers from special diseases, the result is still more striking; thus for liver diseases the ratio is 6 to 1, for nervous diseases nearly 2 to 1, and for alcoholism 5.5 to 1.

The dietetic causes of inebriety form an interesting study. The craving for alcohol is undoubtedly fostered in many cases by monotony of diet, by ill-prepared food, and the resulting catarrhs of the alimentary canal and lack of nutrition. To meet the symptoms of anorexia, heartburn, and weakness from malnutrition "tonics" and "bitters" containing alcohol are often resorted to, or alcohol is taken more directly in the form of strong spirits. While this may temporarily relieve the craving for some form of stimulation, it often merely makes the digestive disturbance worse and increases the mental depression of "biliousness." In such manner the drink habit is easily established.

Dietetic Treatment of Mild Cases.—In the milder cases characterised by nervousness, muscular tremors, indigestion, dyspepsia, a foul breath, coated tongue, and urine loaded with urates or crystalline deposits, if the patient can be induced to stop all alcoholic drink and take abundant water or alkaline effervescing waters (Vichy, Seltzer, Apollinaris, etc.), together with a proper diet, much can be done to ward off an acute attack. A very good example of the appropriate diet is the following from Foods and Dietaries:

"*Breakfast.*—A lightly boiled egg, or a little bit of whitefish or of bacon, or a light savoury omelet; toast, or bread and butter; a cup of weak tea or of coffee and milk.

"*Early Dinner,* 1 *o'clock.*—A slice of roast mutton, or the wing of a chicken, or a plain cutlet, with a spoonful of mashed potato and some well-boiled green vegetable. A few spoonfuls of any plain milk or bread pudding, with occasionally some stewed fruit. *Beverage.*—A glass of plain or aërated water, to be taken slowly towards the close of the meal.

"*Afternoon.*—A cup of tea with milk may be allowed, with toast or rusk.

"*Supper,* 7.30.—A light meal of fresh fish, or of bird, or of calf's head, or of tripe, with dry boiled rice or bread. *Beverage.*—Small glass of milk and soda water."

In cases of periodic alcoholism, in which the patient has no craving for drink between his attacks, it is best to recommend for the intervals a non-stimulating diet, avoiding condiments and richly cooked or highly seasoned food of all sorts. Fruits, plainly cooked cereals, and vegetables should constitute the staple diet, and animal food should be eaten only in moderation.

In some of these cases overindulgence in food excites the craving for alcohol.

Dietetic Treatment of Severe Cases.—The treatment of the severer cases, in which dyspeptic or gastro-intestinal symptoms predominate, but in which delirium tremens is not necessarily present, is mainly that of gastric catarrh, described elsewhere. It must be adapted to the degree of inflammatory or cirrhotic changes which have already taken place in the different organs. The patients usually feel much worse in the mornings, having nausea and vomiting or loathing for food, but later in the day they may recover considerable appetite and power of digestion. Advantage should be taken of this fact in feeding them. The following *menu* from Foods and Dietaries is very well adapted to this stage of chronic alcoholism:

"*Breakfast, say* 8 *o'clock.*—A cup of weak tea with an egg beaten up in it, and a slice of toast.

"*Second Meal,* 10.30.—A cupful of good meat soup, thickened, or a cup of peptonised milk, warmed, with toast or rusk.

"*Early Dinner,* 1 *o'clock.*—A tablespoonful of pounded meat on toast, or a small teacupful of fresh meat juice, with fingers of toast. A couple of spoonfuls of sago, custard, or tapioca pudding. *Beverage.*—Half a tumblerful of milk and soda water (equal parts).

"*Afternoon Tea,* 4.30.—A cup of weak tea or of cocoa nibs, with rusk or a plain biscuit.

"*Evening Meal,* 7 *o'clock.*—A cup of soup or of mutton broth, as at the forenoon meal.

"9.30 *or* 10.—A cup of peptonised milk and a slice of thin bread and butter.

"*Food During the Night.*—In case of wakefulness there should be within reach, and arranged so as to be readily warmed, peptonised milk."

DELIRIUM TREMENS

Delirium tremens is a condition of active maniacal excitement which in its worst form is accompanied by intense general nervous excitement, muscular weakness, and hallucinations, chiefly of sight and hearing, of a terrifying or disgusting nature.

Delirium tremens is sometimes excited by a temporary debauch, but as a rule this results in a condition of coma rather than maniacal excitement. Delirium tremens is much more characteristic of chronic than of acute alcoholism.

In the earlier stages the heart action may be apparently vigorous and the pulse full and bounding, but the heart may become suddenly exhausted and cardiac failure is the chief danger.

Dietetic Treatment.—The indications for dietetic treatment are to make sure that the alimentary canal, which has been previously disordered and congested, if not inflamed by the excessive irritation of strong alcoholic drink, is emptied of any accumulation of abnormally fermenting food. In the earlier stages brisk purgation or an evacuant enema should be given. If the stomach is overloaded with improper food, free vomiting should be produced by ipecac or apomorphine, provided the condition of the patient is sufficiently vigorous to warrant this procedure. Large draughts of water, aërated and saline waters, should be taken to promote the activity of the kidneys and to dilute the poison in the system. The alimentary canal having thus been emptied of fermentation products, it becomes necessary to support the patient's strength with abundant nourishment. The appetite for food is usually entirely absent, being replaced by that for drink, but the patient must be urged to take all the nourishment possible, and to this end it may be given in fluid form in small frequent doses. The food should be stimulating and predigested. If there is much gastro-intestinal irritation, pancreatinised milk, strong meat soups, beef tea with dropped eggs added to it, and egg albumin may all be given. The mucous surface of the stomach has been long accustomed to the stimulating effect of strong alcohol, and if this be suddenly and completely removed, gastric discomfort and craving for drink become intolerable. This condition is often relieved by using strong spices or condiments, such as ginger or Cayenne pepper, in quantities which would be injurious to a normal stomach, and might possibly produce gastritis. These substances may be added to food and non-alcoholic drink, although the stomach may be actually inflamed. Experience proves that highly seasoned food is sometimes borne with the effect of diminishing the suffering of the patient. This applies, of course, only to very robust cases, in which an otherwise vigorous constitution has been abused by excessive indulgence in drink, and the gastric stimulant should not be long continued. In this variety of cases the quantity of food which the patient is encouraged to take need only be limited by the ability to digest it, for the digestive organs can be kept fairly active without being overloaded to the extent of exciting abnormal fermentation. The nervous system is always strengthened and soothed by abundant nourishment.

Ginger ale constitutes a very serviceable non-alcoholic beverage, which in part relieves the craving for stronger drink. It may be drunk in considerable quantity, and it possesses the advantage of being somewhat laxative, diuretic, and mildly stimulating to the stomach. Care should be taken to obtain a pure article, as there is much inferior ale in market.

It is well known that persons who for many years have indulged excessively in spirituous drinks are very apt to develop delirium tremens if taken suddenly ill, or if they sustain an injury such as a fracture, although they may have drunk no liquor for many weeks. In such cases the patient's life is in serious danger and it may be necessary to give more alcohol to maintain the accustomed influence. The conditions here to be met are very different from those resulting from an ordinary debauch, when liquor should be entirely withheld.

PART VII

ADMINISTRATION OF FOOD FOR THE SICK

METHODS OF FEEDING THE SICK

General Rules

In no branch of her work can the nurse be of more service than in her ability to feed a very sick patient properly. There are many details which can only be mastered by extensive bedside experience and close observation, and so much depends upon tact and discretion, which can never be learned from text-books or lectures, that it is impossible to formulate rules for feeding which shall cover all cases; but the following suggestions will be found applicable in many instances.

Miss Nightingale wrote that "to watch for the opinions which the patient's stomach gives, rather than to read 'analyses of foods,' is the business of all those who have to settle what the patient is to eat—perhaps the most important thing to be provided for him after the air he is to breathe."

The Appetite.—In judging of the patient's appetite it must be remembered that what is supposed to be a lack of desire for food is possibly due merely to defective cooking, to serving meals at inopportune moments, or to selecting food which is not to his liking. There may be appetite enough for food, but not for the particular food offered, and it is the province of the nurse to differentiate such matters. She should not only save the patient from physical exertion, but from the effort of thinking as well.

It is the function of the nurse to observe and record all the conditions of the patient's appetite, digestion, and likes and dislikes for different foods, and when her instructions have not been specific, or have not provided for emergencies, she should make it a point to have them understood at the next visit of the physician. A thorough practical knowledge of dietetics should be the foundation of the nurse's education, and this subject should receive much more attention in the curriculum of training schools than is at present bestowed.

The nurse has a far better opportunity than the physician to judge of the patient's appetite and study his whims and fancies in regard to food, and she should not fail to report them and understand very positively from the physician in charge to what extent she is to be permitted to humour them and substitute one form of food or drink for another. Directions are apt to be given too indefinitely to the nurse, and with the best intentions, from lack of instruction, she may neutralise the effects of medicines by overfeeding, or by irregularities in feeding which disorder digestion and interfere with the action of the drugs, besides making the patient worse. She is often merely told to give " soft diet " or " fluid food," and she promptly resorts to milk and eggs, which may or may not agree and nourish. Or instead of such vague orders she may be directed to give only some one form of food, which she conscientiously does, offering it in spite of the patient's accumulating nausea and disgust, with the result of half starving him, because the physician has forgotten to allow the nurse any latitude or discretion.

Regularity in Feeding.—The hospital nurse should be taught that it is as important to give food as medicines at regularly appointed intervals. Punctuality should be carefully observed in serving all meals to the sick. There is much unconscious habit in regard to eating, and an appetite which was ready at the accustomed hour of receiving food may vanish if the meal is delayed. It is well, when possible, to bathe the patient's face and hands before offering a meal. It is best always for the same nurse to have the charge of feeding a definite number of hospital patients. If they are served by a different nurse at each meal it is much more difficult to report those whose appetites are defective or capricious.

Quantity of Food.—Among the first considerations is the proper quantity of food to offer the sick, and the extent of its dilution. Miss Nightingale has said that " an almost universal error among nurses is the bulk of the food, and especially of the drinks, they offer to their patients," and " it requires very nice observation and care (and meets with hardly any) to determine what will not be too thick or strong for the patient to take, while giving him no more than the bulk that he is able to swallow."

By diluting milk, stimulants, and gruels too much, or making beef tea too weak, the quantity of the fluid is so great that the patient soon tires of swallowing, and stops before enough nourishment has been obtained. Predigested milk possesses the decided advantage that it aids the assimilation of the milk without adding to its bulk, as lime water and other substances do.

When the appetite flags it is unwise to ask the patient each time beforehand what he would like to eat. It is often the unexpected which pleases. The smell of cooking and the noise of the preparation of food should be kept from the sick-room. The nurse should never eat her own meals in the presence of the patient.

Details of serving Food.—Hot food should be served very hot and cold articles very cold, for lukewarm food is unpalatable. In serving hot beverages or foods the cups or plates should be first well heated. Milk and butter should be kept cold and well covered. A simple refrigerator is easily improvised by placing a few large lumps of ice in a dish pan or pail kept by an open shaded window, and wrapping them in flannel to prevent evaporation.

Patients may appear too ill to notice details, whereas they are often only too ill to speak of them, and a refined, fastidious, or nervous patient may have the appetite wholly destroyed by the carelessness of a nurse who tastes the food in the patient's presence or with his spoon, or who serves food with unclean hands. Untasted food, dishes after use, or half-emptied cups or glasses should never be left standing about the sick-room. Nothing is more uninviting than to have to drink from a glass to the sides of which stale milk is adhering. If there is any suspicion of the absolute freshness of milk, eggs, butter, or fish, they should never be served.

It is equally important to make all food look inviting by offering it with the most attractive china which the house affords, and with only the cleanest of linen. Dishes should always be wiped dry on the outside, and pains should be exercised not to spill the contents of cups into their saucers.

These may appear trivial details, but it must be remembered that the horizon of the sick-room is very limited, and a patient who has been long confined to bed with a serious illness thinks a great deal of his immediate surroundings. The taking of food is the chief event of the day for him, and too much care cannot be bestowed upon the minutiæ of service, while the natural stimulants to appetite—such as fresh air, exercise, and enlivening companionship—are necessarily wanting.

When patients are able to partially sit up for their meals, the nurse should see that they have a comfortable position in the bed, and that the food tray does not cramp the arms or legs. The effort of sitting up may cause fatigue too soon and destroy the appetite before the meal is half done.

As a rule, twice-cooked food should not be served to invalids. This applies especially to meat, fish, and vegetables. Whenever economy is an important consideration, it is better to cook but little food at a time, and serve it fresh and hot. Food is often made unpalatable by being too greasy, and this is one of the chief objections to the use of meat broths, and mutton or chicken broth should always be several times skimmed before they are given, and blotting paper or a bit of bread can be passed over the surface to remove the last trace of oily substance. A chafing dish is invaluable for the convalescent from protracted illness.

When the dietary ordered is very limited in variety, the patient is often gratified by having his food served in "courses," and will eat more than if given everything at once.

In other cases, when a patient is first allowed to sit up for half an hour or more beside the bed, it may be well to utilise this time for giving the principal meal of the day, which will be eaten with more relish, and perhaps better digested in consequence.

Patients having nausea or other gastric disorder or diarrhœa should be given but little food at once. Small, oft-repeated feedings are best for them. As a rule, invalids need more salt as a condiment, but less sugar, than those in health.

When patients are being fed with fluids, wholly different receptacles should be used for holding their medicines, or the association of ideas may be strong enough to destroy what little appetite there is, and even to produce nausea.

The nurse should always have a cheerful manner and a cleanly and tidy appearance, which contribute much towards the patient's appetite. She should never offer nourishment too soon after removing the vessels employed for the patient's discharges or evacuations, but should allow a proper interval to elapse, and let it be evident that she has thoroughly cleansed her hands. No form of perfumery should ever be used by the nurse. Bread crumbs should never be allowed to fall into the bed, especially of a helpless patient.

When possible, it is well to divert the patient's mind from his ailments while feeding him by introducing some cheerful or interesting topic.

Feeding Helpless Patients.—In feeding helpless patients with fluids, if the head is to be raised, it should be done by placing the hand beneath the pillow and lifting it gently. This affords much better support, and is more comfortable for the patient, for the head is less likely to be bent so far forward as to interfere with swallowing. If a tumbler is used, it should always be small and not more than two thirds filled. An average breakfast-cup holds eight fluid ounces, and an average tea-cup six fluid ounces. A thirsty patient derives more satisfaction from draining a small glass than from sipping from a large one which he is not allowed to empty. The feeble patient should not be allowed to swallow during inspiration, and the nurse should be careful that each mouthful is swallowed before another is given, to prevent serious coughing.

When a glass tube is used for feeding, it should have a flattened end to hold in the mouth, and should be bent near the centre at a slight angle, so that it is unnecessary to flex the patient's head. If feeding-cups with spouts are employed, they should be of glass, so that the nurse can see how much the patient is taking; otherwise fluid is apt to be poured into the mouth in too large a quantity. As a rule, the bent tube is decidedly better to use when the patient has any power of suction at all. Even when he has not, the glass may be raised by the nurse, so that the fluid flows into the mouth without effort. The cup and tube should always be prevented from dripping.

Sleep and Feeding.—Patients need only be aroused from sleep to take nourishment in serious cases. Usually the ease with which a patient drops asleep should determine the necessity for awakening him. Sleep is often more beneficial even than food, but there are cases in which a patient awakens to take a sip of milk or a few mouthfuls of food, and will immediately drop off to sleep again. Such patients may be aroused for food every two hours if there is need, as there may be in typhoid fever. Some patients are annoyed by awakening at three or four o'clock in the morning, not being able to sleep again. Food of some sort should always be kept on hand during the night, and drinking a cup of hot bouillon or cocoa will often enable them to fall asleep again for two or three hours.

Cleansing the Mouth.—The patient's comfort is very dependent upon keeping a clean mouth, as indeed are his appetite and taste. A helpless patient whose mouth and lips are allowed to become parched and sour will refuse nourishment which he might otherwise gladly take. The mouth should be rinsed each time after eating with pure water, hydrogen peroxid, or diluted Listerine (two teaspoonfuls to the tumbler of water), or borax water of similar strength. It is much easier to keep the mouth clean in this manner than to disinfect it after it has been neglected. Milk especially lingers on the mucous surface, and, fermenting there, destroys the sense of taste and develops germs that interfere with digestion. When the patient cannot rinse his own mouth, it must be frequently cleansed by the nurse with a swab of fresh cotton fastened on a small flexible stick, such as a piece of splint, and moistened with the mouth wash. The best tongue scraper is made with a piece of whalebone, about nine inches long, bent into a loop. If this be applied before the patient's meals, the taste nerves of the tongue will be uncovered from the accumulated *débris* which coats them, and the appetite will be improved. Dry lips should be moistened with vaseline or cold cream, not glycerin.

Cracked ice will keep much longer if not allowed to float in melting water. The contact of a metal spoon or dish also melts it sooner, by virtue of the great conductivity of metal.

A piece of cheese cloth, mosquito netting, or linen may be tied over a cup by an elastic band, and the fragments of ice split off with a pin may be laid upon the cloth, so that the melted fluid drains away beneath.

Disinfection of Utensils.—All dishes or utensils used in serving food to patients having syphilis, stomatitis, or diphtheria, or any infectious disease likely to be communicated through such means, should be boiled for at least an hour in water containing a few teaspoonfuls of soda. Syphilitic patients, especially, should have their own set of food receptacles, spoons, forks, etc., properly labelled, to prevent any one else from using them.

Feeding Unconscious Patients.—The feeding of unconscious patients demands special care and skill. They should never be given anything but fluid nourishment, and this must be fed with a spoon or through a catheter. Sometimes, if the jaw is set, a medicine dropper may be utilised. Not over a teaspoonful should be given at once, and the nurse must make sure that it is swallowed before she repeats the experiment. It should be remembered that the mechanism of deglutition is not excited by one or two drops of fluid, but usually at least half a drachm is required to start this reflex. In feeding comatose infants or children with tubercular meningitis, apoplexy, etc., fluid may be poured into the nostril with a spoon rather than into the mouth. It disturbs the child less than does the effort to force open the mouth, and if the head is lying back the fluid trickles down the posterior pharyngeal wall. Any excess of fluid is returned through the other nostril. There is no greater danger of choking when fed by this method than by the mouth. It is usually better, however, to use a soft catheter with a funnel attached to the free end. The catheter is oiled or dipped in vaseline or butter, and passed gently through the nostril down into the œsophagus, or, if desired, into the stomach. Before pouring any fluid into it through the funnel it must be made certain that the patient is breathing easily, and that the tube has not made a false passage into the larynx. Such an accident is very rare. This topic will receive further attention in connection with Lavage.

Gavage, or feeding with the stomach tube, is described under that heading. Nasal feeding is employed sometimes for gavage in young infants, in feeding children with diphtheria, or the insane, who may refuse food or resist the passage of a tube through the mouth by biting, and it may be used when the mouth is sore from ulceration or the effect of corrosive poisons.

When patients are living upon "teacup diet," or broths and gruels, it is a common mistake to give them a diet which is either too low in carbohydrates or deficient in protein. The proper proportions to be prescribed, unless there is some special indication for the contrary, will be appreciated by a comparison of the following table, compiled by Mrs. E. H. Richards, and those previously given on p. 291.

A Common Invalid Ration too Low in Carbohydrates (Mrs. Richards)

	Protein.	Fat.	Carbohydrates.	Calories.
	Grammes.	*Grammes.*	*Grammes.*	
1 pint of beef juice, containing 7 per cent......	31.5	....	..	129.0
1 pint of whole milk........................	17.0	18.0	22	325.5
1 quart of flour gruel made with whole milk...	18.2	18.2	38	397.9
2 quarts of liquid. Total....................	66.7	36.2	60	852.4

Nutrient Enemata

Rectal Absorption.—That all mucous membranes are capable of absorbing certain materials from their surfaces and passing them into the blood vessels or lymphatics has long been recognised; but it is only of comparatively recent years that this knowledge has been applied extensively to the purpose of nourishing patients by means of the rectum, and the fact is now established that sufficient aliment may be absorbed from the mucous membrane of the rectum or sigmoid flexure alone to sustain life for a considerable period, amounting in some cases to from four to seven weeks. Moreover, the rectum may be utilised for accessory feeding for many cases in which the stomach is able to digest some food, but not in sufficient quantity to prevent emaciation.

Whenever rectal food enemata are employed certain principles should be observed:

1. The rectal surface must be cleansed from all mucus and fæces.
2. The irritation of the rectum should be allayed as far as possible.
3. The quantity and quality of food thus administered should be so regulated as to avoid exciting peristalsis, and yet allow of the complete absorption of one injection before another is given.

The minutest details which will secure the best conditions for absorption should never be regarded as too insignificant. Some patients find the idea of rectal feeding very repulsive, and dislike to submit to it; but with a little tact and perseverance their objections can usually be overcome.

CONDITIONS NECESSITATING RECTAL FEEDING

The conditions which may require the use of rectal feeding are these:

I. Temporary obstruction to the entrance of food into the alimentary canal. Rectal feeding must be resorted to until the obstruction—such as the presence of new growths and foreign bodies, or inflammatory conditions with swelling in the mouth, pharynx, or œsophagus—can be overcome.

II. Inability to swallow food from coma, delirium, or paralysis affecting the mechanism of deglutition, as, for example, post-diphtheritic paralysis.

III. Extreme irritability, pain, acute inflammation or ulceration of the upper portion of the alimentary canal, such as that excited by corrosive poisons like carbolic acid, ammonia, etc.

IV. Stricture occurring in any part of the alimentary canal above the rectum.

V. Prolonged reflex vomiting, such as may occur in pregnancy and seasickness.

VI. Gastric ulcer, for the purpose of resting the ulcerated surface and allowing it to heal.

VII. Cancer of the stomach with inability to absorb or digest sufficient food, especially with obstruction to either the cardiac or pyloric end of the organ.

VIII. Any form of severe gastric irritation, such as occurs in acute gastritis.

IX. Exhausted conditions of the system which may be present during the course of severe fevers in which absorption of even predigested food is largely suspended.

X. For the insane who refuse food by the mouth.

XI. To supplement the action of a feeble stomach, or when for any reason, such as total lack of appetite, emaciation is rapidly progressive.

Hunger and Thirst during Rectal Feeding.—These symptoms are not necessarily present after the first day or two of rectal feeding. In an obstinate case of gastric hæmorrhage in which absolutely nothing—not even water—was given by the mouth for more than a week, I questioned the patient in regard to her sensations of hunger and thirst, and she told me that they were entirely relieved after the first twenty-four hours' use of nutrient enemata. The mouth and tongue were not dry, and she did not lose weight during this period. I have been told the same thing by other patients.

An interesting case was reported by C. W. Brown, of Washington, in which a patient suffering from carcinoma with ulceration of the pyloric end of the stomach was supported for forty-three days upon exclusive rectal nourishment consisting of from four to six ounces of beef tea and milk, which were given on an average once in three hours, with the occasional addition of laudanum and a little whisky. During an interval of improvement which followed the exclusive use of injections, the patient was able to take some food by the stomach, though not enough to satisfy the craving of hunger and prevent a feeling of faintness; but these symptoms were overcome by giving four nutrient injections daily in addition to the milk taken by the stomach.

Method of Injection.—The common practice of giving nutrient enemata by a Davidson syringe with a short hard-rubber or steel nozzle is always to be condemned. In the hands of an unskilful nurse, irritation and sometimes hæmorrhages are likely to be produced in this way, sooner or later.

In commencing the use of rectal alimentation, especially in cases which manifest much irritation of the lower bowel, it is important to employ a long, soft, flexible rubber catheter or rectal tube which can be passed well up, for eight inches or more, to the sigmoid flexure. In selecting the tube, one should be chosen which is not so flexible that it is liable to bend or double upon itself, but which is not so stiff as to give pain or damage the mucous membrane if it happens to catch in a fold of its surface. For children a No. 12 or No. 14 ordinary "velvet-eyed" flexible catheter may be used, and passed up as high as the sigmoid flexure. For adults the tube should be of moderate calibre, not exceeding the diameter of a stout pen handle. The tube or catheter should be dipped in sweet oil, melted butter, or vaseline; but glycerin must not be used, for it excites peristalsis.

In adults the tube should be passed in for from ten to twelve inches, for the injection should be placed as high up as possible. When this is done there is less liability to its rejection, and it is brought in contact with an extensive mucous surface. There is a further physiological or anatomical reason for placing the injection as high up as may be, in the fact that the sigmoid veins and those returning the blood from the upper rectum communicate with the inferior mesenteric vein, while those from the lower third of the rectum communicate with the inferior vena cava. Consequently, whatever is absorbed by the wall of the inferior third of the rectum passes into the inferior vena cava without going to the liver, but that which is absorbed higher up is returned to veins whose contents reach the liver directly through branches of the vena porta. It is in the liver that the further assimilation of protein takes place in great part, and hence the desirability of observing this rule.

It was found by Brown, in the case above cited (p. 410), that the patient was able to discriminate between the taste of iodide of potassium and ergot, etc., in from a quarter to half an hour after these medicines had been given *per rectum*. The same phenomenon has been noticed from the injection of such substances directly into the stomach through a gastric fistula, and it is due to their ready absorption and conveyance in the blood to the taste bulbs in the tongue or to the saliva, in which fluid the iodide of potassium is promptly excreted.

According to some observers, under the best conditions not over one fourth of the necessary nutriment can be absorbed from the rectum (Bauer). Such a statement should be considerably modified, for, as a matter of practical experience, many patients may be kept alive and gain slightly in weight upon the use of nutrient enemata, when they are intelligently given. If injected but a short distance into the intestine, the absorbing surface is so limited that comparatively little material is taken up; but if given in the manner prescribed above, through a long catheter inserted high up, much more will be retained, and the benefit derived from such injections will be enhanced.

The injection should be applied by means of a small hard-rubber syringe, which need not hold over two ounces. Very little force should be used, and the patient must be told not to strain. After the syringe is filled, by holding it vertically nozzle uppermost and pressing it until the fluid exudes from the nozzle, all air is excluded. When a Davidson syringe is used for the purpose of injecting small quantities of fluid, it very often happens that air is drawn into the syringe in addition to the materials of the enema, which, when injected, is very apt to excite peristalsis and evacuate the bowel. The use in unskilful hands of a funnel or fountain syringe for filling the tube is open to the same objection—that air is likely to enter the rectum. In any case it is well to fill the tube with the injection fluid before it is inserted.

Quantity.—The proper quantity of food for a nutrient enema for an adult is 4 to 8 ounces; for a young child, 2 to 3 ounces, given every 4 or 6 hours.

Aids to Retention.—Upon withdrawing the tube, if there is danger that the injection will not be retained, a soft compress or folded towel should be pressed up firmly against the anus for twenty minutes or half an hour.

The retention of the enema is aided by placing the patient in a proper position. He should lie, if possible, upon the left side, with the hips raised high upon a pillow, and the injection should be given very slowly and carefully. The "Sims" gynæcological position is the best, but with the hips more elevated.

Temperature of Injections.—All food enemata should be given moderately warm, at a temperature of 90° or 95° F. They are less likely to excite peristalsis than if administered very hot or very cold.

Number of Injections.—The question of how many injections can be given must depend upon the irritability of the rectum. It can never be used like the stomach, and it is advisable to begin by ordering an enema only once in six hours. If the rectum is in good condition the number may be increased to one every four, or even every three hours. In exceptional cases or for emergencies small injections, not exceeding one and a half ounce, may be given once in two hours; but if repeated at such brief intervals, they are almost certain to excite irritation.

CARE OF THE RECTUM

When it is important that nutrient enemata should be continued for some time, the exact condition of the rectum should be ascertained by the physician, and the most minute directions should be given to the nurse. The matter is not infrequently left to an attendant, who is wholly ignorant of the proper conditions to be observed, and failure is sometimes reported when a little intelligent attention bestowed upon details would overcome all difficulties.

As already stated, many cases have been recorded in which patients have been nourished exclusively by nutrient enemata for several weeks, and it is an important fact that the rectum may acquire a certain degree of toleration for them. For the first few days they may be rejected, but when correctly prepared and administered they will soon be successfully retained. But it is only in the most favourable cases that rectal alimentation can be long continued without eventually producing irritation and mucous diarrhœa, and in the majority of instances this is likely to occur after two or three weeks. The enemata must then be discontinued, but may, if necessary, be resumed again after a brief interval. Queirolo, of the University of Pisa, has fed typhoid-fever patients exclusively by nutrient enemata four times a day with success, his idea being to avoid putting anything into the small intestine capable of fermenting or producing toxins, but this practice is not in accord with modern views of the disease.

The presence of hæmorrhoids is a serious drawback when the use of rectal feeding becomes imperative, and care should be exercised not to irritate or inflame them by the passage of the catheter or nozzle of the syringe. In such cases it is necessary to use only a very soft and flexible catheter, and to allay irritation by the topical application of a 2-per-cent solution of cocaine.

Whenever nutrient enemata are employed for a long time the rectum should be thoroughly evacuated and cleansed, at least once a day, by flushing with a copious injection of warm soapsuds and water, amounting to two or three pints, immediately after which a food enema should be given.

The cleansing enemata may be given through a double or single catheter. If a double catheter is preferred, a larger quantity, two or three quarts, of water may be advantageously given, and a few grains of common salt should be added to each injection. If the rectum is irritable, and much mucus coats its inner surface, it may be well to add boric acid to the water in saturated solution. The injection washes out any particles of waste matter or remains of a previous nutrient injection, cleanses the mucous surface, stimulates its circulation, and prepares it for better absorption.

Opium in Enemata.—Opium, while it prevents peristaltic action and favours retention of the enema, may also tend to interfere with its absorption. It is consequently to be avoided, if possible, but when irritation of the rectum exists it becomes necessary to inject a little laudanum. Ordinarily, three to four minims is sufficient, but ten, or even twenty, may be required in some cases. This dosage must not be often repeated. Its effect, of course, should be watched, and it must not be given too freely. If nutrient enemata are constantly employed it is sometimes found that a larger dose injected by a small hard-rubber syringe half an hour or an hour before giving an enema allays the irritation more completely than if the opium is given in one of its constituents. Injected by itself, the quantity of opium is so small that it is not ejected, but is absorbed, and its local action is obtained before the larger bulk of fluid in the enema is injected. In other cases it is sufficient to give the laudanum in very small quantity, five or six minims with each enema. Instead of laudanum, the deodorised tincture of opium or McMunn's elixir may be used.

SUBSTANCES AVAILABLE FOR RECTAL FEEDING

Of the different classes of food stuffs, there are some which are absorbed readily by the rectum, while others are scarcely taken up at all. To the latter class belong starches and most of the fats. Those starches which are predigested and partially converted into sugar may be absorbed to a very limited extent, but not sufficiently to add to the nutrition of the body. Maltine may sometimes be absorbed. Fats and oils not only remain unabsorbed by the rectum, but they prevent the absorption of other foods by coating either the mucous membrane or the food itself, and are therefore worse than useless. Attempts have been made to give them saponified or finely emulsified, prepared with pancreatin or otherwise, but it is doubtful if even under these circumstances enough of any form of fat or oil can be taken up to be of practical benefit in rectal feeding.

It is exceedingly important to use only materials which will be as completely absorbed as possible. Anything else acts as a foreign body, and in time proves more or less irritating. Moreover, it is found that many albuminous materials which are absorbed from the surface of this portion of the intestine become irritating if given in too concentrated a form, such as pure peptone, and they must be diluted to two or three times their volume with water or some bland fluid. Some forms of albumin are undoubtedly absorbed from the mucous membrane of the rectum without predigestion, such as that expressed from chopped meat or egg albumin, but it is much better to at least partially pancreatinise it.

Pancreatinised Meat.—In preparing proteid food for absorption one of the forms of pancreatic extract or pancreatin may be used. Extracts of pancreas are open to the objection that they do not keep very long, and unless perfectly fresh they are apt to prove irritating, and glycerin extracts cannot be used in any quantity on account of the aperient action of the glycerin itself. To overcome these difficulties, Leube suggests using the fresh pancreas, which is to be added in the proportion of one part to three of beef. Both the meat and the pancreatic gland should be scraped or thoroughly minced and rubbed into a paste with a little warm water. Any fat should be carefully removed. The pulp thus obtained is to be injected by means of a suitable syringe with a rather wide nozzle. The digestion, which is begun outside, is continued within the rectum. Leube sometimes adds egg albumen and even fat to the mixture.

Sansom gives the following formula for a meat peptone enema suitable for an infant or young child: Shred raw beef or mutton in bulk about two tablespoonfuls, add an equal bulk of water, and let stand for an hour; then add gradually four tablespoonfuls of milk, heated to boiling. When all is well mixed the temperature of the mixture will be about 140° F., then add a teaspoonful of Savory & Moore's or Benger's liquor pancreaticus, and a pinch of bicarbonate of soda. Let the whole remain for six hours, and heat to boiling. Strain through muslin and preserve the liquid, which will suffice for several enemas.

Blood.—Dried beef blood has sometimes been used as a rectal food, but there is no evidence that it is absorbed. In those cases in which I have employed it it has usually caked within the rectum and prevented the absorption of other materials. Fresh defibrinated blood has also been used for the same purpose—four ounces may be given every six hours—but it possesses no advantage over predigested milk or peptones, and is not to be recommended.

Milk.—Pancreatinised milk in which the process of predigestion has not been carried too far is, on the whole, one of the most satisfactory foods which can be used by rectum. It should not be rich in cream.

Eggs.—Huber proved by experiments upon patients in nitrogenous equilibrium that the rectum absorbs 25 to 35 per cent of the nitrogen of raw eggs, 70 per cent from raw eggs with sodium chlorid, and 75 per cent from peptonised eggs. The whites of two eggs may be added to peptonised milk, or, better, to peptone solution or one of the meat extracts. Ewald, who has experimented extensively with rectal alimentation, states that unpeptonised egg albumen is absorbed as promptly from the rectal surface as commercial peptone, while peptonised egg albumen is taken up even better. The absorption of albumen is furthered by the addition of a little table salt to the injection—about fifteen grains to each egg.

The yolk of egg is not recommended for rectal use, for although it contains albuminous material, so much fat is mixed with it, which is not absorbed excepting by the intestinal villi, that it is useless.

Grape Sugar.—Ewald has demonstrated the existence of anastomoses between the superior and middle hæmorrhoidal veins, extending to within three inches of the anus, hence making it possible for any carbohydrates absorbed per rectum to reach the portal system direct and be assimilated by the liver. Of the various carbohydrates, it has been proved by Schönborn that a solution of glucose is best absorbed. The solution should not be stronger than 10 cc. in 100 cc. of water, and should not be used too often, or it may prove irritant and excite diarrhœa. As much as 95 per cent of such solution may be absorbed.

The addition of salt to all forms of food enemata aids in their absorption.

Alcohol.—The alcohol used for rectal injection should be in the form of good liquor, somewhat diluted. If pure alcohol is given, it should be diluted in three or four parts of water, when it becomes less irritating to the mucous membrane and is more easily absorbed. Very often a small injection of half an ounce of whisky in an ounce and a half of water, or even an injection of whisky, brandy, or sherry and water given alone, will be retained and completely absorbed, when a larger volume of fluid or other ingredients added to the alcohol will not be retained, and the whole enema will pass out again. Rum may be used, or brandy, but, as a rule, good whisky is the most serviceable. When alcohol is given in connection with other rectal foods, it may be unnecessary to dilute it with water, but undiluted whisky sometimes causes precipitation in milk. If added too strong it coagulates casein which has not been pancreatinised, and no solid matter, even in the form of a fine precipitate, is of much use in the rectum, where it acts as an irritant.

Prescriptions for Food Enemata.—Ewald recommends the following: Beat the whites of two eggs with a tablespoonful of cold water, add a teaspoonful or two of starch boiled in a half teacupful of a 20-per-cent glucose solution, a wineglassful of claret and a teaspoonful of peptone solution. Mix at a temperature below the coagulation point of the albumen.

Yeo prescribes expressed meat juice, egg albumen, and peptones.

Leube prefers the mixture of scraped meat and fresh pancreas made into an emulsion as prescribed above (p. 414).

Roberts gives milk gruel and beef tea, with two teaspoonfuls of liquor pancreaticus freshly mixed. He reports a case in which he sustained the patient's life for nine weeks upon this treatment alone.

Food Suppositories.—Rectal food suppositories are sometimes made of predigested and evaporated or condensed forms of milk or meat juice, which are mixed with oil or cacao butter and pressed into an elongated bougie or suppository. They sometimes prove useful, and are certainly convenient, but they possess no real advantage over nutrient enemata, and if rectal feeding is to be long continued, the latter are found more practical.

Other Methods of Feeding

Inunction Foods.—Attempts are sometimes made to get nourishment into the body by means of inunction through the skin, and olive oil, cod-liver oil, and cacao butter are rubbed into the integument of the abdomen and thighs. This means is naturally only employed in cases of extreme emaciation from wasting diseases, such as carcinoma, marasmus, and phthisis. It has proved mainly useful with marasmic infants, but it is doubtful whether it possesses any true value beyond the advantage of lubricating a dry and shrivelled skin, and retaining some of the body heat in case of great feebleness.

Intravascular Feeding.—In extreme cases of collapse, where death has seemed imminent, nutrient injections have sometimes been given directly into the veins. Of late years, however, it has been shown that in collapse from hæmorrhage, or from loss of fluid in the evacuations of Asiatic cholera and cholera morbus in infants, salt-water injections (a drachm to the pint) answer as well, and have the advantage of being much safer and easier of application.

Hodder was the first to practise the intravenous injection of milk in 1850 for collapse from Asiatic cholera, and T. G. Thomas was among the first to inject warm milk into one of the veins of the arm. He reported one case in which eight ounces of milk administered in this way saved life. Both goat's and cow's milk have been so used, but the milk must be rendered alkaline.

Down reports similar success. Fowler tried intravenous injection of peptone solution, and has given as much as six ounces of a digested beef solution in this manner. The peptone does not reappear in the urine, but the casein of milk does, as well as solutions of sugar or albumin when injected into a vein. Some of the fat droplets in milk have greater diameter than the capillaries, which might prove a practical objection to the injection of unskimmed milk.

Hypodermic Feeding.—Feeding in cases of desperate exhaustion by hypodermic injections of milk and of peptone solutions has been several times attempted, but the results, beyond the use of alcohol by this method, have not proved sufficiently satisfactory to warrant its continuance.

Bayle has employed the yolk of egg diluted with an equal weight of normal salt solution (7:1,000), giving three drachms at a dose. Lecithin has been similarly injected.

Credé has made use of a preparation, which he calls "Kalodol," containing 95 per cent of soluble meat albumin and 0.2 per cent of salt. He adds 50 grammes of a 10-per-cent solution of Kalodol to 500 cc. of normal salt solution for hypodermoclysis. This preparation is also quickly absorbed from the rectum.

MEDICINES AND FOOD

Too little attention has been bestowed upon the mutual relations of food and medicines. So little is really definitely known of the intricate chemistry of digestion and assimilation that it is difficult to formulate rules for the right time of giving every drug in relation to fulness or emptiness of the stomach. The reaction of the stomach contents varies from alkaline to neutral and acid, and these several reactions will decompose medicines in various ways. Besides this, the reactions themselves are dependent upon a large number of organic acids, salts, and other substances which may wholly alter the composition of a medicine at one time, and not be present to affect it at another.

A drug given after a full meal may be decomposed by the strong hydrochloric acid of active digestion, which is unaltered in an empty stomach.

Conversely, remedies which are not themselves influenced by the gastric and pancreatic juices may affect these secretions as synergists or the reverse. Chittenden says: "Take, for example, the influence of such substances as urethan, paraldehyde, and thallin sulphate on the proteolytic action of pepsin-hydrochloric acid, and we find that small quantities (0.1 to 0.3 per cent) tend to increase the rate of proteolysis, while larger amounts, say one per cent, decidedly check proteolysis. Similarly, among inorganic compounds, arsenious oxide, arsenic oxide, boric acid, and potassium bromide in small amounts increase the proteolytic power of pepsin in hydrochloric-acid solution, while larger quantities check the action of the ferment in proportion to the amounts added. Again, with the enzyme trypsin, similar results with such salts as potassium cyanide, sodium tetraborate, potassium bromide and iodide may be quoted as showing not only the sensitiveness of the ferment towards foreign substances, but likewise its peculiar behaviour—viz., stimulation in the presence of larger quantities. Furthermore, we have found that even gases, as carbonic-acid and hydrogen-sulphide, exert a marked retarding influence on the proteid-digesting power of trypsin." These gases, being a product of intestinal malfermentation, may thus interfere with digestion.

Hydronaphthol and bismuth salicylate retard gastric digestion. Sodium bicarbonate and other alkalies check pyrosis in chronic gastritis, which is caused by diminished hydrochloric-acid secretion, but increase pyrosis subsequently, because of the greater alkalinity produced, which favours the growth of lactic-acid organisms. According to Leffmann and Beam, beta-naphthol stops the action of diastaste, but not that of the amylolytic ferment of pancreatin, hence it is useful as an intestinal antiseptic without wholly stopping digestion. It, however, retards proteid digestion. They also state that salicylic acid and saccharin both prevent the amylolytic action of diastaste and of pancreatin, but do not retard proteid digestion.

These few examples are sufficient to illustrate the very diverse influence of some of the common drugs.

The following rules are subject to many exceptions, but they will serve as a general guide:

RULES FOR ADMINISTERING MEDICINES IN RELATION TO FOOD

1. Alkalies are best given shortly before meals, unless designed to neutralise hypersecretion of hydrochloric acid.

2. Acids should be given within half an hour after meals.

3. Bitters should be given before meals.

4. Remedies such as iron and arsenic, which may prove somewhat irritant to mucous membranes, should be given either soon after the regular meals or after taking some simple article of food. Ammonium carbonate and potassium iodide, for example, may be prescribed in milk.

5. Most cough medicines, cardiac tonics, diuretics, and systemic remedies which are not especially irritating to the stomach should be taken between meals. They will be more promptly absorbed from an empty stomach, and are less liable to be altered in composition by digestive fluids or to inhibit digestion.

6. Remedies designed to act in the intestine and not in the stomach, such as salol, should be given at the end of gastric digestion, when the stomach contents are about to pass into the intestine.

7. Saline laxatives should always be taken at least half an hour or an hour before meals, preferably before breakfast; but the stronger, more slowly acting cathartics should be given on an empty stomach at night.

Cod-liver oil should be given an hour and a half after meals, or on an empty stomach before retiring.

According to Whitehead, starchy food should be avoided while iodine preparations are being administered, because of the insoluble compound likely to be formed of iodine and starch. Syphilitics, he says, should therefore eat meat and light green vegetables only, in order to get a maximum effect from the remedy. If they are taking very large quantities, such as half an ounce or more a day, this may be advisable, but it is unnecessary for ordinary cases.

Foods and beverages may be often used to disguise the taste of disagreeable or bitter medicines, especially for children. An unpleasant dose may often be smuggled down in a teaspoonful of jam or a little molasses, and quinine is somewhat disguised by mixture in chocolate lozenges. It may be given in solution to adults in coffee. Castor oil is given floating on coffee or beer. Both milk and Vichy partially disguise the taste of potassium iodide.

Milk is an excellent vehicle for powders, such as bismuth, magnesium carbonate, or sulphonal. Many bitter medicines may be followed by a lump of sugar or a strong peppermint lozenge, or the mouth may be rinsed with a little brandy and water. Chocolate is also a good vehicle for the administration of bitter medicines, and it may be employed to emulsify cod-liver oil.

DIET-KITCHEN OUTFIT

When a case of protracted severe illness occurs in a household it is very convenient to improvise a small diet kitchen in a room next the patient's bedroom. The outfit should consist of the following articles, in addition to the usual receptacles for containing the food:

A spirit or gas lamp kept ready to heat a porcelain-lined saucepan at any time, day or night.

A double porcelain-lined saucepan for a hot-water bath.

A cooking thermometer for use in hot fluids.

A measuring glass to hold six or eight ounces.

Pancreatin powders.

A bottle of rennet ferment.

Sodium bicarbonate, two or three ounces.

Borax, half a pound (to clean utensils).

A glass funnel with filter papers.

A meat-mincing machine.

A good chafing-dish and a pair of scales, although not necessary, are highly desirable.

TRAINED PURVEYORS OF FOOD

The training of food purveyors for hospitals, asylums, and other institutions has only quite lately received the attention which it deserves, and hospital managers are awakening to the fact that it is truly economical to employ a skilful trained buyer who understands something of food values, dietetically as well as pecuniarily, and who studies the conditions of the market at different seasons of the year in order to secure variety of food at a minimum cost. To meet the constantly increasing demand for such persons, the Pratt Institute, of Brooklyn, offers a series of three-months' courses for both men and women, which are to cover the following topics: (1) The selection of food material as to quality, food value, and cost. Marketing and buying by sample. (2) Methods of preparation in a large way and by appropriate apparatus. (3) The care of food, cold storage, etc. (4) Serving, embodying general dining economy, labour-saving appliances, etc. Field work, visits to public kitchens, and manufactories of kitchens, and hotel furnishings.

PART VIII

DIET IN DISEASE—DIET IN INFECTIOUS DISEASES

DIET IN FEVER IN GENERAL

THE general principles of the dietetic treatment of the condition of fever which accompanies many different diseases are conveniently studied collectively, while the special modifications of diet required for certain infectious fevers will be considered under their several headings.

The cardinal principles of feeding the sick involve, first, the avoidance of all articles that disagree with the condition present, and second, the giving of the food best adapted to relieve the digestive organs of unnecessary labour and to maintain nutrition. In addition, for certain special diseases there are classes of foods which have distinctly curative value—for example, the use of fresh fruits and vegetables in scurvy, fats and oils in scrofula and tuberculosis. Although there is no curative food for fevers, it should be remembered that there is nothing so easily assimilated as water, and advantage must be taken of this fact to introduce other foods into the body with it, giving them therefore in fluid form.

Pathological Physiology of Fever.—The former treatment of fevers by starvation and depletion, on the theory that the poison of the disease was soonest conquered by withholding all food and drink upon which it might thrive, and starving out "a devouring flame of inflammation," has long been superseded by more scientific methods. This early treatment culminated in France in the first part of this century, and was first combated in England by Graves and his successful followers.

It is now known that in fevers by supplying the patient with abundant nitrogenous food the tissues of the body are spared from consumption—in other words, that the proteid matter of the food is burned up or oxidised instead of the proteid matter of the patient's muscles and other structures. The animal food thus given does not add to the substance of the tissues, but saves them from wasting and combustion.

Bauer believes that "the gravest possible injury to the organism of the fever patient may be brought about by a diet too rich in albuminates," and to some extent carbohydrates and gelatin may be substituted for them, yet he adds that while "an exclusive use of albuminates is undesirable. . . . In fever a larger relative proportion of albuminates is requisite than in health, and so much larger as the albuminous metabolism is greater."

Fever patients commonly excrete much more nitrogen than they take in as food. In so doing it is believed that they first exhaust whatever reserve supply may be on hand in the food proteids previously absorbed and circulating in the blood, and subsequently draw upon the tissues, just as is the case in starvation. The urea daily eliminated during fever may exceed by forty or fifty grammes the normal amount voided in the urine during health, and this may be the case even when no food is given; hence the waste increase is mainly nitrogenous (Bauer). In chronic fevers with remissions, like tuberculosis, there is less rapid waste than in the continuous forms such as typhoid. If the digestion remains fairly good in any fever, the loss of body weight is proportionately checked.

Voit suggested the theory that the tissues act somewhat after the manner of gland cells, and normally attract such albuminous substances as they need without themselves undergoing any serious change, and Bauer believes that this hypothesis may be applied to the consumption of proteids in fever, "that under those conditions which the febrile processes bring with them the tissues yield up to the circulation a larger proportion of their own albumin, and that an abnormal amount of materials for metabolism is thus presented to the cells." The organs meanwhile lose proteids faster than in ordinary starvation, but by the same processes. A single albuminous meal adds more protein to the circulation, which in starvation would aid in restoring equilibrium; but in fever it fails to do so, and the loss continues because the inflamed cells have for the time being lost their power of assimilation. Emaciation therefore proceeds.

Another theory which has been strongly advocated, but which, on the whole, has less to recommend it, is that the inflamed cells consume and destroy proteid material from the blood at a much faster rate than in health, and supplying a purely proteid diet does not check the waste. The entire question is exceedingly intricate and difficult of solution. The experiments which have been made in febrile metabolism are somewhat contradictory, and it is undoubtedly better to be guided at present by the results of clinical experience in feeding fever patients than by theoretical formulæ.

This subject is physiologically very closely related to the parenchymatous and fatty degenerations of organs which attend many diseases, but it is impossible within the practical limitations of this work to enter into this discussion, and the reader is referred to a very able presentation of these theories in the chapter upon Consumption in Febrile Disease by Bauer in his Dietary of the Sick (Handbook of General Therapeutics, v. Ziemssen).

Leyden and Fränkel believe that in fever more fat as well as more albumin is consumed than in health, but other authorities think that fat destruction does not keep even with albuminous waste.

In fever the secretion of hydrochloric acid is diminished or suspended in the stomach, and its peristaltic action is so lessened that the food is apt to remain longer than it should and undergo malfermentation, causing oppression or pain, nausea, and vomiting. Absorption also is much reduced in fevers. The stomach may wholly give out, and, as Roberts observes, it becomes merely a conduit, so that the intestine must carry out the work of digestion unaided.

Dietetic Treatment.—The conditions to be met in the dietetic treatment of fever are as follows:

1. To save tissue waste by supplying sufficient nourishment.
2. To give semisolid or fluid nourishment in a form which will not overtax the enfeebled digestive apparatus or leave a large residue for decomposition.
3. To give abundant fluid with the object of relieving thirst and to wash out through the kidneys the waste matter produced by the increased rate of metabolism.
4. In some cases, to give alcohol as a food as well as a stimulant.

In all fevers presenting periods of remission it is desirable to give the greater portion of the food while the temperature is lowest, so that it will be better digested and absorbed, for at this time the tissues appear to temporarily recover their assimilative power to some extent.

In mild cases, with remissions, if the appetite holds out, it may do no harm to allow some little variety in the diet; but if the fever is brief and the appetite fails, it is unnecessary to force the patient to take food.

As a rule, in fevers which are protracted or severe, nourishment should be given in fluid form. To offer solid food in serious fevers is practically to place foreign bodies in the alimentary canal which merely ferment and putrefy, causing discomfort with flatus, fetor, and diarrhœa. There are some exceptions to this, notably the fever of phthisis, some forms of protracted sepsis, and ague.

Milk being the first and " natural food " of man, it would seem most appropriate that it should constitute the staple article of diet in fevers in which the digestive powers are temporarily greatly enfeebled or wholly suspended. The danger from its continuous and exclusive use arises from its coagulating in lumpy masses, which act practically as solid food, but the many means which are at the disposal of the physician and nurse make it possible to overcome this difficulty almost completely, and by processes of artificial digestion milk may be given ready for absorption, so that nutrition is rendered quite independent of stomach and intestinal digestion. In the majority of cases, therefore, milk is altogether the best food. The methods of giving it have been described in the section upon Adaptation of Milk for the Sick (p. 74), and the reader is also referred to the section upon the Treatment of Typhoid Fever (p. 432).

Next in importance to milk in the diet of fever are to be mentioned the various preparations of meat—infusions, extracts, juice, powder, broths, etc. (p. 112). The fundamental idea of all such preparations is the solution of the nutritious myosin of the muscle fibres and its separation from the much less digestible sarcolemma and the connective tissue constituting the sheaths of the muscle fasciculi. These preparations may be made from tender veal, chicken, roast beef, and beefsteak. Clear soups or *consommés* are nutritious and mildly stimulating in fevers, but if given often or in large quantities patients usually tire of them, and they may be considerably varied by flavouring with vegetable juices and extracts or aromatic herbs, which afford variety, and as a rule do no harm, unless exhausting diarrhœa be present.

Buss gives the following mixture to fever patients: Peptone, 100; grape sugar, 300; rum or Cognac, 200; water, 600 grammes—the quantity to be taken in twenty-four hours in addition to milk, yolk of egg, bouillon, etc. If this food is too sweet, tincture of gentian is added.

Purées may be given, made by thickening clear soup with well-cooked arrowroot, or finely ground rice, or thoroughly baked wheaten flour. Bauer recommends the use of "fruit soups," which are prepared by boiling fruit, either fresh or dried, with the addition, if desired, of grape sugar, lemon peel, etc. The mass is then compressed and strained, and the fluid obtained has an agreeable taste and somewhat laxative action.

In cases of moderate severity and short duration, when the digestive organs are not greatly disturbed, it is not necessary to confine the patient to fluids, although solid food, especially meats, should be withheld. Semisolid food may be given, such as milk toast, cream toast, soft-cooked eggs, beef jelly, or plain rice pudding. Thoroughly boiled oatmeal gruel sustains strength while undergoing severe physical toil, and fever has some resemblance to muscular effort in its temporary arrest of digestive activity, so that sometimes substances of this class prove useful from their supporting power.

Many other varieties of farinaceous and other carbohydrate foods are suitable in febrile cases when carefully prepared in fluid form. Patients often object to these substances for the reason that they are tasteless and monotonous, whereas if prepared with a little care, by giving proper attention to their flavouring, they may be made very palatable. Thin gruels of rice, oatmeal, or barley, from which all solid matter has been very carefully removed by straining through a cheese-cloth bag, may be salted and flavoured with any desirable aromatic, such as cinnamon, clove, nutmeg, lemon or orange peel; grape sugar may also be added. Such gruels may be prescribed either alone or combined with meat extracts, or beef tea, or beaten eggs. The addition of grape sugar has been recommended by See and others because of its ready absorption, and from the fact that it is the form of sugar which is produced from the digestive fermentation of starches, and is to be regarded, therefore, as an easily assimilable carbohydrate which, to some extent, may prevent tissue waste by furnishing fuel to the body.

If a patient be fed upon clear farinaceous gruels alone during fever, he cannot thus obtain over eight or ten grammes of proteid material per diem, or one twelfth of the quantity required by a healthy man at rest, and obviously he will suffer within two or three days from tissue waste and inanition. Egg albumin, meat broths, or gelatin must therefore be added, or the soups must be thickened.

Eggs may be eaten, but they should never be boiled, and in fact they require but little cooking. They may be beaten with boiling water and strained and dropped into *consommé* or light broth or gruel. The yolk and the white may be used either separately or together. The yolk may be beaten with hot milk and water, or with hot tea sweetened with grape sugar (Yeo), or it may be added to brandy. The brandy mixture of the British Pharmacopœia (mistura spiritus vini gallici, Br. Ph.) is made as follows: The yolks of two eggs with half an ounce of refined sugar are beaten and added to four ounces of Cognac and an equal amount of cinnamon water. The brandy in this mixture may be still further diluted or reduced to advantage. Some patients prefer to take eggs raw, while others prefer to have them very slightly cooked by immersing them in water which has been boiling, thus cooking them very slowly at a temperature not exceeding 180° F. for ten or fifteen minutes. Eggs prepared in this way are uniformly and lightly cooked, and the albumin is coagulated in a soft gelatinous mass instead of the hard, white, tough coagulum which is produced by greater heat (see p. 106).

Cold meat jellies as well as simple sherry wine and lemon jellies may occasionally be given, but gelatin alone is not particularly nutritious, and, in proportion to the bulk occupied by this class of foods, comparatively little benefit is derived from them.

Gelatin given with other foods, especially those of proteid composition, is assimilated much better, and makes a desirable addition to the dietary in mild cases. When added to milk in the form of blancmange patients usually enjoy it.

Beef tea and chicken jelly in equal parts make an excellent combination.

Beverages in Fevers

The Value of Water and Other Beverages.—In almost all febrile affections the liberal use of water, or some beverage composed chiefly of water, is to be recommended both for the relief of thirst and on account of its diluent effect and of its increasing the facility with which the waste matter resulting from the rapid metabolism of the fever is eliminated through the kidneys. A dry mouth destroys the appetite. It is believed by many that the toxins produced by the action of typhoid-fever germs or other micro-organisms are rendered less powerful and are in some degree "washed out" of the system by the imbibition of large draughts of water. Patients who are extremely feeble, or who are not wholly rational, may not ask for drink although their mouths are dry and parched, and it should always be the duty of the nurse to give water in proper amount at regular intervals. In long-continued fevers there is a tendency for an increased loss of water from the surface of the lungs, and sometimes from the skin, although the kidneys may be less active than normal, and if care is not taken to replace the fluid in the body the effects of this loss become much more pronounced. If there are profuse watery evacuations from the bowels the drain of fluid from the blood, and eventually from other body tissues, is considerable.

Sour lemonade constitutes one of the most useful and refreshing of beverages. It is not particularly apt to disorder the stomach, especially if taken in the intervals between the ingestion of food, and to many persons it is exceedingly grateful. It may be made effervescing by the addition to a strong lemonade of Vichy, carbonic-acid water, soda water, or ten grains of sodium bicarbonate.

Barley and rice water with a little lemon juice and sugar, or with cinnamon, wine, and sugar, afford refreshing drinks to many persons, especially children, but they contain very little nourishment. Either tea or coffee may be allowed once a day in many cases of fever, although this fact is often overlooked. Tea should be avoided if there is marked indigestion in the stomach, and coffee as well as tea should be avoided in cases where there is insomnia or excessive nervousness. If there is flatulency they should be given without sugar, and not with other food. Persons who object to the taste of milk may take it if a tablespoonful of good coffee be added to the tumblerful. Strong black coffee, moreover, is useful in controlling vomiting, and is mildly stimulating in cases of heart failure. Its diuretic action is also valuable in fever, but it should be remembered that those who are not ordinarily disagreeably affected by the daily use of strong coffee may be made very nervous by even small quantities given when the system is reduced by the wasting processes of fever. Both tea and coffee should be used, therefore, with discretion, although they may at times prove valuable in relieving the monotony of a fluid diet. Other useful beverages are whey, or whey and beef tea, either hot or iced, and unfermented grape juice.

For the immediate relief of thirst cracked ice may be given, but it sometimes parches the lips. Some patients prefer a glycerin mixture. A drachm or two of glycerin and half a drachm of borax or boric acid may be added to a tumbler of water and used to rinse the mouth.

By sipping fluids, thirst is more relieved than if they are quickly drunk. There is more satisfaction in draining a small glass than in merely taking a few mouthfuls from a large tumblerful.

The question of the temperature at which milk or any form of beverage should be given in fevers may safely be left, in most cases, to the liking of the patient. I have elsewhere shown (p. 338) that the body temperature can be but little if any affected by that of ingested fluids, and it is a matter of far more importance to give them in so agreeable a form that they will not be refused. An excess of cold drinks may embarrass digestion or cause stomach cramps, and should be avoided, but any cold fluid slowly sipped will do no harm.

Alcohol as a Food in Fevers

The principal theory of the action of alcohol in all fevers is that it serves as a food; it is readily absorbed and carried in the blood to all parts of the body, and it is believed that its combustion saves in some degree the wear and tear of the tissues, as the alcohol burning in a spirit lamp furnishes energy in the form of heat, and itself becomes oxidised to waste products, but spares the carbon of the wick. The latter is not itself burned up or oxidised until the alcohol has been exhausted. Another theory of the use of alcohol is that it possesses a positive antipyretic action by which it controls the body temperature by restricting heat production. It is also believed that alcohol in fevers acts upon the nervous system, strengthening and supporting it, in this manner indirectly controlling the nerve currents which preside over the activity of nutrition, chemical change, and heat production. The subject is a very broad one, and is obscured by the lack of definite knowledge as to the exact nature of the chemical processes concerned in heat production, which are probably very complex. It is possible that in many instances alcohol may act simultaneously in all the ways suggested, having the combined effect of a food, a nerve tonic, and an antipyretic. This view is ably advocated by Dujardin-Beaumetz, who gives an exhaustive discussion on the subject in his work on alimentation in fevers (Du Régime Alimentaire dans les Maladies Fébriles, p. 227).

Light white wines, diluted claret, and even beer are recommended in fevers by some writers on dietetics, especially in those countries in which good water is unobtainable, or in which for other reasons wine drinking is in much more common daily use than it is in America, where there is an abundant supply of pure water. In France and Germany light red wine is frequently allowed throughout the course of mild fevers, and from five to ten ounces are given daily. The fever diet in the Munich General Hospital includes 150 to 300 grammes of light red wine or white wine. Beer is also much used in Germany for fevers, and it contains some nourishment.

If alcohol is not required for its stimulating effect upon the circulatory or nervous systems it is better to withhold it, for in continued fevers emergencies may at any time arise in which it is imperatively demanded to strengthen the failing powers or aid in controlling the exhaustion of delirium. Its influence will always be more decided and its action can be much better controlled if spirits have not previously been given, and when it is needed for any such reason it is best to prescribe it in the form of brandy or whisky.

In general, it may be stated that alcohol is usually needed if the temperature remains for several days above 103° F., and is always required if it remains as high as 105° F. The typhoid condition supervening in the course of any fever always demands it—i. e., the condition characterised by great prostration, low muttering delirium, subsultus, rapid feeble pulse, dry tongue, etc.

In the convalescence following prolonged fever the daily use of liquors with meals, or in the form of toddy or punches between meals, two or three times a day, is often indicated. This is particularly the case among elderly people convalescing from pneumonia and other acute febrile diseases or who have been greatly weakened by some prolonged adynamic disease. In infancy also, and early childhood, the use of alcohol may be demanded in the course of acute fevers.

Persons who have been habitual though moderate drinkers for many years, or throughout their lives, when attacked with any severe acute or infectious disease possess less vitality and resistance than those whose tissues have not been constantly bathed in alcohol. To withhold the long-accustomed stimulation in these cases is often to precipitate serious exhaustion, and the problem of properly adapting the quantity of alcohol to the patients' actual needs becomes a very serious one to the physician, to which he should give careful and thorough study. Caution should be given against the continued use of alcohol by patients in whom there is danger of inducing the alcohol habit. It not infrequently occurs that those who have been addicted to excessive drinking, but who have been temporarily cured of the habit, and who have taken no liquor for possibly several years, acquire some acute disease in which there is need of active stimulation. In such cases, having in view the possible recovery of the patient, with a renewal of his alcoholic habit, this stimulant should be withheld as long as possible while efforts are made to sustain the enfeebled heart power by strychnine, digitalis, or diffusible cardiac stimulants, such as ether, ammonium carbonate, aromatic spirits of ammonia, camphor, etc.

From the above account it appears that the question of the use of alcohol in all febrile disorders should be considered from two chief standpoints, embracing, first, its value as a food, with its relation to other foods and to nutrition; second, its value as a stimulant and the extent to which it may be replaced or re-enforced by drugs. The continued use of strong alcohol always disorders digestion, and since the stomach is weakened in fevers, it is more susceptible to such influences, and this is an additional argument for not employing alcohol in a routine method, but for saving it for positive indications, such as asthenia. But in those cases in which the battle for life must be waged largely with stimulants as much as one ounce an hour (twenty-four ounces per diem) of brandy or whisky must sometimes be given, and it is a curious fact that in the presence of high fever patients can often tolerate such dosage without the indications of alcoholic poisoning which in health would promptly follow the use of a smaller quantity.

Diet in Convalescence from Fevers

Convalescents who have long subsisted solely upon fluids must be careful in resuming solid diet, for the rapidity of recuperation of the digestive organs varies in different persons, and taking meats or other solid foods too soon may cause rise in temperature, rapid heart action, and possibly visceral congestion. The first meat given, therefore, should be in a finely subdivided state, such as scraped beef or minced chicken.

During convalescence from protracted fevers the more easily digested forms of starchy foods are found to be very useful, especially if there has been much loss of weight. Sago and tapioca thoroughly cooked and served with cream are highly nutritious, and dried bread crumbs rolled through a fine sieve may be added to thicken clear meat broths. Crackers and zwieback are useful.

Other ingredients which may be added to thicken soups during convalescence are panada, semolina, tapioca, and macaroni. Custard puddings, cooked fruit, wine and beef jellies, blancmange, or baked custard may be allowed. "Mush," fine hominy, cornstarch, farina, and boiled rice, with beef juice, can be ordered.

The following dietary will serve as a general guide for feeding convalescents from fevers of ordinary severity in which special lesions of the alimentary canal are not present. It is taken from a Handbook of Invalid Cooking:

"FIRST DAY

"*Breakfast.*—Poached egg on toast. Cocoa.

"*Lunch.*—Milk punch.

"*Dinner.*—Raw oysters. Cream crackers. Light wine if desired.

"*Lunch.*—One cup of hot beef broth.

"*Supper.*—Milk toast. Wine jelly. Tea.

"SECOND DAY

"*Breakfast.*—Soft-cooked egg. Milk punch. Coffee with sugar and cream.

"*Lunch.*—One cup of soft custard.

"*Dinner.*—Cream-of-celery soup. Sippets of toast. A little barley pudding, with cream. Sherry wine if desired.

"*Lunch.*—Milk punch.

"*Supper.*—Water toast, buttered. Wine jelly. Tea.

"THIRD DAY

"*Breakfast.*—Scrambled egg. Cream toast. Cocoa.

"*Lunch.*—One cup of hot chicken broth.

"*Dinner.*—Chicken panada. Bread. Light wine if desired. A little tapioca cream.

"*Lunch.*—An eggnog.

"*Supper.*—Buttered dry toast. Baked sweet apples and cream. Tea.

"FOURTH DAY

"*Breakfast.*—An orange. Oatmeal (H. O.), with cream and sugar. Poached egg on toast. Baked potato. Cocoa.

"*Lunch.*—One cup of hot soft custard.

"*Dinner.*—Potato soup. Croûtons. A small piece of beefsteak. Creamed potatoes. Baked custard. Coffee.

"*Lunch.*—One cup of chicken broth, with rice.

"*Supper.*—Raw oysters. Banquet crackers. Graham bread, toasted. Wine jelly. Tea.

"FIFTH DAY

"*Breakfast.*—An orange. Coffee. Oatmeal, with cream and sugar. Broiled mutton crop. Toast.

"*Lunch.*—One cup of mulled wine.

"*Dinner*.—Chicken soup. Bread. Creamed sweetbreads. Duchess potato. Snow pudding. Cocoa.

"*Lunch*.—Siphon soda, with coffee sirup and cream.

"*Supper*.—Buttered dry toast. Orange jelly. Sponge cake and cream. Tea."

A further discussion of this topic will be found in the section upon Convalescence in Typhoid Fever.

While brandy and whisky constitute the best form in which to give alcohol in the acute stage of fevers, in convalescence it is often advisable to use some other alcoholic drink, and an occasional change from one variety to another renders the patient somewhat less liable to the danger of acquiring a permanent alcoholic habit. For convalescence, if the patient's purse can afford it, champagne, port wine, sherry, Madeira, or a good claret or Burgundy, may be taken with advantage in the class of cases above mentioned.

TYPHOID FEVER

Pathological Physiology.—Careful nursing and diet regulation are the life-saving agents in typhoid fever. In few diseases does a closer relation exist between right feeding and symptoms.

In average cases the fever lasts a month, no matter what the treatment, whether by cold bathing or otherwise, while in some it continues for five or even six weeks. There is then a convalescent period of at least two weeks, and often as many months, during all which time constant care in feeding must be exercised. At any time during the prevalence of the fever the slightest departure from the strict rules for diet laid down by the physician may determine a fatal issue, but it is during the period of ulceration that the greatest danger is met.

The ulcers involve the Peyer's patches and solitary follicles in the lower end of the ileum, but they may extend into the jejunum, and even into the large intestine. They are deep and clean-cut, often including the whole thickness of the muscular layers, and sometimes perforating through the serous layer. An overloaded intestine or a distended bowel may precipitate perforation at any moment. It is therefore important to select a diet which will leave but small residue.

More or less intestinal as well as gastric catarrh is often present, interfering with both digestion and absorption.

The prolonged fever is itself a menace to life by the secondary changes which it induces in the alimentary system. The digestive secretions are altered in quality and lessened in quantity. Enfeebled circulation retards or inhibits absorption, and the functional activity of the liver is in abeyance.

Poisonous products suspended in the blood, as well as its elevated temperature, interfere with the normal rate of metabolism through the body, and finally the excretory organs are overworked.

The typhoid bacillus has curious behavior in relation to certain food materials, e. g., if cultivated in milk it prevents coagulation; whey cultures become distinctly acid, and potato cultures show peculiar modes of growth.

Dietetic Treatment

There are two chief factors which should influence the selection of a proper diet for typhoid fever. These are: 1. The supposed danger of mechanically irritating the ulcerating surfaces in the intestine and the danger of overloading an intestine and stomach whose digestive functions are impaired by fever. 2. The relations of the chemical ingredients of the food to the increased tissue change that causes or accompanies the excessive production of heat. If the proper fuel can be furnished as food, the tissues are spared too great self-consumption in producing heat.

Milk Diet.—In regard to the first factor the danger of mechanical irritation of the intestinal wall is somewhat exaggerated. In prescribing a milk diet for typhoid fever in order to lessen this danger many overlook the fact that undiluted milk, on entering the stomach, becomes almost solid, and large firm milk curds are likely to prove quite as irritating to the ulcerating surfaces, or even more so, than are starchy foods.

When patients are fond of milk and digest and absorb it thoroughly, there is no better diet for typhoid fever, and it answers every requirement of a fever food. It contains all the essential elements of nutrition, is easily digested, furnishes fluid to the tissues, is a good diuretic, and, if properly administered, in many cases it is soothing to the stomach when a mild degree of gastric catarrh exists.

Those who dislike milk at first may later grow accustomed to it and take it contentedly for a month or even six weeks.

Due emphasis should be given to the fact that an exclusive milk diet need not and should not be prescribed in routine for all cases. Within the past few years a number of writers (notably Shattuck of Boston and A. G. Barrs of London) have advocated a departure from the strict milk diet which had come to be the rule for typhoid fever, and it is found beneficial to enlarge the dietary of some patients considerably by such articles as strained vegetable soups, boiled rice, macaroni, soft-cooked eggs, soft cream toast, cream and water, buttermilk, softened soda crackers, blancmange, wine jelly, and ice cream. It is much easier to put all hospital cases of typhoid fever on a routine milk diet, but it is often better to devote a little study to securing suitable variation in the food.

In typhoid fever every effort should be made to maintain good stomach digestion. If all food is thoroughly disintegrated before it enters the intestine there need be little fear of a mechanical irritation of the ulcerating surfaces. Far more danger may occur through malnutrition of the intestinal wall, which prevents absorption of nutriment. An accumulation of undigested food in the intestine is therefore highly undesirable, and the stools should be periodically examined to see that undigested milk curds do not appear in them.

Milk for some persons in health is really a poison. They completely fail to digest it. It causes constipation with clay-coloured or white stools, and fills the bowels with products of malfermentation, ptomaines, and gases. They digest it even less when they acquire a prolonged fever. Others, with whom the milk agrees, become very tired of it after taking it exclusively for several weeks at a time.

I have several times seen cases of typhoid fever with symptoms which resembled scurvy, with swollen and bleeding gums and great emaciation, occurring in patients who had been fed too long upon an exclusive milk diet which they failed to assimilate.

Quantity of Milk Required.—If milk is the only food, enough should be given, and the problem of what constitutes enough must be solved in each case separately. Much harm is done by overfeeding, which induces indigestion and restlessness, increases the pulse rate, and aggravates the abdominal symptoms—such as tympanites, diarrhœa or constipation, hæmorrhage, and abdominal pain. Ingestion is very different from digestion.

There are many writers upon dietetics who give a special caution against the practice of overfeeding in cases of enteric fever on account of the fact that more or less gastric catarrh is usually present and that it is an undue tax upon the digestion of the patient to have to deal with a large bulk of food.

On the other hand, underfeeding causes malnutrition, favours the occurrence of complications, and prolongs convalescence.

For an exclusive milk diet the outside limits lie between one and three quarts per diem, depending somewhat upon the age and size of the individual, but more upon the condition of his digestion. A clean tongue, a soft abdomen, and natural milk stools, not too hard and without coagulæ of casein or flakes of fat, indicate that the milk is being well digested.

The reverse of these symptoms suggests that the milk is supplied in too large quantity, or that it is not being digested, and one or more of three things must be done: (*a*) The quantity must be reduced; (*b*) the mode of administration must be changed—i. e., the milk must be predigested; (*c*) other foods must be substituted, either wholly or in part.

(*a*) When milk appears to be well digested, but the patient emaciates rapidly early in the disease, he is not getting nourishment enough, and the quantity must be increased or other food must be added. As a general rule, from one and three fourths to two quarts of milk per diem (or six ounces every two hours, day and night), however diluted, is sufficient during the height of the fever to sustain the patient properly. It is best to give as much as can be thoroughly assimilated according to the symptoms above noted.

Johnston believes that from three to four ounces of milk given every two or three hours is sufficient. Moore states that very few patients digest over one and a half to two pints of milk, and " it is scarcely ever necessary to exceed the amount of one quart of milk in the twenty-four hours," or three ounces of milk in ten feedings at intervals of two and a half hours. This estimate, for uncomplicated cases at least, is too low. It may be necessary to reduce the allowance to this figure if severe gastro-intestinal disturbance occurs, or, in fact, with violent vomiting to temporarily discontinue the milk entirely, and give only cracked ice or half-ounce doses of iced champagne, but patients kept too long on as low a diet as that mentioned will emaciate, grow feeble to an alarming degree, and require excessive stimulation.

(*b*) The milk may be given raw, boiled, diluted with plain water, barley water, lime water, Vichy, Seltzer, or Apollinaris, or pancreatinised according to taste and need. Gelatin, as well as gum arabic, is sometimes added to milk to dilute it and prevent tough curds from forming. The milk should never be skimmed. Its taste may be disguised by the addition of a little strong coffee or some of the extract of coffee, or a little caramel makes it agreeable to the taste where patients have refused it before, or it may occasionally be preferred with a cup of cocoa in which the milk predominates. If diarrhœa is present, a milk diet is especially useful, and the milk should be boiled.

When vomiting occurs, it is better to use peptonised or pancreatinised milk than soda or lime water, for the latter tend to neutralise the activity of an already enfeebled gastric juice. These fluids may be given either hot or cold, according to taste. If cold, the nausea is sometimes controlled, but digestion may be somewhat retarded. If the vomiting is very obstinate, koumiss, kefir, or zoolak may be given for a time with very good result in place of milk. Whey or buttermilk is also used sometimes for a change for a few days. A. L. Loomis recommended from four to six quarts of the latter per diem.

(*c*) **Substitutes for Milk Diet.**—When milk is obviously disagreeing and producing flatulence, I have often seen improvement follow an entire change of diet for a day or two to animal broths. Similar results are familiar in the treatment of infantile diarrhœa.

In cases like those above described in which, after fair trial, it is found impossible to urge upon the patient the taking of milk, there is no objection to giving strained broths of mutton, chicken, or beef, a little clam broth for a relish, and light farinaceous articles, such as the prepared starchy foods, like Mellin's or Nestlé's, barley water, farina, arrowroot, and other gruels, custards, egg-nog, or a piece of zwieback softened by soaking in milk, weak tea, or bouillon. I have used gruel made from banana meal, which is palatable, highly nutritious, and easily digested (see p. 182). Junket and cream are very nutritious and agreeable to the palate. Egg albumin can be made very palatable by beating it with a little milk and sherry. In this manner considerable variety is secured for the patient; the appetite, and in many cases the digestion, are improved, and by alternating one or more of these articles with the milk, a much larger quantity of nourishment will in the end be taken and absorbed. Layton estimates that typhoid patients may sometimes lose half a pound in weight per diem, and in that class of cases in which rapid emaciation is a most alarming feature of the disease these various adjuncts to the milk diet are especially useful. Moreover, patients fed in this manner are not likely to become ravenous during convalescence.

It is well expressed by Henry that "it is not so much solid as indigestible food that should be eschewed, and it should never be forgotten that all foods except such as are predigested are solid in the first stage of digestion." A pint of milk contains as much solid material as a mutton chop.

The continued use of beef tea, beef juice, or meat extracts and peptonoids undoubtedly produces loosening of the bowels, and such substances must be avoided when diarrhœa is present; but in cases where there is a tendency to constipation this may be a decided advantage. Veal and chicken broth are less apt to have a laxative effect than beef and mutton broth, and calf's-foot jelly is allowed by some clinicians. When patients tire of the taste of beef tea or broth it may be flavoured with a little celery salt or, if there is no diarrhœa, with a very little tomato juice or other simple vegetable extract.

Henry advocates the use of gelatin as an "albumin sparer," although it should not be given if diarrhœa is present. As much as a claret-glass full may be given on alternate days, and it can be in the form of simple blancmange or peptonised milk jelly, which is made by adding, while hot, gelatin dissolved in a little water to peptonised or pancreatinised milk, and flavouring with lemon or orange and sherry or rum. It is eaten cold. In the stomach it is quite as fluid as predigested milk.

Farinaceous Gruels.—I have alluded to the occasional advantage of giving farinaceous gruels, for, despite the fact that many writers are opposed to them on the ground that they may excite tympany, I believe them to be at times of great service. Stromeyer feeds his patients largely upon oaten grits boiled for three hours without sugar.

Da Costa recommended giving three pints of milk and one pint of broth every twenty-four hours, with a midday allowance of some gruel, such as arrowroot. There is a variety of enteric fever in which without any noticeable complications, and even without a very high temperature curve, emaciation is rapid and extreme. In such cases especially the use of farinaceous gruels is indicated. They must not be given too sweet, and a little cream or lemon juice may be added in lieu of sugar. It is often advisable to add a tablespoonful of malt extract, or one of the "prepared foods," such as Mellin's, Horlick's, Ridge's, or malted milk may be given in milk.

Sleep and Food.—In all cases of typhoid fever the question arises in regard to waking the patient at night for nourishment, or to take the temperature.

Some patients awaken easily, are fed, and drop off to sleep again almost immediately. They may be fed every two hours day and night. Others, if awakened, do not readily fall asleep again, and lose half the night's rest or more, and this may considerably retard their recovery. It is sometimes best to let them sleep for three, or even four, hours without being aroused, for the rest may be of more value to them than food. So much depends upon the temperature, pulse, and general condition of each case that no rigid rule should be formulated, but it is best never to let four hours pass while the fever lasts without giving food. If patients are told that they have a little longer interval than usual in which to rest undisturbed, they will sometimes go to sleep at once. Of course, if they sleep during the day there is less need of postponing feeding by night. Constant drowsiness may indicate a need of more food. The nurse should always furnish a daily record of the exact amount of milk or broths actually given in twenty-four hours, making allowance for dilution, and this should be compared with the quantity of urine voided.

Thirst.—Thirst is a prominent symptom in typhoid fever, and cool water should be given in abundance by the nurse, without waiting for the patient to ask for it. Water favours nutrition and the elimination of waste. If diarrhœa is absent it is well to acidulate the water with a little dilute phosphoric or hydrochloric acid, ten or fifteen drops to the tumblerful, or water flavoured with infusion of orange or serpentaria. Hoppe-Seyler has washed out the stomach in cases of typhoid fever, and shown that while the temperature remains high there is little or no acid contained in the gastric juice, and a mildly acidulated beverage may prove serviceable by aiding digestion as well as by relieving thirst.

Relief of the latter symptom is sometimes sought by painting the tongue with glycerin, which is used to prevent evaporation from the surface and not because of any special virtue in the glycerin itself, which, in fact, is hygroscopic and tends to abstract water from the mucous surface unless it is already very much diluted, and it cannot protect it sufficiently from the evaporation which occurs in mouth breathing. The use of cracked ice in excess aggravates thirst rather than relieves it, and it is better to sip cool water at a temperature of 50° to 60° F. rather than ice. The juice of a sweet orange or a lemon is often very acceptable, and in the absence of serious complications it can do no harm. Iced tea may prove agreeable. As a rule, it is well to restrict the use of effervescent drinks for the control of thirst on account of the danger of increasing flatulency, and stretching the ulcerated intestinal wall.

In addition to the need of water for relieving thirst, it is of great service as a diluent for washing out the waste products of the febrile action from the system through the kidneys. Many clinicians, as Henry, Meigs, and Beverley Robinson, make it a special feature of their treatment to give large draughts of water. Henry advises giving each patient eighty ounces of water (including that contained in fluid food) per diem, and Meigs has given as much as one hundred and thirty ounces with benefit, including from thirty to fifty ounces of free water. Debove gives six ounces every two hours. It should not be drunk too soon after the fluid food, but in the intervals, so as not to dilute the gastric juice too much. In mild cases a little coffee or a cup of cocoa may be drunk in the morning.

Alcohol.—The question of how far alcohol serves the purpose of a food and a " force regulator " in typhoid fever is very important. The employment of it in excess as a *routine* treatment is greatly to be deplored. It is seldom required at all in the first fortnight. Later the heart is enervated and its muscular tissue is enfeebled. In all complications which threaten life, such as severe hæmorrhage, sudden cardiac dilatation, hyperpyrexia (107° F.), pneumonia, or uncontrollable diarrhœa, alcohol must be given without stint. When the complication is passed the dosage should be gradually reduced.

Patients above forty years of age usually require stimulation early.

It was formerly customary to prescribe whisky in typhoid fever at the rate of twenty or twenty-four ounces per diem, and in some chronic alcoholic patients large quantities of alcohol may be needed to prevent collapse. Sometimes delirium will disappear when excessive dosage of alcohol is discontinued, and I am inclined to prescribe very much less alcohol than formerly, especially for young and robust patients. Undoubtedly there are cases of greatly weakened circulation in which its use must be pushed rapidly, and in which it quiets restlessness, insomnia, and delirium better than opium or other narcotics, but it is not to be forgotten that there are other valuable cardiac stimulants. By giving small doses of digitalis or strophanthus, or the two in combination, by the use of caffeine, camphor, small doses of morphine, and other remedies in combination with alcohol, much less of the latter will be required, and there is far less danger of inducing the alcohol habit. Strong whisky often intensifies the stomach catarrh and interferes with the natural absorption of food. One very noticeable feature of the Brand cold-bath treatment is that the patients do well with so little alcohol, many of them requiring none at all in the intervals between the baths.

The kind of alcoholic stimulant prescribed must depend upon the circumstances of the case. Brandy and whisky possess the advantage that the dosage is more uniform and the bulk is not great. It is a matter of routine hospital practice, founded largely on economical reasons, to give whisky or brandy as the only form of alcoholic stimulation, but in private practice, especially among women, liquors may be distasteful, and equally good results can be obtained by ordering some good strong wine which is more agreeable to the taste, such as one of the Hungarian wines, Malaga, port, sherry, claret, etc. In Germany patients are often allowed beer, but this beverage is open to the same objection as the effervescent drinks, for there is more or less gastric catarrh usually present. It is not much prescribed in this country. It serves better during convalescence than while the fever is present. Brandy in milk or soda or Seltzer water is best for diarrhœa, and dry champagne is good if there is vomiting. As the latter is used in small doses—an ounce or less at a time—it is economical to place a patent cork with a faucet in the bottle, so that a little may be drawn at a time without losing all the effervescence. In any case in which alcohol is given the best guides for the proper quantity are found, as in pneumonia, in the breath, delirium, tongue, and pulse. If the breath has no odour of alcohol an hour or two after the dose has been taken, if delirium has subsided, if the tongue becomes more moist, and the pulse becomes more full and slow, the alcohol is doing good.

During convalescence a little alcohol—two ounces of whisky or four or five of Burgundy a day, for example—may be needed as a tonic, but should be given only with food.

Relation of Intestinal Antisepsis to Diet

It is said that bacilli fed on beef juice produce ptomaines which act more strongly upon the nervous system than if they are fed upon milk (Rachford). The starches do not make ptomaines.

The typhoid germs certainly thrive in nitrogenous media, but not upon carbohydrates. Their development in the former is accompanied by the production of toxic material in the intestine, which, on being absorbed into the system, produces the symptomatic phenomena of the disease. This theory, which is of comparatively recent adoption, has emphasised the possible value of antiseptic treatment of the alimentary canal. While there are as yet no remedies known to therapeutics which can be used in sufficient strength in the intestine to be completely antiseptic or germicidal to the typhoid bacilli, there is another aspect of antisepsis, or rather asepsis, of the alimentary canal, which should not be overlooked—that is, the prevention of those fermentative changes which accompany indigestion in any fever. In typhoid fever the importance of maintaining as nearly as possible the normal digestion and absorption of the food is of special urgency on account of the length of the disease. Moreover, it would appear that the overdistention of the intestine by flatus must have a very injurious effect upon the ulcerating surfaces by stretching them. At autopsies upon typhoid patients ulcers are often seen which might have been easily torn by slight distention, and the prognosis of typhoid fever is more grave when extreme and obstinate intestinal flatulency appears early in the disease, before there has been time for either perforation or peritonitis. One can do much to prevent this condition by bestowing special care upon the whole alimentary canal.

Care of the Mouth.—The mouth should be washed very frequently at regular intervals, and always after taking a glass of milk, for nothing causes coating of the tongue more than a milk diet, or forms a better field for the development of bacteria, which are constantly being carried down to the stomach to excite indigestion and flatulency there. Listerine and hydrogen peroxid make most satisfactory and cleansing mouth washes. A whalebone bent in a loop forms a good " tongue scraper," and cleans its surface quite thoroughly. If patients are too feeble to rinse the mouth, the nurse should swab it out for them with a bit of cotton. Nurses should be made to understand the importance of this simple detail, for, if properly attended to, it adds greatly to the patient's comfort and appetite. When this is faithfully done, one seldom sees even in fatal cases a typical " typhoid tongue "—brown, dry, hard, fissured, and so stiff that it is useless to the patient. Patients can often learn to use a tongue bath to advantage—that is, to hold the mouth full of fluid for several minutes at a time, when much moisture is absorbed by the mucous membrane. The proper care of the mouth will greatly lessen the liability to parotitis and catarrh of the middle ear.

The Stomach.—The dangers of overfeeding with milk have already been considered upon page 433. Milk disagrees with many patients sooner or later, and the fermentation processes of which it is capable produce large quantities of gas and sometimes elevation of temperature. Small doses of salicin or cerium oxalate with each tumbler of milk often prevent dyspepsia, and the milk, if sterilised, may be retained and digested where vomiting has been extreme. If there is the least indication of ordinary milk disagreeing, it should be at once changed for some other form—peptonised, or sterilized, or boiled. With a clean tongue, and with sterilized milk in the stomach, much may be done to favour the further digestion of milk in the intestine.

The Intestine.—Many typhoid patients are severely constipated by an exclusive milk diet. Constipation favours abnormal fermentation, and begets the flatulency which is so injurious. Such cases should not, as a rule, be allowed to go more than forty-eight hours without encouraging a movement with an enema. While it is not possible to render the alimentary canal in any sense truly aseptic throughout, a great deal may be done to favour the vital conditions of nutrition by preventing the opposite extreme of excessive ingestion of bacteria of various kinds and the production of malfermentation. This appears to be at present a more encouraging field for germicidal efforts than treatment directed against the seat of war in the Peyer's patches. The judicious daily use of rectal enemata never excites intestinal hæmorrhage, but excessive constipation provokes meteorism, stretches the thin ulcerating surfaces to the point of rupture, and tends to keep the temperature elevated. If relapses are due to reinfection or to simple septic absorption through ulcerating intestinal surfaces, there is all the more reason for the prevention of accumulation of too much food in the intestine.

Convalescence.—As the fever subsides, it becomes an important question how soon to allow a return to solid food. Relapses are very easily induced by indiscretion in this regard.

The patient's appetite is always a dangerous guide to follow in this disease. After four or five weeks of an exclusive milk or milk and broth diet, when the temperature subsides, and often before it has become normal, he becomes ravenous. Like a long-starved man, he thinks of nothing but food, and demands something new to eat every day. A hospital ward containing a dozen convalescing typhoid-fever patients is difficult to manage, as a bread riot is constantly menaced. Ill-advised but sympathetic friends attempt to smuggle in all manner of forbidden fruits, and the patient just arrived at the hungry state is tempted to steal solid food from his more advanced neighbour.

In the milder cases it is undoubtedly both safe and wise to allow a strengthening diet at an early date, and it will greatly prolong convalescence to forbid it. Light farinaceous diet—tapioca, rice, vermicelli, cream-toast, a cracker soaked in cream, etc.—may be given with impunity in cases which have run a mild course as soon as the temperature remains normal. Meat broths may be thickened with rice, sago, or vermicelli. In a day or two more the soft part of oysters or a chop are permissible. In cases which have presented no serious complications, if there is good stomach digestion there is no need of prolonging a fluid diet for fear of intestinal injury.

The following is a list of foods suitable for the different days of convalescence, commencing a day or two after disappearance of all fever. Milk should still be given until gradually wholly replaced by solid food.

First Day.—Chicken broth thickened with thoroughly boiled rice. Milk toast or cream toast once only during the day. Beef juice.

Second Day.—Junket, mutton broth, and bread crumbs. Cocoa. Milk toast. A piece of tender steak may be chewed but not swallowed. One of the prepared farinaceous foods, such as Mellin's or Horlick's, may be given with a cup of hot milk.

Third Day.—A small scraped-beef sandwich at noon. A soft-cooked egg or baked custard for supper. Boiled rice or potato *purée* strained. Arrowroot gruel.

Fourth Day.—The soft part of three or four oysters. Meat broth thickened with a beaten egg. Cream toast. Rice pudding or blancmange and whipped cream, or Bavarian cream.

Fifth Day.—Scraped-beef sandwich. A tender sweetbread. Bread and milk. A poached egg. Wine jelly or calf's-foot jelly. Macaroni.

Sixth Day.—Mush or crackers and milk, scrambled eggs, chicken jelly. Bread and butter. The soft parts of raw oysters.

Seventh Day.—A small piece of tenderloin steak or a little breast of broiled chicken. Bread and butter. Boiled rice. Wine jelly. Sponge cake and whipped cream.

Eighth Day.—A slice of tender rare roast beef, a thoroughly baked mealy potato served with butter or mashed with cream. Other foods as before.

Ninth Day.—A little broiled fresh fish for breakfast. Beefsteak at dinner. Rice, macaroni, eggs. Sago, rice, or milk pudding. A baked apple.

Tenth Day.—Mush and milk. A squab or breast of partridge or roast chicken. Other foods as before. Ice cream.

For the next four or five days the patient may select articles from the *menu* of the previous day, so that three good meals a day are taken, besides three or four glasses of milk between meals.

It is often desirable to give a little alcoholic stimulant, especially if there is much difference in the frequency of the pulse between lying and sitting or standing, or if the pulse rate is very slow, say 56, as it sometimes is. A glass of sherry or of good sound Burgundy or a tumbler of ale may be drunk, but with meals only.

Rules for Feeding in Atypical Cases.—If at any time during convalescence after several days of a normal temperature it begins to rise above 100° or 100.5° F. it is safest to return at once to fluid diet. If the temperature falls again in a day or two, convalescent diet may be resumed. A sudden rise to 103° F., or even higher, lasting but a day or two, may be caused only by constipation, and it is not to be considered as a genuine relapse, but until the cause is ascertained the above precaution must be observed.

There is a class of patients in whom the thermometric record is likely to fail as a guide for feeding unless it is correctly interpreted. After a protracted fever lasting four or five weeks the temperature falls to about 100° F. and fluctuates daily up to 100.5° or 101.5° F. without reaching the normal, or it may become subnormal and fluctuate between 97.5° or 98° F. in the morning, and 101° F. in the afternoon. These patients, in the absence of any sequelæ to account for the temperature elevation, have a "starvation fever," and they are usually considerably emaciated. It is necessary to give them solid food cautiously to bring the temperature to normal. Sometimes even then the fever lasts until they are allowed to sit up.

In estimating the proper time for giving solid food, regard must always be paid to the general severity of the disease.

Complications, such as an abscess or furunculosis, may protract the fever, although the intestinal ulcers are completely healed, and such patients should have solid food in spite of a slight elevation of temperature. Patients who have been very ill with repeated hæmorrhage or hyperpyrexia should be fed with the greatest caution during convalescence.

Many recent writers among those with largest clinical experience with typhoid fever advocate a liberal diet throughout the disease in ordinary uncomplicated cases, giving semi-solid food before the temperature has become normal. Of recent years I have adopted this practice, with benefit in many selected cases. Relapses are rarely, if ever, induced by judicious increase in diet, and the patient is often better able to withstand a relapse, having been strengthened with more food. As a sample of a liberal dietary, such as that above referred to, Frederick W. Shattuck's may be quoted; he recommends for use throughout the fever such articles as the following named:

Milk, hot or cold, with or without salt, diluted with lime-water, soda-water, apollinaris, vichy, peptonised milk, cream and water, milk with white of egg, slip, buttermilk, kumiss, matzoon, whey, milk with tea, coffee, cocoa. Soups: Beef, veal, chicken, tomato, potato, oyster, mutton, pea, bean, squash; carefully strain and thicken with rice (powdered), arrow-root, flour, milk or cream, egg, barley. Horlick's and Mellin's food, malted milk, panopeptone, bovinine, somatose. Gruels: Strained corn-meal, crackers, flour, barley-water, toast-water, albumen-water, with lemon-juice. Ice-cream. Eggs, soft-boiled or raw, eggnog. Finely minced lean meat, scraped beef; the soft part of raw oysters; soft crackers with milk or broth. Soft puddings without raisins; soft toast without crust; blancmange, wine jelly, apple-sauce, and macaroni.

The objection that particles of solid food may act as mechanical irritants, erode a partially or recently healed ulcer, and thereby induce relapse, is hardly consistent with the modern view of typhoid fever, as a disease in which the germs are by no means confined to the alimentary canal, but are widely distributed throughout the body.

Many so-called " relapses " are not relapses at all, in the ordinary sense, but are cases of mixed infection or some form of auto-intoxication. Of course, it would not be maintained that a diet of corned beef and cabbage may not produce great intestinal havoc and perhaps induce fatal hæmorrhage, but I do maintain that a carefully increased dietary such as that described is not a *cause* of relapse. I have seen many dietetic misfits, in which over-zealous friends had smuggled improper food to hospital patients, yet without producing relapse, and on the contrary, many relapses occur while the patient is still taking only a milk diet.

Typhoid fever is essentially a disease of so-called " relapses." About ten per cent of all cases are followed by relapse, no matter what the treatment. It fell to my lot to treat some two hundred cases of typhoid fever among the soldiers who returned from the Spanish War, and I was much impressed by the comparatively slight effect which a perfectly irrational diet had had upon them—relapses were not more common among them than the average, which merely shows that the ulcerated intestine may be more tolerant of food than is generally supposed.

At the end of a fortnight of normal temperature, if the bowels are moving regularly and if there is no diarrhœa, the patient may usually be allowed to select his own *menu*, although he must be warned to avoid for a long time eating food likely to leave much insoluble residue, such as raw vegetables, raw apples, soft-shell crabs, berries, green corn, old peas, beans, cabbage, tough meats, dried fruits, etc. He must be instructed also not to excite diarrhœa by eating too much fresh fruit. With any attack of indigestion he must return for a few days to a very simple diet. I have seen a second distinct relapse occur on the twentieth day after the first, but such cases are fortunately quite exceptional.

Typhoid Fever in Children

Typhoid fever in young children is rare. When it occurs in infants between two and five years of age they must be fed, if possible, exclusively upon milk in some form, predigested if necessary, but in each case sterilised or Pasteurised. Children usually take koumiss well and thrive upon it.

If milk is refused, and emaciation threatens in consequence, some concession should be made in the rigour of the diet, but of course no solid food can be allowed. Beef juice, beef, mutton, or chicken broths (not thickened), and beaten egg albumin sweetened and flavoured with a few drops of sherry, may be substituted for milk or alternated with it. Children take junket extremely well. When stimulants are required, from ten drops to a teaspoonful of brandy or whisky, well diluted, should be given.

If they refuse this, a little Tokay, champagne or wine whey may be tried. As a rule they need no alcohol unless they are very feeble, or if complications arise. The nurse must offer water freely. Barley water with a little lemon juice is useful to relieve thirst.

It must be remembered that the temperature curve of typhoid fever in children is often very regular, and a fall to near the normal must not be regarded as justifying an allowance of solid food at once, and no matter how clamorous the child may be for it, exactly the same rigid rules must be enforced as in the case of adults, and for the same length of time during convalescence.

TYPHUS FEVER

In general the dietetic treatment of typhus fever should be the same as that of typhoid fever, but as intestinal ulceration is absent from the former, the extreme care of the alimentary canal is less imperative. The fever is high and the patient is usually delirious, hence an exclusive milk diet is best during the height of the fever, provided it is well digested. The duration of this fever is much shorter than that of typhoid fever, and some of the objections to a milk diet are therefore less apt to arise. From four to six ounces of milk may be given every two hours.

If the milk is not well assimilated it may be alternated with or supplemented by broths, custard, raw eggs, farinaceous gruels, etc.

Abundant water should be offered, and the prominent tendency to ataxic symptoms and stupor may be counteracted by strong black coffee, alcohol, etc.

Convalescence.—During convalescence the precautions observed in the treatment of typhoid fever are not necessary, and patients may return much sooner to a solid diet; but some alcoholic stimulant, such as ale or porter, will be needed with the meals. The directions given in the section on Diet in Fever in General (p. 423) may be observed; for, although any severe fever may leave the digestive organs somewhat enfeebled, there is no unusual danger of this kind in typhus fever, and relapses are not occasioned by dietetic errors.

SMALLPOX

The invasion of smallpox is usually abrupt, and the temperature may reach 104° F. on the first day. There are anorexia, thirst, vomiting, and prostration, in addition to other symptoms. The fever continues for three days, or until the eruption has fully developed, after which it subsides. During the febrile stage a light fluid diet should be given, such as is recommended for fever in general—milk, broth, gruel, etc. (p. 423). The thirst is usually considerably relieved by taking cool liquids in abundance, such as water, iced lemonade, Seltzer water, etc. If there is much eruption in the throat, there may be considerable dysphagia.

During the suppurative stage of the eruption the patient requires an abundant supporting diet, and as much milk, eggs, whisky, and stimulating meat broths should be prescribed as can be digested. The patient should be fed at least once every two hours, and must be awakened three or four times at night for food. Vomiting is not to be dreaded after the onset of the disease. The combined effect of the irritation of so large a cutaneous eruption, and of the secretion of so much pus from the pustules, which may amount to many ounces, is exhausting to the last degree, and earnest effort must be made to counteract it. This is especially true of all confluent cases. A dozen eggs, three quarts of milk, and ten or twelve or more ounces of whisky or brandy is not too much to order for an adult. These materials may be given alone or in combination, as eggnog, milk punch, etc. If the stomach rebels against so much food, the rectum must be utilised for part of the work.

This supporting treatment should in all severe cases be commenced early, even in the vesicular stage of extensive eruption, without waiting for signs of exhaustion, which are otherwise certain to follow. If strong liquor is not tolerated, champagne or other wine must be substituted.

Convalescence occupies from one to four weeks, according to the severity of the attack. The diet should be slowly increased, and should comprise abundant animal food, meat, milk, and eggs, and alcoholic stimulants, such as ale, porter, or Burgundy.

SCARLET FEVER

In mild cases of scarlet fever the temperature subsides in a few days, and after that time, during the period of desquamation, special care in the diet is unnecessary unless nephritis is present. While the fever lasts the diet should be of fluid character, and milk, koumiss, soups, broths, and farinaceous gruels of arrowroot, farina, etc., are to be given. In all cases there is liability to renal irritation, and desquamative nephritis may occur; and in order to eliminate the scarlatinal poison and waste products of the fever from the system as rapidly as may be, it is advisable that the patient take as little nitrogenous food as possible, except milk, and drink large quantities of fluid. Dryness of the mouth and thirst are prominent symptoms, and there is often difficulty in swallowing, owing to the inflamed condition of the throat. Water, effervescing waters (Seltzer, Apollinaris), barley water, orange juice in Vichy, and sour lemonade may be drunk in considerable quantities.

In mild cases a little plain vanilla ice cream is much enjoyed by children. It is nutritious, cooling, and grateful to the parched throat.

If the fever is high, four or five ounces of fluids must be given every hour. In severe cases there is gastric derangement, and the diet must be restricted to milk in some form, as koumiss or peptonised milk. If nephritis is present, the milk diet should be continued, and all other nitrogenous food must be withheld (see Albuminuria). Jaccoud maintains that scarlatinal nephritis can be usually averted by keeping the child upon a strict milk diet from the commencement and continuing it for several weeks.

Convalescent children who have had very mild attacks are often hungry, but it is best to control their diet carefully for two or three weeks, even if albuminuria is not detected. They may be given at first such articles as junket, rice pudding, crackers, farina, cornstarch or sago with cream, milk toast, cream toast, baked custard, blancmange, wine and beef jelly, mush, baked apples, stewed prunes, oranges. The resumption of animal fare should be very gradual in all cases, and fish, oysters, chicken, or eggs should be given before meat.

MEASLES

The diet in ordinary cases of measles does not require special care beyond that described under the section on Diet in Fever in General. The appetite is usually wanting in the prodromal and eruptive stages, and milk with farinaceous gruels answers every requirement. Thirst is prominent, and cool water or lemonade may be offered, or orange juice or unfermented grape juice in Vichy. Alcoholic stimulation is only needed if the patient is very feeble, or if severe complications arise. The resumption of a solid diet must be gradual, but it may begin as soon as the fever and catarrhal symptoms disappear.

When nursing or hand-fed infants have measles they should be fed somewhat oftener than usual, and must be given less food at each feeding. A child of eight or ten months of age should be fed on diluted milk like one two or three months younger. In this manner any existing catarrh of the stomach is less likely to cause serious indigestion and vomiting. It is particularly necessary to give water, and half an ounce should be offered at least every two hours, or oftener, while the infant is awake.

If there is much gastric irritation or catarrh, it may prove best to suspend milk feeding for a day or two and substitute meat juice or beef or mutton broth.

MUMPS

For mumps no special diet is required beyond the necessity of giving fluids or soft food while the swelling of the parotid glands and fever last. The suggestions for the dietetic treatment of tonsillitis apply to this disease. Anæmia is apt to be extreme during convalescence, and meats should therefore be plentifully supplied. Cod-liver oil is very appropriate in protracted convalescence.

WHOOPING COUGH

In whooping cough the paroxysms of coughing are so severe as to give rise to vomiting, and in bad cases they are excited by taking food which does not have an opportunity to become assimilated, and nutrition may suffer very seriously in consequence, adding to the general exhaustion which accompanies the disease. All food must be made easily assimilable. It is best to give food regularly in moderate quantity at each time, and it should be predigested if necessary. Pancreatinised milk, koumiss, the prepared amylaceous foods, cream toast, eggs, junket, chicken broth, malted farinaceous foods, custard, milk puddings, gruels thickened with meat extracts, and stimulants in the form of egg albumin in sherry, egg-nog, or milk punch, are recommended for patients who vomit solid food. The worst cases require nutrient enemata, as exhaustion becomes critical.

INFLUENZA

Symptoms.—Influenza is an acute and moderately infectious fever of microbic origin which is recognised by catarrhal inflammation of the mucous membranes of the upper air passages, and by symptoms referable to the nerve centres. In many cases the symptoms are mild and of short duration, and no special dietetic treatment is required beyond that common to febricula, but a large number of cases are accompanied by a variety of serious complications or they present sequelæ. In the majority of instances the mucous membranes of the air passages are the principal seat of the inflammation, but in others the gastro-intestinal mucous membranes are similarly attacked, giving rise to pronounced digestive disorders, nausea, vomiting, and diarrhœa. The fever, commonly of moderate severity (103° to 103.5° F.), persists for three or four days or a week. There is usually great depression of spirits, with extreme malaise, muscular pains, enfeebled circulation, and almost total loss of appetite. As an adjunct to other treatment, absolute rest in bed is imperative in all severe cases, not only for the purpose of maintaining a uniform temperature and of protecting the body from draughts, but to guard against syncope from debilitated heart action.

Dietetic Treatment.—While the fever lasts, the stomach is usually irritable, and the diet must be fluid and restricted. Food should be given in very small quantities, according to the rules applicable in cases of extreme debility.

In severe cases it is necessary to prescribe an exclusive milk diet for the first two or three days, and two and a half quarts should be drunk if possible. Later the patient may be given nourishing beef, mutton, or chicken broths, with beaten eggs added, milk toast, custards, eggnog, and milk punch. As soon as solid food can be eaten, scraped-beef sandwiches, oysters, tender breast of chicken, eggs poached or scrambled, and light farinaceous articles with which cream is taken, are appropriate.

As a stimulant, champagne is particularly serviceable in relieving both the physical and mental depression which is so characteristic of nearly all phases of this disease.

Convalescence is frequently prolonged, and debility, muscular weakness, irritability of the heart, and enfeeblement of digestion are often present to a degree which appears wholly disproportionate to the intensity and duration of the febrile attack. The diet must therefore still be carefully supervised, while every exertion of either body or mind must be prohibited. The food should be of a highly nutritious character and served in an appetising and palatable manner, and as abundant as the condition of the stomach will allow. (See Convalescence from Typhoid Fever, p. 440.)

Patients with whom milk usually agrees do well to take it in quantities amounting to a quart a day, in addition to abundant solid nitrogenous food, roast beef, beefsteak, chicken, eggs, etc.

Alkaline waters should be drunk. If the appetite flags and return of strength is delayed, tonics and possibly change of air may be required.

When convalescence is protracted it is advisable to continue alcoholic stimulation, and milk punches, plain whisky and water, or a glass of sound Burgundy may be given two or three times a day, as a tonic, with the meals. Malt liquors may also be indicated in some cases.

DIPHTHERIA

Symptoms.—Diphtheria is an acute, infectious disease characterised by croupous inflammation of mucous membranes which particularly affects the pharynx and upper air passages. Clinically the disease presents fever of an irregular type, with great debility, and frequently albuminuria. Anæmia and rapid loss of flesh and strength are characteristic. The mortality is high, especially among children, whom the disease chiefly attacks, and death may result from toxæmia, sudden heart failure, obstruction to the entrance of air caused by accumulation of the diphtheritic membrane, the extension of the inflammation down the air passages, or exhaustion from inability to swallow food. Recovery is uniformly slow, and may be still further retarded by paralysis or other sequelæ. Owing to the extent to which the throat is involved, with consequent difficulty in swallowing, and to the general weakness and prostration, there are few diseases in which greater care in regard to dietetic treatment becomes imperative. There is anorexia, and the sense of taste is lost; nausea is frequently present as well as constipation. The cervical lymphatic glands are more or less swollen and give rise to pain or soreness on opening the mouth. Albumin may appear in the urine as early as the second day.

Dietetic Treatment.—"Alimentation occupies the first place in the general treatment" (Trousseau). Throughout the active stage of the disease while the fever lasts, there is difficulty in swallowing. All food must be given in fluid form, of which milk is the best, or if, as sometimes happens, semisolid material is more easily swallowed, the food must be thickened with cream, gelatin, eggs, or farinaceous articles; or beef meal, Mellin's food, malted milk, etc., may be added for this purpose to other foods. The diet should consist chiefly of nutritious beef or chicken broth and beef tea, egg albumin, eggnog, milk, and milk punch. Plain vanilla ice cream is nutritious, and if not too sweet it is well borne, and is frequently very grateful to the inflamed throat. Simple farinaceous foods, such as arrowroot, thoroughly cooked rice, soft cream toast, and gruels, may be taken. Continued disgust for food is a very bad prognostic sign, and every effort must be made to counteract it by offering variety. When the child is unable to swallow on account of pain or accumulation of membrane in the throat, forced feeding with a nasal or stomach tube may be better than nutrient enemata.

Intubation and Tracheotomy

When intubation of the larynx has been performed the child sometimes experiences great trouble in swallowing without drawing food into the trachea. It is difficult to close the epiglottis with the tube in position, or to draw up the larynx beneath the root of the tongue to the extent which should occur in normal deglutition, and hence fluid food particularly is liable to trickle through the tube into the trachea, exciting violent dyspnœa and spasms of coughing. Semisolid food or solid food, such as junket, mush, or eggs, is more liable to glide over the instrument without being sucked in through it during inspiration. Patients usually require considerable nourishment to support their strength, so that the difficulties of feeding may be serious.

Very young infants, who are dependent upon a milk diet, can swallow best if laid upon the back across the nurse's lap with the head downward supported below her knees. While in this position the bottle is given. Regurgitation through the nose may occur, but that is of little moment compared with the accident of inhaling the milk through the tube into the lungs.

In older children, when proper precautions are taken in regard to the position of the head in swallowing and the avoidance of inspiration at the same time, these dangers may be reduced to a minimum, or they may be overcome by the passage of an œsophageal tube, though this irritates the throat and may spread the diphtheritic membrane along the œsophagus. Intelligent children can learn to swallow well with a little practice and care while wearing the intubation tube. Some even swallow easier than before its insertion by reason of the relief of dyspnœa, which always makes deglutition difficult. In other cases the tube may be temporarily removed, if the dyspnœa is not extreme, while the child takes nourishment; but this requires skilled attendance, and, as the patient must be very frequently fed, it possesses great disadvantages. As a rule, the longer the tube remains in position, the better the patient acquires facility in swallowing. In some cases it may be well to resort to rectal alimentation for a day or two to obviate the necessity of swallowing while the tube is worn.

The late Dr. O'Dwyer said: "Solids and semisolids, when there is an appetite for such food, and when the patients can be induced to take it, are swallowed much better than fluids, and do not enter the tube, as far as I am aware"; and he added that a bolus of food tends to press the epiglottis down over the tube, while fluid tends to raise it, or slip in under it, although he modified the head of the tube by giving it a concave surface to fit the epiglottis.

It should not be forgotten with very young children that a failure to take food may be due to loathing or nausea, and not to physical inability to swallow with the tube *in situ*. O'Dwyer wrote: "I always instruct children who are old enough to understand, to drink as rapidly as they can, and then cough to expel any fluid which may have entered the tube, instead of coughing after each deglutition, as they usually do." He discountenanced the theory that food may enter the tube and excite pneumonia by reaching the deeper portions of the lungs, and said: "I do not believe—and there is no evidence so far to prove—that any of the fluid entering the tube ever reaches the bronchi, for it is promptly expelled by coughing." He cited cases in support of this statement, one being that of a woman who wore the laryngeal tube for over ten months continuously, and enjoyed good health. He said that vomited food enters the tube even less often than swallowed food.

TRACHEOTOMY

The operation of tracheotomy is performed for obstructions of various kinds, such as accumulation of diphtheritic membrane in the larynx, œdema of the glottis, laryngeal new growths, etc. The conditions which require this procedure are usually among those which interfere to a greater or less extent with swallowing, although the presence of the tracheotomy tube in the trachea is well borne and does not necessarily conflict with deglutition in any manner. No special precautions in feeding are necessitated by the presence of the tube, as in the case of intubation.

Post-Diphtheritic Paralysis

In post-diphtheritic paralysis the soft palate is oftenest affected, but the muscles of the tongue and pharynx, or even the œsophagus, may also be involved, in which case deglutition is hindered and the patient must be fed through a catheter or stomach tube (see Gavage) or by enemata. (See Food Enemata.) Meltzer has shown that in man and the horse the mylo-hyoid muscles contract upon fluids so as to squirt them down into the œsophagus at a rate exceeding that of ordinary peristaltic motion, or several feet a second; hence, in paralysis affecting these muscles fluids can scarcely be swallowed. W. B. Cannon and A. Moser, by means of the X ray, studied the swallowing of capsules of bismuth, and found that "solids and semisolids are slowly carried through the entire œsophagus by peristalsis alone."

The phenomenal success of antitoxin inoculations in reducing the mortality of diphtheria to less than one third of its former degree have made sequelæ of this nature very infrequent.

CEREBRO-SPINAL MENINGITIS

Symptoms.—Cerebro-spinal meningitis is an infectious disease of microbic origin, in which the chief lesions are an inflammation of the meninges of the brain and spinal cord. This inflammation of the membranous coverings of the nervous system results in the production of a variety of symptoms, including fever, disturbances of the nervous and muscular systems, nausea, vomiting, and constipation.

The symptoms vary greatly in severity and duration, lasting from a few days to several months. In mild cases convalescence is established at the end of a week, but in severe and protracted cases the nervous symptoms increase in severity. The stage of excitement and irritation of the nerves with active delirium is succeeded by profound prostration and coma, with progressive emaciation, a variable temperature, and paralysis of the sphincters, with involuntary evacuations. Such cases as a rule prove fatal, but they are not necessarily hopeless, and recovery may occur at any time. Much, therefore, depends upon the careful nourishment of the patient, and every effort should be directed towards maintaining strength and promoting nutrition.

Dietetic Treatment.—In mild cases a liquid diet of milk, broth, meat, and egg albumin, with, perhaps, a little toast or crackers, may be given while acute symptoms last. In protracted severe cases, and especially where convulsions, delirium, and coma are present, the patients must be fed with great care, and all nourishment must be given in frequent small doses and in an easily assimilable form. Huebner sometimes employs forced feeding with the stomach tube. Pancreatinised meat broth, pancreatinised milk, albumoses, and beef juice must be ordered, if necessary, every fifteen minutes. Brandy or whisky is required when hyperæmia is succeeded by exhaustion. If given too early, alcohol may increase the delirium. In extremely feeble patients such fluids must be administered in teaspoonful doses, or even in smaller quantities, with a medicine dropper, by which they are passed between the closed teeth. It will be also advisable to employ rectal alimentation. There is seldom any lesion of the alimentary canal present, and consequently in those cases in which larger quantities of fluid nourishment, or even solid food, can be taken there is no objection. If the patient is able to eat and swallow properly, milk toast, scraped beef, eggs, custard, wine jelly, farina, Bavarian cream, blancmange, etc., are indicated. Water may be given *ad libitum* to relieve the thirst, which is often severe.

Convalescence will be promoted by giving abundance of food. Five or six meals a day may be taken. The appetite is frequently good from the commencement of convalescence. Beefsteak, chops, roast beef, mutton, or chicken, bread and butter, oatmeal, porridge, hominy, and rice with cream, may be allowed as soon as the patient's digestion admits. A milk punch, or glass of claret should be ordered three times a day.

ERYSIPELAS

Symptoms.—Erysipelas is an infectious disease caused by a specific micrococcus, and characterised by high fever and intense local inflammation of the skin and contiguous mucous membrane. There is usually more or less prostration and enfeeblement of the heart and circulation.

Dietetic Treatment.—The indications for dietetic treatment are to support the strength by stimulants and nutritious foods, which must be adapted for easy digestion. When the temperature is high, and nausea and vomiting exist, nourishment should be taken in small quantities—an ounce or two at a time every hour. In ordinary cases, pancreatinised milk, beef peptonoids or albumoses and beef juice, eggnog, milk punch, and farinaceous gruels are recommended. Alcohol is needed and it is well tolerated, for it seems to be consumed in the system without intoxicating effects. From eighteen to twenty ounces of brandy or whisky may be given within twenty-four hours. In extreme cases an ounce an hour may be taken, or if allowance is made for sleep the individual doses may be increased. The liquor should be diluted with plain water, or with Vichy or carbonic water, or soda water. Aged or debilitated persons and young children especially need vigorous alcoholic stimulation. After the local inflammation subsides the period of convalescence requires a very nutritious diet, and fluids may gradually be replaced by beef, soft-cooked eggs, toast, bread and butter, and light farinaceous foods with cream.

If the disease invades the pharynx, an exclusive milk diet is necessary, and alcoholic stimulants as well as medicines, except those designed for local treatment, should be given per rectum to avoid increasing the local irritation.

Heuter favours the drinking of large quantities of hot tea to induce perspiration, but it is doubtful whether this in any way affects the cutaneous lesion.

CHOLERA

Dietetic Prophylaxis.—Cholera is a zymotic disease, the germs of which can only enter the system by the mouth, and they are spread chiefly through the agency of contaminated water used for drinking or washing purposes. All raw foods and cooking utensils washed in such water are liable to become infected.

No raw food or drink of any kind whatsoever should be taken. In many cities it is customary for the local health boards to prohibit the sale of raw fruits while a cholera epidemic is in progress. It is a standard rule to cook all food and boil the drinking water.

Tea, coffee, chocolate, and cocoa should be made only with water previously sterilised by boiling. Sterilised water only should be used for cleansing the teeth. Water should not be cooled by direct contact with ice, or the latter should be newly made from distilled water. No beer, ale, soda water, or artificial mineral waters should be used if there is any chance of contaminated river or well water having entered into their manufacture. Milk may become infected from washing the milk cans in impure water.

Acid beverages should be freely drunk, for the cholera germs do not thrive in acid media, and if accidentally introduced into the stomach they may perish there if the gastric contents always have an acid reaction. Sour lemonade made with ten or fifteen drops of dilute sulphuric acid has an excellent reputation as a prophylactic against cholera. Vinegar, sour pickles, or lime juice may be taken for the same purpose.

Indigestion, perhaps because it promotes alkaline fermentation in the stomach, favours infection, and hence during the prevalence of an epidemic it is desirable to eat only plainly cooked, wholesome food, and to avoid all excesses in eating and drinking. All foods, such as pastry, fried dishes, etc., having the reputation of easily disagreeing should be eschewed.

During the prevalence of an epidemic of cholera it is highly important to avoid eating anything likely to produce diarrhœa, and all indigestible substances, such as meat, eggs, fish, or milk not strictly fresh, unripe or overripe fruit and vegetables, must be absolutely forbidden.

Symptoms.—The symptoms of cholera are usually divided into four typical periods, which are those of—

1. The premonitory diarrhœa.
2. The period of profuse serous diarrhœa.
3. The algid stage, or that of collapse or asphyxia.
4. The reactionary stage.

The dietetic treatment varies with each of these stages of the disease. It is imperative that the patient be kept absolutely quiet in bed throughout all the active phase of the disease.

First Period.—There is alkaline watery diarrhœa with frequent profuse stools, nausea and, usually, vomiting. The stomach is too irritable to retain food, and undigested broths and milk only furnish culture media for development of the cholera bacilli and production of toxins.

During this period only light fluid food in very small quantity should be eaten. Nothing can be worse than overeating. Whey, gruels, bouillon, or pancreatinised milk only are permissible.

The contents of the stomach should still be kept acid, and sour lemonade, lime juice, dilute acid phosphates, dilute vinegar, and dilute hydrochloric acid, twenty or thirty drops in a half tumblerful of water, or diluted aromatic sulphuric acid in similar dosage, are to be swallowed from time to time. The acids should be given through a glass tube to spare the teeth.

Hyperacidity of the stomach artificially produced favours the passage of a portion of the acid stomach contents into the small intestine, so that its normal alkalinity is, to some extent, neutralised.

The duodenum indeed may temporarily acquire an acid reaction, which is inimical to the development of cholera germs.

Second Period.—The stools become more frequent and serous. They are almost continuous, and enormous quantities of fluid are rapidly drained from the system, in which whitish flakes of desquamated intestinal epithelium are suspended. Sometimes they contain blood. As much as two quarts of fluid may be discharged in a single evacuation. Nausea and epigastric distress occur with projectile vomiting of fluid, which exceeds in quantity that which is drunk. Intense abdominal cramps follow and extend down the legs. The patient rapidly emaciates, and the feebleness and prostration are extreme. There is a cold clammy perspiration, and in a few hours the victim passes into collapse. Active efforts must be made to stop the vomiting and diarrhœa. The abdomen must be incased in flannel, and turpentine stupes are of service if the cramps are severe. A mustard paste may be placed over the epigastrium, and a hypodermic injection of morphine is required. Cracked ice, cold lime water, iced champagne and carbonic-acid water, iced fresh lime juice in Vichy, weak cold brandy and Seltzer, or plain soda—are all good remedies which should be offered in very small doses every five or ten minutes. Strong black coffee may be tried. The thirst may be assuaged by dilute hydrochloric acid or lemon juice in water. A little fluid held in the mouth for a few minutes sometimes affords more relief of this symptom than larger quantities swallowed. It is worse than useless to attempt to give even predigested milk while the vomiting and diarrhœa continue.

Third Period.—In both the second stage and in the third stage of collapse the best results are obtained by the method of hypodermoclysis—that is, of hypodermic injections into the thighs and sides of the abdominal wall of large quantities of normal salt solution made by dissolving 60 grains (a scant teaspoonful) of salt to the pint of boiled water. The injections are given at the temperature of the blood, and the entire quantity may be used in the course of half an hour. The salt solution replaces to some extent the fluid drained by the serous diarrhœa and emesis, restores the blood pressure and equilibrium of the circulation, and almost immediately relieves the thirst.

Fourth Period.—If vomiting ceases and the symptoms of collapse abate, a little fluid nourishment must be very slowly and cautiously tried. A teaspoonful or two of pancreatinised milk, koumiss, Liebig's or Valentine's meat extract, or fresh beef juice is first given. If this is retained, the dose is to be repeated and continued by increasing the quantity and diminishing the frequency of administration as the patient improves. The stomach remains feeble and irritable for many days, and for a week or two it may be necessary to limit the diet to predigested milk, beef albumoses, nutritious broths, egg albumen in diluted brandy, and champagne. The further dietetic treatment may be conducted in the manner of that of the convalescence of typhoid fever (p. 440).

YELLOW FEVER

Symptoms.—Yellow fever is an acute, infectious disease characterised by a sharp febrile paroxysm, gastric hæmorrhage, jaundice and suppression of urine. The nature of the symptoms is exceedingly acute and intense. In those patients who die very soon after the invasion of the disease no definite lesions are found. In other cases hyperæmia and visceral degenerations are noted. These important changes are found in the liver and gastro-intestinal mucous membrane, and during the active progress of the infection digestion becomes almost impossible. The liver presents the lesions of parenchymatous hepatitis. The hepatic cells here and there are filled with granular material and oil globules. Many of them are distended or fused and have indistinct or absent nuclei. The small bile ducts are filled with degenerated epithelium, and the functional activity of the liver is therefore almost completely suspended. The whole alimentary canal presents the picture of acute catarrh, but the stomach particularly is softened, swollen, and ecchymotic, and it may be eroded.

The disease presents three different stages, the dietetic treatment of each of which is important, and it will therefore be necessary to briefly describe them. These stages are:

1. The cold period, followed by febrile reaction.
2. Remission or " stage of calm."
3. Second exacerbation, a uræmic condition or else collapse.

The first stage begins with almost immediate vomiting and great prostration. The ejecta consist first of mucus, then bile in increasing amount, and finally, if the retching continues and muscular straining is severe, the irritability of the stomach in this period becomes greater than in almost any other disease. The slightest pressure over the epigastrium excites projectile vomiting. Constipation is present from the inability to retain fluids; the mouth becomes dry and the gums sore and swollen, and thirst is extreme. The urine is much diminished in volume as the changes in the liver progress, and the bile ducts are blocked with degenerated epithelium; the bile enters the blood, and the skin and conjunctivæ become decidedly jaundiced.

After several days—usually four or five—these symptoms subside and the second period is reached. The duration of this period seldom exceeds two days, and it may continue but a few hours. It is a condition of calm, in which all symptoms are abated; the fever, which may previously have existed, subsides and the gastric irritation is lessened.

The third period promptly succeeds the second, and in it the symptoms of the first period return with renewed severity, and in addition a condition of uræmia develops. Hæmorrhage of the stomach, known as "black vomit," is present in about one third of the fatal cases. The vomited material ejected during the course of the disease consists, first, of whatever food the stomach may contain, then of bile-tinged mucus, and finally of a deep brown or black acid semifluid substance resembling coffee grounds, which consists of red blood-corpuscles, pigment granules, degenerated mucus, epithelial cells, leucocytes, fatty matter, and serous fluid. The action of the gastric juice upon the extravasated blood pigment turns it dark brown or black. The quantity of this fluid may reach several pints. It is acrid and irritating to the fauces and mouth. The blood from the passively congested surface oozes freely from the capillary walls of the gastric mucous membrane. The intestinal mucous membrane may be similarly affected, in which case the stools are black and diarrhœal. The urine becomes very scanty, and may be entirely suppressed. There is hæmaturia.

Should recovery result, the jaundice continues for some days, but the other symptoms subside gradually and convalescence is always slow and may be retarded by various complications, among the most serious of which are an exceedingly irritable stomach and intestine. Errors in diet have been known to cause fatal hæmorrhage from the stomach as long as a fortnight or three weeks after beginning convalescence. The heart action after such a severe ordeal is always feeble, and reparative and nutritive processes advance slowly. Irritability of the stomach may even persist for several months after the subsidence of all other symptoms. This brief account of the more important features of the disease emphasises the necessity for most careful dietetic management.

Treatment of the First Period.—The patient must be immediately put to bed and kept absolutely free from excitement. Rest in a recumbent position must be carefully enjoined, and the patient must not be allowed to even raise the head to drink. Medicine and fluids must be given through a tube or with a teaspoon. If the patient is seen promptly, and there is a probability of undigested food being present in the stomach, that organ should be unloaded by an emetic, and as little medicine as possible should be ordered. If constipation is present the bowels should be emptied by a purgative enema. It is generally considered that profuse perspiration is an advantage. This object can be accomplished by covering the patient with blankets and giving a hot lemonade or hot toddy, such as hot whisky and water.

As the vomiting becomes more and more severe, efforts may be made to relieve it, but if all measures fail, it will be best to let the stomach have absolute rest, which is secured by hypodermic injections of morphine, mustard paste over the epigastrium, and the use of the rectum for all medication. Among the various means at command for the relief of the vomiting are cracked ice, light acidulated and effervescing draughts, such as acid lemonade, Vichy, Seltzer, or carbonic water, strong coffee, plain lime water in frequent half-ounce doses given cold, besides dilute hydrocyanic acid, cerium oxalate, etc. Iced champagne, very dry Mumm or Pommery sec, or acid lemonade with bitartrate of potassium, will sometimes be retained. With the supervention of uræmic symptoms, or when there is suppression of urine, there is urgent need of getting more fluid into the body. The lumbar region should be cupped or poulticed or covered with a mustard paste. If aërated waters are not tolerated by the stomach, three or four pints of salt water should be injected into the rectum every two hours, or it is suggested that hypodermoclysis might prove of service after the manner employed in cholera (p. 455). While the fever lasts, or throughout the first period, it is usually best not to attempt to give food at all, for the stomach is almost certain to reject or fail to digest it.

Cochran dissents somewhat from the prevalent practice of allowing no food during this stage, and believes that an attempt should be made to supply a little nourishment per os, to fortify the system against the future drain upon it which is certain to follow. He says: "I have seen infants at the breast pass through attacks of yellow fever to prompt recovery, throwing up black vomit frequently and freely, and nursing as regularly and heartily as if there was nothing the matter with them."

Many cases of yellow fever occur among previously healthy people who can withstand the absence of food for a day or two without serious loss, provided exhausting symptoms can be held in check. In many instances, however, prostration and exhaustion occur with extraordinary rapidity, and in an hour the patient may be too feeble to articulate or move. Active stimulation by the rectum and hypodermically is then necessary. For this purpose whisky is best. It should be obtained pure and injected hypodermically with a sterilised syringe in quantities of one to three drachms. The injections may be made beneath the skin on the outer surface of the thigh and arms in four or five places. Two ounces of whisky diluted in an equal part of water may be injected per rectum.

Treatment of the Second and Third Periods.—During the interval of the second period abatement of the fever and of the gastric irritation may admit of a little nourishment being taken by the stomach. Some patients recover without passing into the third period, but because many do not, extreme caution must be observed and food, if taken at all, must be in very minute quantities. The same rules in regard to diet and stimulants apply to the third period which have been prescribed for the first, and the main reliance for nourishment should be through rectal alimentation. When the paroxysm is over and the symptoms have abated, the greatest care must still be exercised in regard to diet even if the patient is hungry, as sometimes happens. In the worst cases no solid food should be permitted for at least ten days or a fortnight, and it must be remembered that fatal relapses have been precipitated by not observing this rule. When the vomiting and epigastric pain have ceased, half-teaspoonful or teaspoonful doses may be given once in fifteen minutes of pancreatinised milk, koumiss, Liebig's or Valentine's meat extract, iced dry champagne, or good Rhine wine. If such foods are retained, they may be followed after some hours by a few spoonfuls of pressed beef juice, salted, and later still by warm, nourishing beef broths, chicken broths, gruels, or buttermilk. Stimulating or nutrient enemata should still be ordered, because in the early stages of convalescence the stomach will not tolerate all the food which the impoverished tissues require. Any epigastric fulness or distress, or tympanites, should be regarded as a warning, and food should be again withheld until the difficulty is corrected by antacids or antifermentatives.

It is to be noted that children usually require rectal feeding and stimulation even earlier than adults. Large doses of opium given to aid the retention of nutrient or stimulating enemata should be avoided on account of the tendency to suppression of urine. In mild cases, after four or five days, and in severe cases after a fortnight, solid food may be occasionally given, commencing with milk-toast, crackers, junket and cream custard, farina and boiled or broiled chicken, soft-cooked eggs, wine jelly, boiled rice, scraped beef, and similar nourishment.

Fruits and vegetables should not be allowed for several weeks.

SEPTICÆMIA

In all septic conditions the diet must be made as nutritious as possible, and alcoholic stimulation may be required, brandy or whisky being the best forms. As a rule, the diet must be fluid, but in very chronic cases and those accompanied by prolonged local suppuration easily digestible solid food—such as broiled fish or beefsteak or chicken, oysters, toast, light bread and butter, and light farinaceous articles with cream—may be allowed. The directions given in the article upon the Diet of Fever in General (p. 423) and convalescence are applicable here, and if the patient improves, the stimulating diet recommended for some cases of tuberculosis (see Dietetic Treatment of Tuberculosis, p. 464) is recommended.

MALARIA

Intermittent Fevers.—The dietetic management of malarial fevers consists of the treatment during the paroxysms and of that between them. In intermittent fever the paroxysms, although severe, are comparatively brief. Vomiting often accompanies the chill. If the patient is disinclined to take food there is nothing to be gained by urging it upon him, and the stomach may be allowed to rest for a day. Otherwise a glass of milk or a cup of broth may be given. When the paroxysm is over, if the appetite returns, solid food may be given without much restriction. If a patient has had several attacks at brief intervals he is usually both anæmic and constipated, and the subsequent diet should contain a liberal proportion of animal food to counteract the former condition, and of fresh fruits and green vegetables for the latter. Beyond these general directions but little is usually necessary.

Remittent Fevers.—In the continued malarial fevers, indigestion or feeble digestion may be a prominent symptom, requiring a milk diet while the fever is at its height. The reader is referred to the article upon the Diet of Fever in General (p. 423), which will cover the ground for these cases.

Patients with malarial fever are inclined to resort too freely to the whisky bottle, and overstimulation in the continued fevers is a common fault. Only the severer forms of Southern and tropical agues, bilious remittent fever, etc., require much alcohol. The dietetic treatment of the latter corresponds with the directions given for that of yellow fever (p. 457).

TETANUS

Symptoms.—Tetanus is an acute infection produced by a bacillus which enters the body through an abraded surface, develops toxins in the system, and causes greatly exaggerated irritability of the central nervous system. With the heightened reflexes, tetanic contraction of the voluntary muscles occurs, especially of those of the jaw, face, and the extensors of the back. The ordinary reflex action from peripheral excitation is so far intensified that the slightest pressure on the surface of the body, or change in surrounding temperature, or even a loud sound, may throw the patient into violent convulsions and painful tonic spasms. Efforts in swallowing may induce them. The muscles of the jaw are often set in a condition of rigid contraction, making it impossible for the patient to open the mouth to take food, and forcible efforts to separate the teeth excite convulsions. It is necessary to support the strength by every available means, for tetanus is not invariably a fatal disease, although, according to Gowers, death results in about 90 per cent of all cases.

Dietetic Treatment.—Food can only be given in liquid form, but if a front or side tooth is absent a soft-rubber catheter may be passed in between the set teeth and fluid can be conveniently poured into the mouth through it. Milk, egg albumin, eggnog, nutritious beef, mutton, or chicken broths, malted gruels, wine, brandy, and whisky should be given as frequently as the condition of the patient will admit. If possible, from two to four ounces should be administered every hour. The spasm does not affect the involuntary muscles, so that food is swallowed if it can be placed far back in the pharynx. Alcoholic stimulation and nourishment can also be given by the rectum, but this method is as apt to excite convulsions as mouth feeding. If severe convulsions are induced by every attempt to feed the patient, it becomes necessary to put him under primary anæsthesia by the inhalation of chloroform, and then a tube may be passed into the stomach, through which twelve or sixteen ounces of soup or predigested milk, eggnog, and stimulants may be poured. By this means he is disturbed much less often and larger quantities of nourishment are taken at one time. In a recent case of tetanus which came under my observation, and in which tetanus bacilli were found, the muscular spasms were intense and almost continuous for over five weeks. The difficulty in feeding the patient was extreme, and emaciation was very pronounced. He complained incessantly of thirst, and often of hunger, but he was able to swallow milk broths and stimulants given between the closed teeth in very frequent doses, and his final recovery was attributable mainly to persistent efforts at careful feeding, chloroform anæsthesia having been several times successfully employed to relax spasm.

RABIES

In feeding a patient with rabies, substantially the same plan is to be followed as that above described for tetanus. In some cases, however, even in the early stages, all efforts to swallow fluid food excite violent general convulsions. Osler suggests that this spasm may be lessened by application of cocaine to the throat, so that the patient can swallow. Failing this, nutrient enemata must be relied upon, but they also sometimes excite convulsions. In this case it is justifiable to produce primary anæsthesia with chloroform, and to seize the moment of temporary relaxation for feeding.

TUBERCULOSIS

Causation.—Tuberculosis is an infectious disease, due to the presence in some part of the body of the *Bacillus tuberculosis*. The disease may be either acute or chronic, but fever is present whenever there is an exacerbation of the symptoms. The latter are both local and general, and vary with the particular organ or organs affected, but the lungs constitute by far the most frequent site for the development of the germs. The bacillus produces from the tissue or "soil" in which it grows a toxin or poisonous substance which enters the circulation by absorption and which modifies nutrition, causing pyrexia and an increased production of tissue waste, with more or less rapid emaciation.

Several factors combine to disturb the digestive system. These are:

1. The fever itself.

2. The impoverished condition of the blood, which affects the quality and quantity of the digestive juices.

3. In pulmonary tuberculosis, after the expectoration becomes considerable it is often ropy and tenacious, and some of it is liable to adhere to the surface of the mouth or pharynx, and be swallowed with the food or saliva, with the result of exciting gastric and intestinal catarrhs, or possibly of locally infecting the mucous membrane of the intestine with the bacilli, which produce ulceration with further impairment of digestive functions and absorption.

The prognosis of a given case depends very largely upon the digestion.

General Consideration of Dietetic Treatment.—Proper dieting is unquestionably one of the most important factors in the prophylactic as well as the active treatment of pulmonary tuberculosis, and in prescribing a regimen many things must be taken into consideration besides the mere classification and selection of food. The disease may be exceedingly protracted, lasting for years, with intervals in which the patient enjoys a comparative degree of health and comfort, which temporarily emancipate him from dietetic restrictions. But even then he should see to it that his food is ample for his bodily needs. Malnutrition at any time may permit the renewed activity of a latent tubercular process, and, on the other hand, an increase in body weight is accompanied by marked improvement in the symptoms of the disease.

The disease being very chronic the pecuniary circumstances of the patient must be considered. By ordering him to abandon his only means of livelihood or to undertake a long and expensive journey he may be so impoverished that he cannot afford to procure the best food, which is so essential both to repair the tissue waste, which sooner or later is a prominent feature of the disease, and to supply energy; and good climate is of little use unless it helps him to acquire a better appetite and easier digestion.

The appetite, too, must be consulted. It is sometimes better to humour whims than to seek to combat them, and inflexible rules can no more be enforced for dieting than for medication. The appetite is often very poor or capricious, and the physician's dietetic expedients will be severely taxed to devise suitable foods which meet all requirements. The patient should be given a list of foods which he can regularly eat, foods to be avoided, and foods which he may have as an occasional indulgence.

Young phthisical girls especially may long for sweets and confectionery, and despise the more wholesome animal food; in fact, some writers regard this as a symptom of the disease in such cases. If they cannot have what they crave they will refuse what they are allowed, and much tact and persuasion is required to induce them to eat rationally.

Since so much depends upon sustaining the nutrition and strength of tuberculous patients, it is of the utmost importance to keep the stomach and bowels in the best possible condition.

Patients should be warned never to swallow the sputum, for this always excites dyspepsia, and sooner or later gastric catarrh. The occurrence of the latter is also favoured by the habit, which many patients acquire, of perpetually taking cough medicines and patent "sure cures," many of which contain potassium iodide and other gastric irritants. In advanced cases the catarrh may be a sequel to enfeebled circulation.

All food should be fresh and carefully selected, and the cooking should be as simple as possible without monotony. Viands should be savoury, and served in a manner to tempt the palate.

The most important articles of diet for the consumptive are the animal foods, and milk, beef, and fats and oils should form the essentials, rather than too much meat; but in ordinary cases any variety of properly cooked animal food may be eaten. Starches and sugars are allowable in milder cases, but never to the exclusion of nitrogenous aliments, and not at all if gastric catarrh exists.

In phthisis there often seems to be a failure to assimilate amylaceous and saccharine food, which is beyond that which is explainable by the presence of catarrhal conditions. These substances, which ordinarily furnish a large proportion of the energy of the body, in tuberculosis appear to do so less readily than the fats and proteids. Growing children, however, require more carbohydrates than do adults. Malt is especially valuable as a tonic in tuberculosis, and the diastase aids assimilation of farinaceous foods.

Great diversity exists among different phthisical patients in the power of assimilation of food, and even in individual cases during the progress of the disease.

Bauer says: "One not infrequently sees phthisical patients who consume the full hospital diet without any visible ill effects, although their evening temperature oscillates between 102° and

104° F. With such patients one need feel no anxiety as to the choice of foods, provided their nutritive value be the same."

Rest is important in its relations to digestion, and patients should not eat when fatigued. Great benefit is often derived by lying down and quietly resting, even without sleeping, for half or three quarters of an hour before dinner and supper. It is best to take the principal meal in the middle of the day unless there is fever at that time or soon after it, in which case a hearty breakfast and a light lunch will be better borne.

If much hectic fever is present, it is desirable to employ the intervals when the temperature is low for feeding, and it often happens that a hearty meal taken between 7 and 10 A. M. may be better digested than at any other time of day.

Patients should avoid eating more food at any one time than they can comfortably digest, and it is often best to give food five or six times in twenty-four hours, to avoid overworking the stomach. If the digestion is feeble, it is best to give only one article of food at a time, or else only such varieties of food as require the same length of time for digestion (p. 351), and patients often do better when they eat all their animal food at one meal and vegetable food at another, having regard to the separate action performed by the stomach and intestines upon these different food classes. If there is stomach catarrh, or if the gastric juice is feeble, the quantity of fluid taken with meals should be restricted to a minimum, excepting in very advanced cases, in which the diet may be necessarily entirely fluid. But half a pint of very hot water may be taken with advantage half an hour before each meal, to cleanse and stimulate slightly the gastric mucous membrane.

A. L. Loomis wrote: "When the pressure of food in the stomach excites cough, or when paroxysms of coughing have induced vomiting, the ingestion of food must be delayed until the cough ceases, or an appropriate sedative may be employed. In those extreme cases where every attempt at eating excites nausea, vomiting, and spasmodic coughs, excellent results are attained by artificial feeding through the soft-rubber stomach tube."

Meats.—Raw beef is extolled by many physicians, especially among the French, as possessing peculiar nutritive and even curative value for tuberculosis, and in the popular mind its blood-red colour and scarlet juice seem to suggest an intimate connection with blood formation. It is true that blood and muscle have great similarity of composition. The red wines are erroneously regarded by laymen in the same light. It has yet to be demonstrated that raw meat possesses any advantage over rare steak or underdone roast beef beyond the fact that the scraping and mincing process to which it is usually subjected prepares it somewhat better for solution by the gastric juice.

Patients will often take scraped raw-meat balls contentedly for several days, and then acquire a distaste for them. This may be overcome by seasoning with a little aromatic herb, such as thyme, parsley, or marjoram. Yeo suggests that when made into small balls the meat may be covered with powdered sugar or gum, and swallowed with a sip of wine or brandy, or the mouth may be rinsed with claret to remove the after-taste.

Both scraped beef and the various preparations of beef powder, beef meal, etc., are useful to re-enforce broths, hot milk, milk punch, or light soups of vermicelli, tapioca, etc. According to Professor Chittenden, the nutritive value of lean beef being placed at 100, that of beef peptonoids is 140 and that of Mosquera's beef meal is 400. If preferred, from one to five ounces of beef meal may be eaten daily, spread like jam upon bread and butter. Insomnia may be often prevented by taking on retiring a cup of hot bouillon, clam broth, or gruel, with a cracker or two.

Beef juice, extracted by a small meat press, may be ordered two or three times a day. It may be seasoned and drunk like bouillon, or eaten as a luncheon upon dry toast, crackers, or boiled rice.

H. P. Loomis gives the following useful details in regard to the preparation of this important food: "To obtain from the meat the maximum amount of juice, a meat squeezer is absolutely essential. There are a number of good ones in the market, which range in price from one to three dollars. The best kind of meat from which to squeeze the juice is a thick round steak free from fat. This should be seasoned with pepper and salt, broiled over a brisk fire, cut in pieces two inches square, and then put into the meat squeezer. About eight ounces of juice can be obtained from each pound of meat. No further direct heat should be applied to the juice, as the albumin would be at once coagulated and the juice rendered worse than useless. If the juice becomes cold and it is advisable to heat it, this can be best accomplished by placing the cup in hot water. Freshly squeezed beef juice is the best of the artificial preparations of meat known, and the trouble of preparing it is well repaid by the marked improvement in the patient."

It is often desirable to give dilute hydrochloric acid and a little pepsin after the ingestion of meat or other animal food unless it has been predigested.

Eggs.—Eggs are not well borne if there is dyspepsia or decided gastric catarrh. Otherwise they are nutritious and wholesome. They may be given raw, beaten, or very lightly cooked in hot water, but never hard boiled. They may also be eaten scrambled or as an omelet if lightly made. Egg albumin may be well digested when the yolk proves too rich. "A raw egg sucked from the shell will often relieve an irritable condition of the larynx" (H. P. Loomis).

Cereals.—Cereals may be used in the early stage of the disease, before the alimentary canal is much disturbed, and such foods as corn mush, farina, oatmeal, wheaten grits, or germea may be allowed with cream. If cream and sugar disagree, they may be eaten with lemon juice.

Fruits.—The succulent fruits are well borne in mild cases, and are very wholesome and nutritious. Baked and stewed apples may be given with cream.

Fats and Oils.—Fats and oils are indicated in tubercular disease, and especially in pulmonary phthisis, in as large amounts as the patient may be able to digest. Crisp fat bacon, butter, cream, whole milk, egg yolk, cod-liver oil, and olive oil all furnish desirable forms of fat when the intestine absorbs them. Russell's emulsion of mixed fats is a very digestible preparation by which to administer this class of food.

While fat is being taken it is well to occasionally observe the stools to see that none passes away undigested, and if any one fat disagrees and causes dyspepsia its use must be restricted, or temporarily withheld while another is tried. As a rule, cream butter and cod-liver oil will prove the best. If a patient can take one quarter pound of butter a day it furnishes about one half of the necessary heat units. Fats, well digested, seem in some instances to have an almost curative power, so greatly do nutrition and body weight improve during their use.

Cod-liver Oil.—The use of cod-liver oil in phthisis should be determined by the condition of the digestive organs and the general nutrition of the patient. Wherever the digestion is fairly good, in the absence of gastric catarrh, the oil is of great nutritive value, and it is usually well borne when properly administered. If there is much gastric catarrh, or if the stomach is irritable and nausea is easily excited, persistence in the use of the oil will only make matters worse. It should be at least temporarily discontinued, though in the chronic forms of tuberculosis unaccompanied by fever, in which debility and emaciation predominate, cod-liver oil is often well tolerated. It is on the whole more satisfactory for children than adults, particularly in cases of tuberculosis in which the bones or glands are enlarged.

The presence of diarrhœa is to be regarded as a contraindication for the administration of cod-liver oil, but unless it is given in large quantities it has very little if any laxative effect upon adults, and it may usually be continued in doses of a drachm two or three times a day, with no ill effect, and, in fact, by improving the nutrition it may sometimes benefit diarrhœa. Ringer suggests that for this class of patients a teaspoonful or more of the oil given at night before sleep may be better borne than at any other time in the day.

Commonly it is best to give the oil pure and uncombined if it can be tolerated. It may be given in capsules, although they are not always dissolved at the proper time in the stomach. Patients who require alcohol may take the oil in whisky. For the many different methods of administering it and of disguising its taste the reader is referred to the section on Cod-liver Oil (p. 204). The isolated active principle of the oil, called gaduin, has been employed with some degree of success (p. 203).

Alcohol.—Alcohol is not believed to possess any specific action in phthisis, and in many cases it is positively harmful. As a rule, if patients have a fair appetite and are improving in strength its use is contraindicated. When alcohol is required as a food and tonic rather than as a stimulant, the best form in which to give it is that of malt liquor or light wine. One or two pints daily may be prescribed of beer, stout, or porter, or half a pint of claret or sound Burgundy is useful if anæmia is marked. The light Hungarian, Italian, or Greek wines may be used by those whose purse places them within reach. One of the Tokay wines, with cocoa, may be prescribed. Sweet wines, sherry, port, Madeira, and champagne are not as useful. They are liable to disagree and cause dyspepsia and headache.

The promiscuous habit of daily drinking rum, whisky, or other strong liquors in tuberculosis is to be condemned.

No class of patients exhibits more painfully and rapidly the inroads of the disease than those who for a long time have been hardening their own tissues, like pathological specimens, with daily draughts of strong alcohol. The cirrhotic changes which occur in various organs are the best possible preparation for the advancement of tubercular processes. If the exhibition of alcohol increases the temperature and the pulse rate, and is followed immediately by greater weakness, it is doing harm. Advanced cases of tuberculosis show great toleration for alcohol, but it does not follow that it is proportionately benefiting them. When in the course of an ordinary case the hectic fever becomes high and exhausting, the pulse feeble and rapid, and the digestion fails, it may be best to lessen the quantity of food and give more stimulation. Usually three or four, but seldom more than six, ounces of whisky, brandy, or rum may be required daily for this purpose. Special pains should be taken to use only such liquors as are strictly pure and of the best quality.

Diet in Mild Cases

The following liberal *menu* will furnish abundant variety from which to select the dietary for tubercular patients in whom the progress of active lesions is in abeyance or completely arrested, and in whom there is little or no gastric catarrh. Patients should eat all they can digest, especially of milk, eggs, and butter, and should allow five hours' interval between meals.

FOODS ALLOWED IN NON-ACTIVE CASES WITHOUT GASTRIC CATARRH

Soups and broths: Mutton, oyster, clam, barley, vermicelli, bouillon, chicken with rice.

Purées of peas, beans, tomatoes, celery. It is often well to add to them meat extracts, peptonoids, beef meal, etc.

Milk or cream in any form, including buttermilk and koumiss, clotted or Devonshire cream, whipped cream, etc.

Shellfish: Oysters or clams, either raw, roasted, or broiled (the livers or "soft parts" only).

Fish of any kind if fresh, either boiled or broiled (never fried), sardines (if they "agree") for the sake of the oil.

Eggs, preferably raw or very lightly cooked, or in eggnog or custard, also poached, scrambled, or in plain omelet (never hard-boiled).

Meats: Beefsteak, rare roast beef, scraped-beef sandwiches or meat balls, lamb or mutton, roasted or boiled; chops; chicken, capon, turkey, either roasted, boiled, or broiled.

Game: Partridge, squab, woodcock, snipe, prairie chicken, quail, roasted or broiled.

Meats, especially beef and mutton, should predominate. Gelatin may be used, but it is not very nutritious. It should be combined with meal or meat preparations.

Entrées: Sweetbreads.

Fats and oils (as much as can be digested): Good fresh butter, olive oil on lettuce or raw tomatoes, cod-liver oil, the fat of beef or mutton (if it "agrees"), cream (on everything with which it can be appropriately eaten), a little fat bacon. Pancreatin or pancreatic emulsions will aid the digestibility of fats.

Vegetables: Baked potatoes, tomatoes stewed or raw, very young green peas, string beans, spinach, celery (stewed), onions, boiled asparagus, lettuce, cauliflower.

All vegetables to be eaten in moderation.

Cereals: Whole-meal bread, wheaten or rye, only if stale or toasted, zwieback, rusk, milk-toast, cream-toast, crackers, malted bread and biscuit, rice in any form, mush, hominy, farina, cracked wheat, wheaten grits, oatmeal, macaroni, spaghetti.

Some authors recommend lentil flour, on the ground that it contains both iron and phosphorus. Oatmeal contains considerable fatty matter, and maize has still more. All cereals are to be eaten sparingly.

Fruits: Apples, baked or stewed, oranges, shaddock, grapes, pears, peaches, plums, strawberries, blackberries, olives.

Desserts: Wine jelly, custard, blancmange, rice pudding, bread pudding, junket and cream, Bavarian cream.

Avoid fried foods, rich sauces, pastry, cakes, hot-breads, ragoûts, beans, carrots, turnips, cabbage, confectionery, puddings, dried foods, salt fish or meats (except as specified above).

Beverages Allowed.—Water, tea, coffee, cocoa, milk, koumiss, zoolak, buttermilk, milk punch, lemonade or orangeade, Vichy or other aërated water, non-fermented grape juice, malt extracts.

Alcohol: Beer, ale, porter, wines, liquors, are permissible only if needful for special symptoms—that is, if desirable for food or to aid digestion and promote exercise.

H. P. Loomis gives the following useful sample diet, with the appropriate intervals for taking food. A glass or two of milk may be added at night with advantage:

"*On Awakening.*—Eight ounces of equal parts of hot milk and Seltzer, taken slowly through half an hour.

"*Breakfast.*—Oatmeal or cracked wheat, with a little sugar and an abundance of cream, rare steak, or loin chops with fat; soft-boiled or poached egg, cream-toast, half pint of milk, small cup of coffee.

"*Lunch,* 10 A. M.—Half pint of milk or small teacup of squeezed beef juice, with stale bread. 12, noon: Rest or sleep.

"*Midday Meal,* 12.30.—Fish, broiled or stewed chicken, scraped-meat ball, stale bread, and plenty of butter, baked apples and cream, two glasses of milk.

"*Lunch,* 4 P. M.—A bottle of koumiss, raw scraped-beef sandwich, or goblet of milk. 5.30 P. M.: Rest or sleep.

"*Dinner,* 6 P. M.—Substantial meat or fish soup, rare roast beef or mutton, game, a slice of stale bread, spinach, cauliflower, or other fresh vegetables in season (sparingly)."

At 9 P. M. half an ounce of cod-liver oil should be taken, or an ounce of peptonised cod-liver oil and milk. At 2 A. M., or thereabout, if the patient awakens, a glass of milk, zoolak, or diluted cream should be drunk, or a scraped-beef sandwich may be eaten.

Diet in Advanced Cases

It not rarely happens that patients who have suffered much from indigestion in the earlier stages of phthisis finally reach a condition in which, although greatly emaciated and prostrated, they seem able to eat and digest a much larger variety and quantity of food than before. As these cases are utterly hopeless, it is often best to let such patients select their own diet, providing only that it is nutritious and of a quality which does not excite cough or diarrhœa.

If the bowels are not too loose, fresh fruit, especially oranges, may be allowed, and proves very refreshing.

In very advanced cases, and in all cases during acute exacerbations of severity, with marked prostration, the patient must have food every two or three hours, and the intervals of feeding should never be longer than the latter. A diet consisting very largely of milk or milk and cream is best, but broths and pancreatinised meat preparations, albumoses, and egg albumin may be added.

Milk Diet.—Milk is a food which is especially adapted for consumptives, many of whom do best when living upon it almost exclusively, while others should drink it freely in connection with other nourishment. It is fattening, is assimilated without overtaxing the digestive organs, and taken hot, either alone or with an equal part of Vichy, it is soothing to the throat and ameliorates the cough.

Advanced cases of tuberculosis living upon full milk diet should take between two and a half and four quarts a day, but not over eight ounces at once. It should be sipped, or really eaten, and not drunk, for it then will coagulate by slow degrees in the stomach and not form large indigestible curds. This should be insisted upon and ten minutes should be occupied in drinking half a pint. If the milk disagrees at first it may be modified in any one of the ways suggested on p. 74, but it is best not to give it in connection with beef juice.

In this country cow's milk is preferred, but elsewhere the milk of other animals serves equally well. Goat's milk, drunk largely in Switzerland, contains more salts of lime and is good for cases of tubercular diarrhœa, and sometimes ass's or mare's milk proves more digestible. The latter varieties are principally used in Russia.

Lebert's Milk Cure (from Bauer).—" Lebert directs the patient to drink slowly three hundred to five hundred grammes of milk every morning and evening between five and six o'clock, fasting. He prefers it freshly drawn from the cow, and if, in consequence of having stood for some time, a separation of the cream has already begun, recommends it to be skimmed off.

" During the continuance of the milk treatment the patient is allowed a substantial dinner, at least of soup, roast meat, young vegetables, stewed fruit, etc., and a little beer or wine. At the discretion of the physician a proper breakfast may be taken an hour after the morning's milk of a cup of tea with plenty of milk and biscuits and, perhaps, one or two light-boiled eggs, and again in the evening a good soup, as well as, when possible (i. e., in the case of non-febrile patients), some more roast meat. If milk is well borne, the regular breakfast and supper may be supplemented by further doses of one hundred to two hundred grammes of milk."

Whey or koumiss may be drunk instead of milk. For those who can digest it, cream is an excellent food. With some patients cream diluted with an equal bulk of hot water agrees even better than milk. The taste, if complained of, may be modified by a very little tea or coffee, or salt or sugar. Yeo sometimes adds a teaspoonful of rum or brandy or aromatic spirits of ammonia. Some patients can take a quart of cream besides a quart and a half of milk per diem with profit.

Suralimentation

Suralimentation, called also "superalimentation," or "forced feeding," is based upon the theory that the best method to combat the symptoms of phthisis is by "stuffing" the patient with all the food which he can possibly digest. More food is needed than in health to counterbalance rapid tissue waste. The appetite is not always a reliable indication of the strength of the digestive organs, and, acting upon this fact, Debove introduced the plan of feeding by means of the œsophageal tube. It is only necessary to use this method when a patient loses all appetite, or acquires a positive disgust for food, and rapidly emaciates in consequence. The tube is employed in the manner described for feeding cases of insanity, and any form of desirable fluid food is introduced through it. It is sometimes only necessary to pass the tube to the level of the œsophagus, and the first few times that it is used it may be well to brush the pharynx with a two-per-cent solution of cocaine. The meals may be given three or four times a day, or a patient whose appetite is not wholly lost, but is inadequate, may prefer to eat part of his food himself and have other meals furnished through the tube.

The following are the foods most suitable for tube feeding: 1. Milk and its preparations; cream. 2. Raw eggs, eggnog. 3. Meat extracts, beef meal or powder. 4. Leguminous *purées* and cereals, thoroughly cooked and made fluid by predigestion with malt extract. A quart may be given at a time. If gastric catarrh is present the gavage should be preceded by lavage.

Debove, speaking of his method, says: "A patient who has no appetite, or who has a decided disgust for all food, will digest perfectly a large meal introduced by the tube, and even at the end of a certain time will recover appetite."

His method is first to wash out the stomach with cold water, and then pour in through the tube a litre of milk, one hundred grammes of fine meat powder, and an egg.

He adds that with suralimentation night sweats, cough, and expectoration are all reduced or disappear completely, while there is considerable gain in weight and strength and improvement in the physical signs in the chest.

Suralimentation may also be conducted without the stomach tube in patients who are able and willing to eat. They may be given five or six meals a day. This applies to patients who are not having severe hectic fever, and in whom gastric catarrh is not a prominent symptom. Should vomiting occur during the treatment, it will be necessary to suspend it until the stomach is again in order. As a rule, in such instances it is better to discontinue medicines than food, if both are being taken. The presence of moderate fever—one or two degrees—is not in itself alone a contraindication for forced feeding, or for keeping the patient confined to bed. The gain of appetite which often accompanies removal to a favourable climate may be utilised to promote forced feeding.

The following diet recommended by Solis-Cohen serves as a good illustration of the proper regimen in the cases under discussion:

"DIET FOR FORCED FEEDING

"The patient is to take a pint of hot water in the early morning to stimulate the stomach and cleanse it of mucus accumulated overnight.

"A half hour after the morning bath, milk punch and beef meal or peptonoids.

"*Breakfast*, a half hour later, consisting of rare steak or chop, eggs, sliced tomatoes, bread with plenty of butter, or cracked wheat and cream. In two hours, koumiss or soup, milk, bread and butter, celery salad, broth, and peptonoids.

"*Dinner*, 1 P. M.—Bouillon, rare beef, greens, Burgundy, beer, fruits.

"3 *or* 4 P. M.—Koumiss, cream, or milk punch, peptonoids, malt extract.

"7 P. M.—Supper, like breakfast.

"9 *or* 10 P. M.—Cream and cocoa or coca wine, milk, and peptonoids."

The patient should keep milk, or peptonoids, or some nutritious beverage by the bedside to be drunk if he awakens in the middle of the night.

Another diet well suited to some patients is thus outlined by Weber in his Croonian Lectures:

"7 A. M.—While still in bed, a cup of milk with a dessertspoonful of Cognac or lime water, or a cup of tea or cocoa, with bread and butter.

"8.30 *to* 9 A. M.—After dressing, milk and tea or coffee, bread and butter, fish, ham, or bacon.

"11 A. M.—Milk, koumiss, or broth, or a sandwich and glass of wine.

"1 *to* 1.30 P. M.—A substantial meal of meat, poultry, fish or game, fresh vegetables, a light pudding, fruit and a glass of wine.

"4 P. M.—Milk or koumiss, tea or coffee, with bread and butter or biscuit.

"7 P. M.—Another meal like that at 1 P. M.

"9.30 *to* 10 P. M.—A cup of milk, bread and milk, or milk or cream and farinaceous food, such as Hart's, Liebig's, Nestlé's, or Mellin's. A glass of brandy if there are night sweats."

The question may properly be asked whether it is not possible to overfeed patients in this manner? This will happen when the increase in body weight exceeds the breathing capacity of the lungs —in other words, when the facilities for oxygen supply are disproportionate to the bulk of tissue to be supplied. The symptoms will be a coated tongue with dyspepsia and biliousness, increased pulse frequence, and possibly increased dyspnœa on exertion, all occurring without aggravation of the local physical signs. The food must then be reduced in amount. Both fluids and solids are to be restricted, and fish may replace meat temporarily.

Aids to Dietetic Treatment

It is not within the scope of this work to discuss the details of hygiene, but they should be at least mentioned as important adjuncts to dietetic treatment. In those cases especially in which forced feeding is recommended it is desirable to promote oxidation in every way. Patients should live in the open air all they can, sleep with the windows open, and, if possible, should go to a climate which enables them to be outdoors all day long. They should wear flannel undergarments, but should avoid dressing too warmly, and keep the feet warm and dry. Habits of moderate exercise, instruction in proper methods of breathing, cold bathing, massage, and reasonable mental diversion and good cheer are all useful factors in improving the digestion and assimilation of food. Worry and nervous strain of every kind should be avoided. Nine hours should be nightly allotted for sleep.

Of the long list of medicinal remedies which have from time to time won favour or notoriety for the treatment of tuberculosis, those which have best withstood the test of practical experience are the ones which, like creosote, act mainly by maintaining asepsis and preventing malfermentation in the alimentary canal. It is immaterial whether cod-liver oil be considered as a medicine or as a food. It has already been discussed as a food. In a negative way it should be stated that one of the best aids to digestion consists in preventing the patient from disordering the stomach and the appetite with all manner of cough mixtures and ill-advised tonics.

Such medicines as may from time to time be required for emergencies will be much better absorbed if the stomach has not been long kept in a state of dyspeptic irritability. In patients with constipation appetite and digestion will be improved by catharsis.

Diet "Cures" for Phthisis

Many special forms of dietetic treatment have been devised and extensively practised for the cure of pulmonary tuberculosis. The details of these "cures" are elsewhere described. The principal ones are the "Milk Cure" (p. 733), the "Whey Cure" (p. 735), the "Koumiss Cure" (p. 83), practised chiefly in the steppes of south-eastern Russia, and the "Grape Cure" (p. 738), conducted at Meran, Montreux, and elsewhere in the months of September and October. Aside from climatic influences and the effects of good hygienic surroundings, their benefits are attributable only to the fact that the patient is encouraged to take a large quantity of easily digestible food and live constantly in the open air. Patients with chronic phthisis are notoriously sanguine as to the possibilities of their ultimate recovery, and it is also true that their mental state reacts to a greater degree upon their physical condition than in almost any other disease.

All manner of absurd foods, such as fish roes in Germany and snails in the south of France, have achieved fame with credulous persons as possessing specific virtues in the cure of phthisis. It should be as much the duty of the physician to protect them from the chagrin, disappointments, and expense of following dietetic illusions as to encourage them in every reasonable effort for improvement. Beyond the requirements of a good, nourishing, easily digestible diet, there is no specific food "cure" for tuberculosis, as there is no medicinal cure.

DIET IN DISEASES OF THE RESPIRATORY SYSTEM

Laryngismus Stridulus

In children who are subject to spasmodic croup the attacks are often precipitated by dyspepsia caused by overfeeding and nursing, by improper food, or by constipation. The diet must therefore be regulated according to the rules laid down under the heading Infant Feeding. The habit of night feeding especially should be much restricted after the first month of life. This can usually be done after two or three trials. If the infant awakens crying at night it must be offered a little cool water, and it may presently drop asleep. Up to the fourth month six meals a day, three hours apart, are all that are allowed, and from that time on until the second year five meals must suffice.

Between the attacks the milk should be lessened in amount, and so modified as to insure more perfect digestion. Children over six months of age should be given from one to three tablespoonfuls of pressed beef juice in a day.

Older children had better be kept upon a fluid diet of meat broths, milk, and egg albumin, solid food being withheld until the seizures abate. Cod-liver oil should be given in most cases.

Tubercular Laryngitis

In tubercular laryngitis intense pain is excited by the act of deglutition. Nutritious but non-irritating food is therefore required. Thick soups and gruels, *purées*, cream, beaten raw eggs, scraped rare beef, raw oysters, junket, can all be swallowed more readily than very fluid or solid food. Strong condiments, vinegar, and salt must be avoided, for they increase the pain.

The difficulty experienced in deglutition is considerably relieved by the method proposed by Wolfenden, which is to have the patient lie prone on a lounge, and with his face protruding over the lower edge he is to suck through a glass tube semifluid food from a tumbler on the floor. Sajous advises the patient to lean over forward when eating, which, he says, " causes the food to pass down along the pyriform sinuses, thus avoiding the upper portion of the larynx, contact with which causes the severe pain experienced by advanced cases during the act of deglutition."

Hæmorrhage of the Lungs

Hæmorrhage of the lungs, or rather from the bronchial mucous membrane, when occurring suddenly and in considerable amount, greatly reduces the strength, and naturally alarms the patient and excites the nervous system. Absolute quiet must be immediately secured by rest in bed without a pillow, so that the body may lie flat, and the head and arms should on no account be raised. The room should be kept quiet and the patient must not be allowed to speak or to feed himself. A reliable and quiet nurse should be secured for him, and he should be fed upon a nutritious diet, which requires no effort in eating. Small quantities only of fluid should be given at one time through a glass tube or by a teaspoon, so that the head need not be raised. If nausea occurs, every effort must be made to control it, for the violent muscular action and the temporary circulatory and respiratory disturbances occasioned by the act of vomiting might excite further hæmorrhage. It is desirable to reduce the blood pressure in the lungs as much as possible in order to allow coagulation of the blood to occur over the oozing surface of the bronchial mucous membrane, and therefore large quantities of fluid should not be given at first. The patient is usually thirsty from the loss of blood and temporary drying of secretions. The thirst may be relieved by crushed ice and small quantities of cold acidulated drinks, such as very dilute phosphoric acid or sour lemonade, and if the stomach is in normal condition, plain milk may be given or else pancreatinised milk and strong beef broth in quantities not exceeding two or three ounces in as many hours.

It is customary to administer all fluids cold, but the advantage of this is overrated. Warm fluids have a somewhat more stimulating effect upon the heart, and are more rapidly absorbed, but the idea sometimes advanced that the cold of iced fluids taken into the stomach is ever sufficient to constrict the bleeding bronchial vessels, even by supposed reflex action, does not appear rational. For a full discussion of this question the reader is referred to experiments reported upon p. 338.

If coincident gastric disorder is present with bronchial hæmorrhage, to forestall vomiting it may be better to resort to nutrient enemata.

In cases where exceptionally large quantities of blood have been lost, the blood pressure may be greatly reduced and the danger of death from heart failure may appear imminent. It then becomes necessary to give a larger quantity of fluid, and the rules in regard to the dietetic treatment of severe and sudden hæmorrhage taking place anywhere from the body must be observed. Salt and water, a teaspoonful to the pint, may be injected into the rectum, or even beneath the skin. Most cases, however, are more mild, and after a few hours of rest and quiet, furthered, perhaps, by the hypodermic injection of morphine, the patient will be able to retain a little simple semisolid food, such as milk toast, a beaten egg, junket, etc.

If there is no return of the hæmorrhage in a day or two, the diet should be increased and anæmia consequent upon the bleeding must be treated by an abundant meat diet. As a rule, alcoholic stimulants should be avoided, on account of the relation of blood pressure to the bleeding, or they should be given in moderation, unless the danger of heart failure is imminent.

Acute Capillary Bronchitis

In acute capillary bronchitis in infants and children a wholly fluid diet of the simplest but most nutritious kind must be enforced. In young infants milk alone, in older children milk, meat juice, meat broths, and beaten eggs or egg albumin, should be fed at least every two hours in such quantities as the stomach will bear. It may be best to pancreatinise all food. Very feeble children will require food oftener, and sometimes a teaspoonful only should be ordered once every fifteen or twenty minutes. If the child refuses food or vomits constantly, nutrient enemata (p. 414) must be prescribed once in three or four hours.

Chronic Bronchitis

The diet for chronic bronchitis is substantially the same as that recommended for the earlier stages of pulmonary phthisis, to which the reader is referred (p. 462).

The cough is often momentarily relieved by drinking hot lemonade, hot milk and Seltzer or Vichy, glycerin and whisky, and sometimes by sucking a raw egg through the perforated shell.

Asthma

Spasmodic bronchial asthma is believed to be occasioned by temporary spasm of the bronchial muscles which narrows the lumen of the tubules and obstructs the free entrance and exit of air. It is also attributed to hyperæmia and swelling of the bronchial mucous membrane, and possibly, in some cases, to a reflex spasm of the diaphragm and other muscles of inspiration. Asthmatic patients soon find from experience that errors in diet are liable to precipitate an attack, and overloading the stomach or eating particular kinds of food, which are unwholesome or against which the individual possesses some idiosyncrasy, may excite dyspnœa. Aitkin showed a true appreciation of the importance of diet in this disease when he wrote: "More is to be done for asthmatic patients on the side of the stomach than in any other direction," and "the asthmatic can never with impunity eat and drink as other people."

Accumulation of large quantities of undigested and fermenting food results in the production of gas in both the stomach and intestines, which become distended and by pressure interfere with the movements of the diaphragm and abdominal muscles in free respiration. The chemical irritation of undigested food may be a cause of reflex spasm of various muscles, and may possibly affect those of respiration. It is therefore necessary for asthmatics to exercise care in the selection of their food and to keep the digestive organs in as normal a condition as possible. All food which is constipating or which is liable through fermentation to evolve large quantities of gas should be shunned. In general, fats and sweets should be given up, and starchy food, if eaten at all, must be very thoroughly cooked and slowly masticated, in order that the salivary digestion of it may be as complete as possible. Pork, veal, and cheese must never be eaten, and elaborate cooking and desserts are forbidden. No water should be allowed with meals or until at least three hours thereafter. A cup of very hot water may be drunk an hour before each meal and again at night.

In most persons the asthmatic attacks are worse at night, and in many they only occur at that time. It is consequently better for them to take the principal meal of the day at noon and to eat a light supper, so that gastric digestion may be finished before going to bed.

The following diet may be offered as giving a general idea of the regimen for somewhat advanced cases:

Breakfast.—Bread and milk or well-cooked oatmeal porridge or wheaten grits without sugar (lemon juice may be added instead). A chop or a little broiled fresh fish, coffee without sugar.

Dinner (not later than 2 P. M.).—Beef or mutton, bread, one or two green or succulent vegetables, such as spinach, stewed celery, stewed or raw tomatoes. Blancmange or custard (not sweetened), or a little rice pudding. Fresh fruit in season, such as a peach or baked apple.

Supper (6 P. M.)—A soft-cooked egg or a little cold fowl or game, stale bread, toast, or zwieback, milk, stewed fruit (without sugar).

Patients should eat very moderately, masticate thoroughly, and take their meals with punctuality.

Among beverages, coffee without sugar is better borne than tea. Loomis believed that "not infrequently a paroxysm of asthma can be warded off by taking two or three cups of strong coffee immediately upon the accession of the first asthmatic symptom."

During an attack non-alcoholic patients may take a hot strong lemonade with whisky or a hot brandy and soda. Malt liquors are forbidden.

EMPHYSEMA

Patients suffering from emphysema have more or less engorgement of the venous circulation, and hence are liable to catarrh of the stomach and intestines. The dyspnœa from which they suffer on exertion is considerably aggravated by flatulency, and their diet must be regulated to prevent this occurrence. In general, starchy and saccharine foods are to be avoided, as constipation must be prevented. For a discussion of these principles, the reader is referred to the articles upon Gastric Dyspepsia and Constipation.

The patient must be particularly warned against too rapid eating and overeating. Condiments, sauces, fried and greasy food, and all obviously indigestible articles, must be shunned. Fluids should not be taken with solid food, and should be used in moderation. Water may be drunk an hour before meals, but not for three hours after. In the early stages a nourishing diet, consisting chiefly of animal food, meat, fish, milk, cream, eggs, and good butter, should be taken. If dyspnœa predominates with frequent asthmatic attacks, it will be best to substitute milk largely for other foods, and in the later stages, with a feeble heart and increasing congestion of the abdominal viscera, the diet should consist solely of milk and meat broths. Cod-liver oil is an excellent food in emphysema.

Pneumonia

Symptoms.—Pneumonia is an infectious inflammatory disease of the lungs, accompanied by grave constitutional disturbances, such as fever and rapid and enfeebled heart action. The mortality at some seasons of the year, and especially among debilitated or alcoholic patients, is very great, and since no known remedy can limit the disease, it is exceedingly important to maintain the strength of the patient through the few days during which the fever lasts, or until the crisis by which it terminates has been reached. All danger, however, is not then over, and convalescence in all cases, and especially in aged persons, must be promoted by careful dietetic treatment. The onset of the disease is acute, and the fever is often high, reaching 104° or 105° or more on the first day. The duration of the fever varies from five to seven or nine days on the average, when it subsides by a sudden fall. The rate of respiration is greatly accelerated, with or without subjective dyspnœa. More or less cough accompanies the fever, and there is frequently delirium.

Dietetic Treatment.—The indications for treatment are to give a light diet, which will not excite the cough in swallowing or increase dyspnœa by distention of the stomach, or augment the enfeeblement of the heart action by overtaxing the digestive powers. Vomiting should be especially guarded against, and if nausea exists, efforts should be made at once to control it. It is not necessary to keep the patient upon a rigid milk diet, but if milk is well borne, it is advisable to give nothing else while the acute symptoms last; otherwise, whey, meat juice, broths, and egg albumin may be allowed. Starchy and saccharine food must be withheld. Cold drinks are both acceptable and beneficial to the patient, and water, plain or aërated, such as Apollinaris or soda water, may be drunk in considerable quantity. It is believed by some authorities that the activity of the kidneys may be thus promoted, and that the poison which occasions the constitutional symptoms of the disease may be better eliminated. There are cases, however, among persons with robust circulation in which the onset is very sudden and violent. The pulse is full and bounding, and the heart is greatly overworked by the effort to propel a large volume of imperfectly aërated blood. In such instances the addition of large quantities of fluid to the circulation, besides what is actually required for nutrition, may have the effect of still further straining the heart.

It is stated that carbonated waters reduce the viscidity of the sputum, which is often very tenacious.

The diet should be kept fluid until defervescence has occurred, with a normal temperature and commencing disappearance of the exudation—in fact, it is well to prolong the fluid diet for three or four days after the temperature has become normal, in order to make sure that a relapse of the fever is not likely to follow. In those cases in which resolution is postponed and the patient becomes more and more feeble, although the temperature may be nearly or quite normal, it may be desirable to give a little properly prepared solid food somewhat earlier, and scraped beef, milk toast, or a soft cooked egg may be added to the milk diet.

During the entire period of convalescence the diet must be very nourishing and of easy digestion; milk may still be given, and after slowly returning to the regulation three meals a day (see Convalescent Diet, p. 441) patients do well to take milk punch, or egg-nog, or a glass of wine and a biscuit three or four times a day in the intervals.

Alcohol is exceptionally well borne, and it undoubtedly serves both as a food and as a support to the overworked heart. The fact that it is thoroughly oxidised in the circulation or tissues is demonstrated by the large quantities which patients can often digest and absorb without toxic symptoms. Doses may be thus tolerated which in health would ordinarily produce drunkenness. In alcoholic subjects who have been drinking up to the time of the onset of the disease it is indispensable to continue the use of alcohol, for the sudden withdrawal of its stimulating effect on the organism may give rise to rapid collapse. In aged and constitutionally weak persons it is also important that its use should be begun early in considerable quantities.

In extreme cases as much as an ounce every two hours, or twelve ounces in the day, may be given with benefit, but ordinarily from six to eight ounces will suffice. There are other cases found among robust subjects who do not need such stimulation, and possibly may not require alcohol at all. The custom now in vogue of prescribing other forms of cardiac stimulants, such as strychnine, and vasodilators, like nitroglycerin, makes the employment of excessive doses of alcohol less imperative. It should always be remembered that it is undesirable to produce toxic symptoms of alcoholism in pneumonia as well as in any other disease. So long as the pulse is slowed and its force strengthened the use of alcohol may be regarded as beneficial; but if delirium is increased and the odour of whisky or brandy is strong in the breath an hour or two after it has been given, it is an indication that the patient is receiving more than is desirable, and the dosage should be reduced. From its serving as a fuel, and thereby saving tissue waste in the muscles, the free use of alcohol in pneumonia undoubtedly saves many lives.

Broncho-Pneumonia

Symptoms.—Broncho-pneumonia is common at the extremes of age, in the very old and very young. The mortality is greatest in children under two years of age. It is the sequel to many of the acute diseases of childhood, and is also produced by the tubercle bacillus and by the inspiration of particles of food or fluid which are drawn through the larynx to the bronchi by inhalation during the act of swallowing. The latter variety may occur as a result of drawing seeds or other hard substances into the bronchi; from operations about the mouth and upper air passages after tracheotomy; and from the conditions which impair the normal sensitiveness of the larynx and the reflex action of the epiglottis and vocal cords, such as profound uræmia or apoplectic or alcoholic coma, and post-diphtheritic or laryngeal paralysis. A few cases have been produced by carelessness in the passing of the œsophageal catheter into the larynx and pouring liquid food into it.

Dietetic Treatment.—Broncho-pneumonia is always a very critical disease and the utmost care is required in nursing and feeding. The diet should consist of such articles as meat juice, predigested milk, and egg albumin. Stimulation is early required and in considerable quantity. Brandy or whisky sweetened with a little sugar and cold water should be systematically given, especially to young children, who are unable to make their want of drink known. Hot milk and Vichy, in the proportion of one part of Vichy to two of milk for older children, or half-and-half for young infants, may have the effect of loosening the tenacious mucus and easing the cough. If there is any tendency to flatulency, aërated waters had better be avoided.

When the disease occurs in children the diet should be adapted to foster the strength and tax the digestive organs as little as possible. At first food should be given every two hours, and milk is usually all that is required. Later it may be alternated with or supplemented by egg albumin, expressed meat juice, plain beef or mutton broths, arrowroot, or other gruels.

Pleurisy

Of the various forms of pleurisy, those which are chiefly influenced by diet are pleurisy with effusion and empyema. In pleurisy with effusion the objects to be attained are to preserve the strength of the patient and promote the reabsorption of the fluid in the pleural sac. A diet is therefore advised which shall consist of nutritious solids with a minimum amount of fluid, in order that the blood may become more dense and that favourable osmosis may occur from the pleuritic cavity into the blood vessels; at the same time free action of the kidneys should be promoted. To still further favour the absorption of fluid, a special dry diet has been recommended in which, as in case of aneurism, the patient is encouraged to take as little fluid as possible and to eat table salt by the teaspoonful, the idea being to increase the density of the blood both by withholding fluid and adding salt, and that the latter may also promote osmosis. This treatment has been attempted in several of the New York hospitals and elsewhere, but has not met with success, mainly, no doubt, on account of the difficulty of overcoming the thirst of the patient, which is doubly aggravated by the lack of fluid and the supply of salt.

An extreme dry diet known in Germany as "Schroth's Method" has been indorsed by Niemeyer, Pimser, and others. The patient is fed upon lean roast veal and stale rolls (*Butterbrod*) without fluid of any kind but a little water until the third day, when half a pint of red wine is given. At the end of a week a pint is allowed. Very few patients will submit to such treatment in this country, and it certainly is severe. A reasonable abstinence from fluids, especially water, is all that can be expected. Practically, many patients are found to go on reabsorbing pleuritic exudation while continuing a milk or other fluid diet which is necessitated by some complication in the digestive system.

Several French writers, as Serre and Eloy, advocate an exclusive milk diet, giving from three pints to three quarts daily, to be sipped in small quantities every hour or two. They rely upon the diuretic effect of the milk, and give it in any form most agreeable to the patient. The treatment is continued for a week or more after the exudation has been absorbed, and return to a solid diet must be gradual.

This method is obviously directly opposed to the dry diet, and possesses no advantages over it, excepting sometimes in cases complicated by chronic valvular heart disease, gastric catarrh, or advanced anæmia. In England and Europe thoracentesis appears to be much less practised than in this country, where it is performed with but little hesitation.

If the pleuritic exudation accumulates in sufficient quantity to severely embarrass respiration or the action of the heart, it is so easy to absolutely withdraw it by the aspiration needle when antiseptic precautions are taken that annoying the patient by experimental dietetics is hardly justifiable, and I have found solid diet with reasonable restriction to be, on the whole, the most satisfactory. Patients who are fairly robust will naturally endure privation of food and drink better than the feeble and anæmic.

Empyema

The dietetic treatment of empyema is based upon the need for nutrition to supply the drain on the system of the constant excretion of pus, and fatty food, such as butter, cod-liver oil, and cream, should therefore fill a large portion of the dietary. The general supporting treatment prescribed for the early stages of pulmonary tuberculosis is recommended (p. 468).

DIET IN DISEASES OF THE CIRCULATORY SYSTEM AND BLOOD

Diseases of the Heart

The proper dietetic treatment of advanced heart disease deserves careful consideration, for on it to a great extent depends the patient's comfort, if not the prolongation of his life. It cannot be said that the several conditions of cardiac enlargement, valvular disease, fatty degeneration, etc., demand different forms of treatment *per se*, but there are certain general principles which should be observed in any case when particular symptoms arise. The dietetics of cardiac diseases may, accordingly, be conveniently reviewed together.

Pathological Physiology.—The general conditions involved are largely physical, or rather mechanical—perhaps more so than in any other form of disease.

1. We have to deal with a pump whose action is impaired by more or less weakness of its walls, or leakage or obstruction of its valves, or which is overworked by the imposition of increased resistance.

2. The balance of food pressure in the vessels is usually disturbed and the rate of blood flow is altered.

3. As the disproportion increases between the driving force or the resistance of the vessels and the volume of the fluid to be propelled, there is apt to be leakage of serum in various situations, producing dropsies or general anasarca. Or these conditions may result from a diminution in the vitality of the peripheral blood vessels or changes in the composition of the blood itself.

4. The rate of absorption of the materia alimentaria by osmosis depends as much upon the activity of the circulation—i. e., upon the rapidity of renewal of the layer of blood in the capillaries of the absorbing surface—as upon the density and composition of the blood, the action of individual cells, or any other factor. A feebly beating heart or an obstructed vascular system promptly checks absorption. Moreover, the reabsorption of transuded serum will depend upon the reversal of the conditions which originally caused it.

5. The elimination of waste and the various processes of secre-

tion depend upon almost identical conditions with absorption, and while not due merely to filtration, they are nevertheless controlled very promptly by alterations in blood pressure and in the velocity of the current.

Bearing in mind these elementary principles, the first question which arises in the dietetic treatment of advanced cardiac disease must concern the administration of fluids.

Fluids.—An additional pint of fluid beyond the needs of the system may be sufficient to overtax the heart, alter the balance of blood pressure, disturb a temporary compensation, and precipitate anasarca, renal congestion, pulmonary œdema, or other symptoms. On the other hand, with too little fluid the blood pressure may fall to a dangerous degree or there may not be water enough in the vascular system to maintain the free diuretic action which is so desirable. It is a well-known physiological fact that the heart, like any other muscle, does better work if it has reasonable resistance to overcome. Such are the problems, briefly stated, which must be met by the comparison from day to day of the amount and quality of the urine, the degree of arterial tension, the force of the heart beat, and the possible presence of œdema.

Dietetic Treatment.—It is difficult to formulate any but the most general rules for the dietetic treatment of chronic valvular disease of the heart. These cases often extend through a period of many years, and the variety of secondary symptoms which may appear is very great. The forms of valvular disease which are most apt to result in disturbances of digestion are those in which obstructed venous circulation results in local engorgement of the abdominal viscera, producing nausea, vomiting, and great distaste for food. Constipation and more or less chronic gastric and intestinal catarrh may be among the symptoms. The hypostatic congestion of the liver retards the activity of that organ, and the ingredients of the food which are brought to it by the portal system are no longer properly elaborated, so that general nutrition and assimilation suffer in consequence. A depleting diet is, therefore, sometimes to be recommended, and concentrated food is required to prevent overburdening the circulation. If gastric catarrh necessitates the use of fluid food, the quantity of beverages taken in addition should be considerably restricted. When acute attacks of indigestion supervene in the course of chronic valvular disease, the bowels should be kept thoroughly open, and a diet of milk, beaten eggs, and broths, taken once in three hours, must be prescribed for a few days, after which boiled fish, broiled chicken, scraped beef, beefsteak, or rare roast beef may be added. Fats, farinaceous foods, and sugars should not be allowed, owing to their tendency to produce flatulency and aggravate existing symptoms. The use of alcoholic stimulation may at times become necessary, and whisky diluted in some non-effervescing water is perhaps the best. Beer should be particularly avoided, and recommendation of the regular use of stimulants, in this as in other forms of chronic disease, should be made with great caution lest the alcoholic habit be acquired and become permanent. Patients with sudden cardiac dilatation, such as sometimes occurs during convalescence from typhoid fever, need to return to a milk diet.

When acute symptoms of palpitation, dyspnœa, etc., develop, the patient should never eat very much food at one time. It is better to take four or five meals a day, if necessary, and eat only small quantities. A large meal always distends the stomach considerably for several hours, causing this organ to elevate the diaphragm and displace somewhat the heart, which lies upon it, and diminishing the vertical diameter of the chest. The heart may become irritated by the mechanical pressure to which it is subjected by a moderate degree of displacement, and it is indirectly affected by the greater difficulty of breathing, as well as by reflex irritation from the disordered stomach. All food which is liable to ferment in the stomach, such as sugar and indigestible starches and fats, must be particularly avoided. Gastric catarrh is readily excited and aggravated by coarse or fermenting food. On this account also the use of strong alcohol should be forbidden except in the case of aged and feeble persons, to whom light wine or diluted spirits may be given. The regular use of tobacco should be prohibited, and tea and coffee, if permissible, are to be taken only in very dilute form. The tendency to constipation can be overcome by attention to diet, and a moderate amount of fruit, such as baked or stewed apples, stewed prunes, and grape fruit, may be allowed between meals.

CARDIAC VALVULAR DISEASE IN CHILDREN

Children who have chronic valvular disease or enlargement of the heart, but who are not strictly confined to bed, should be closely supervised in regard to their habits of eating. They should eat slowly and moderately, and have their meals at regular intervals, taking the principal meal at noon, and a light supper two hours before bedtime. In general, animal food is better for them than vegetables, but they may eat the lighter fresh vegetables, such as spinach, tomatoes, or stewed celery in season, and sometimes a little roast or mashed potato. Rice and macaroni may be given. Bread should be only eaten dry or toasted. Sweets should not be allowed, except very rarely, when a taste of jam or preserves may be given. Such substances are apt to cause flatulency and palpitation, if not more serious disturbances, and everything depends upon saving the heart from excitation or strain. All food should be very simply cooked, and too great variety is harmful.

In acute endocarditis it is very important to avoid all food likely to cause dyspepsia. Raw eggs with brandy, broths, and chiefly milk must be prescribed, and if the stomach is weak and irritable, a part of the nutriment may be given per rectum (p. 414).

DIETETIC TREATMENT OF THE SENILE HEART

In persons past middle life the heart may become enfeebled from a variety of causes independent of inflammatory conditions or valvular lesions. Fatty degeneration is a very common cause of such weakness, and in other cases the heart muscle may gradually lose its normal strength and "tone" from strain, or a disturbance of balance between its power and the peripheral resistance to be overcome. In the aged the arterial walls become less and less resilient, if not actually rigid, from fibrosis or calcareous deposit, and, moreover, the heart suffers no less than other organs from impaired nutrition. In such cases the prolongation of the patient's life as well as the maintenance of his comfort may be fostered by attention to dietetics.

A weak heart implies impaired circulation in the gastric vessels, and hence the gastric juice becomes poor in quality and lessened in quantity. Digestion is consequently retarded, and absorption of food products is less active than it should be. The heart and the stomach being both supplied by branches of the vagus nerve, it is easy to understand how gastric irritation, caused by products of malfermentation, organic acids, accumulated undigested food, or gaseous distention, may affect the heart through reflex action. Mechanically, too, a stomach distended by gas presses upon and irritates the heart. Balfour (The Senile Heart) says: "If the heart is weak the discomfort induced by such irregularities is after middle life more apt to be felt in connection with that organ than in the stomach itself." The result is intermission in the pulse rate, unevenness in force and frequency of the heart beat, its "fluttering" action, and sensations of palpitation, præcordial distress, fulness or constriction, and dyspnœa. In order to avoid these symptoms as far as possible, the patient must have his diet carefully supervised. A sufficient interval—fully five hours—must always elapse for the complete digestion of one meal before a second is taken, and because the gastric juice is feeble it is best not to allow more than four or five ounces of fluid of any kind to be taken with the meals. While sufficient variety of food may be allowed to maintain a fair appetite, it should never be so great as to entice the patient to eat too freely.

Balfour summarises excellent rules for dieting to be followed by patients whose cardiac action is enfeebled by any cause, but especially for the condition described as "the senile heart."

Balfour's Rules for dieting for Weak Hearts

"1. There must never be less than five-hour intervals between meals.

"2. No solid food is ever to be taken between meals.

"3. All those with weak hearts should have their principal meal in the middle of the day.

"4. All those with weak hearts should have their food as dry as possible."

A good typical *menu* is given by the writer above quoted:

Balfour's Diet for the Senile Heart

"*Breakfast*, 8.30 A. M.—Dry toast, one small piece—one or one and a half ounce—with butter; one soft, boiled egg, a small piece of whitefish; three to five ounces of tea or coffee with cream and sugar, or an infusion of cocoa nibs, or milk and hot water, or cream and Seltzer. Sometimes oatmeal porridge is permissible, but not over three or four ounces should be taken.

"*Principal Meal*, 1.30 *or* 2 P. M.—Fish, such as haddock or sole, or meat and pudding. Two courses only are allowed. No soups, pickles, pastry, or cheese. Whitefish and short-fibred meat only are allowable. The fish may be boiled in milk. A little spinach or one potato may sometimes be eaten, or a half pound of fruit, such as pears, apples, or grapes. Four to five ounces of hot water may be drunk with each meal, but no more.

"5 *to* 6 P. M.—Three to four ounces of tea (one teacupful) infused for four minutes may be drunk, but absolutely no solid food is to be taken with it. If desirable, a teaspoonful of Liebig's extract of meat may be stirred in with the tea.

"*Supper*, 7 P. M.—Whitefish and a potato or toast and pudding, or milk pudding, or bread and milk, or revalenta made with milk or Liebig's extract.

"*Bedtime*.—Four to five ounces of very hot water, sipped, helps the patient to fall asleep."

Upon this very limited regimen the patient, if heavy and waterlogged, at first loses weight by absorption of "œdematous soakage," or if much wasted he may gain in weight. In this manner the natural equilibrium of the body is re-established.

In not too critical cases a little more latitude is permitted, and such vegetables may be occasionally eaten as asparagus, onions, leeks, tomatoes, lettuce, cress. The heavier, coarser vegetables (like cabbage, sprouts, turnips, parsnips, carrots, beets, legumes), pastry, nuts, dried fruits, and sweets of all kinds are forbidden.

Equal care mut be given to the selection of proper beverages. If there is much palpitation, tea, coffee, and chocolate must be proscribed. In many cases Balfour allows a little weak tea, made by infusing a teaspoonful (about one hundred grains) in four or five ounces of water for only three or four minutes. Alcathrepta may be drunk. The two latter beverages may be taken at 5 P. M. or on retiring, when the stomach is empty. They must not be made too sweet.

No champagne or effervescing drinks are allowed, and all alcoholic beverages should be given only in moderation. If more than two ounces (a claret-glassful) of one of the stronger wines is taken, it excites acid dyspepsia, and claret, Burgundy, or hock should not be allowed in greater measure. A small glass of port or sherry may be drunk twice a day; but, as Balfour observes, there is so much idiosyncrasy in the digestibility of wines that in general plain liquor is better for these cases and in the small quantity recommended in the *menu* given above. Alcohol is by no means a necessity, and many patients are better without any. He has great faith in the stimulating properties of hot water, slowly sipped, and says: "This will be found to have quite as good an immediate effect upon the heart as alcohol."

It has been elsewhere shown that the frequent acts of deglutition performed in sipping any fluid tend to increase the pulse rate slightly through reflex stimulation of the vagus branches which are concerned in the act.

As the heart becomes more and more feeble, the inactive circulation, perhaps aided by alteration in the composition of the blood or by albuminuria, results in the production of localised œdema or general anasarca.

In referring to the use of dry diet for these conditions as occurring in connection with the senile heart, Balfour says: "When there is anasarca, or any evidence of soakage in any dependent part of the body, it is of the greatest importance to place the patient, for a time at least, on the driest possible diet, and not too much of it. . . . I have seen a considerable amount of œdema of the lower limbs disappear within twenty-four hours before there had been time for any change in the heart, which was feeble and dilated." His dry diet is as follows:

Breakfast.—A single slice of dry toast, without butter. A cup of tea (infused only four minutes).

Dinner.—Two lean chops, or their equivalent in chicken or fish. No vegetables. Dry toast *ad libitum*. Half an ounce of brandy, whisky, or Hollands in three ounces of water.

Supper.—As much dry toast as desired. Half an ounce of liquor, as at dinner.

Nothing else is allowed; but if the patient is thirsty, very hot water may be sipped between meals. This, Balfour maintains, is an excellent cardiac tonic.

ANGINA PECTORIS

The only indication to be met in the dietetic treatment of angina pectoris is to reduce the arterial tension. A vegetable diet with restricted fluids, and no alcohol, is to be recommended. These patients often are subjects of the gouty diathesis, and the directions for diet in that condition are to be observed. (See Gout.)

CARDIAC PALPITATION

The dietetic treatment of cardiac palpitation is sufficiently indicated under the heading of Flatulent Dyspepsia. Overeating should be avoided, as well as all stimulating foods and beverages. Tea, coffee, and tobacco should be forbidden—at least temporarily. Effervescing drinks of all kinds, from their tendency to produce flatulency, should also be proscribed, as well as all sweets and much starchy food. Laxative foods, especially fruits, will be found useful, for the reason that the primary cause of functional palpitation is often to be found in autointoxication from intestinal indigestion or an overtaxed liver.

ARTERIO-SCLEROSIS

The ætiology of arterio-sclerosis is varied. In many cases it is traceable to toxæmias, as lead poisoning, gout, chronic alcoholism, or syphilis. In other cases it accompanies autointoxication from deficient elimination of waste, as in chronic interstitial nephritis. In a very large number of cases it appears to be the result of severe mental or physical strain. In my wards in Bellevue Hospital, filled with representatives of the hardest working labouring classes—longshoremen, diggers, foundrymen, truckmen, etc.—it is the exception to find a man past thirty-five years of age who does not present an advanced grade of it. There is some doubt as to the influence of diet as a causative factor, but it is probably at least a contributing factor, and the results of dietetic treatment are often beneficial. The question of fluid restriction must be decided upon the merit of each case, rather than by rule. Much fluid taken into an empty stomach, being promptly absorbed, tends to raise arterial tension and tax a heart already working against greatly increased arterial resistance, thereby accelerating cardiac hypertrophy. In cases complicated with cardiac dilatation or myocarditis, it is desirable to restrict fluids as much as possible in order to lessen the weight of fluid that an enfeebled heart, already working against great arterial resistance, is obliged to pump through the circulation. On the other hand, too little fluid ingested lessens renal activity and the excretion of waste, and should be avoided whenever interstitial nephritis or renal inadequacy exists. Tobacco should be much restricted, and fried foods, much fat, and any indigestible foods should be prohibited.

The dietetic treatment of arterio-sclerosis should be substantially the same as that of lithæmia, with such common-sense modifications as the patient's social position may dictate. It is futile to tell a day laborer to lie down and rest before or after his meals, but it is possible to keep his elimination of waste products active through catharsis and diuresis, and to regulate his diet, while it may be possible to induce him to drink water occasionally, in lieu of poor beer and worse whisky.

In those cases in which renal inadequacy is a pronounced feature it will be well to put the patient upon a milk diet for several weeks. In general a non-stimulating diet is requisite, with a minimum of butcher's meat, and no strong condiments, richly cooked dishes, or alcohol should be allowed. If too much red meat be eaten the extractives irritate the vascular system and increase arterial tension. According to Pabst, although white meats contain less proteid than red, they are alike in the quantity of extractives present, hence a diet largely vegetarian is to be recommended in this condition.

ANEURISM

In aneurism of the larger arteries the vessel wall is dilated and thinned, and rupture is liable to occur at any time from increase of the blood pressure or obstruction to the circulation produced by sudden movement, or otherwise. The most favourable result of treatment which can be anticipated is thickening of the diseased vessel by the deposit of coagulated fibrin from the blood. The coagulability of the blood varies with its composition, and is favoured by increased density of the blood and by structural changes in its albuminous ingredients. To a limited extent this process can be aided by diet. The feeding of patients with gelatine has been recommended, on the ground that gelatine increases the firmness of clotted blood, but it is so altered in the process of digestion and absorption as to be of no practical value for aneurism.

The real object to be attained in the dietetic treatment of aneurism is to reduce the volume, and consequently increase the density of the blood. The latter does not necessarily increase its coagulability, however. This method of treatment was originally formulated by Bellingham and Joliffe Tufnell, of Dublin, and it is now described by the latter's name. It is only less rigid than the very old method of Valsalva, who gave half a pound of pudding morning and evening, and nothing else—practical starvation! In conjunction with the dietetic treatment absolute rest of the patient is enjoined; he should lie horizontally in his bed, and not be permitted to make exertion of any kind, and mental strain and emotion should be carefully guarded against. He should be fed by a nurse, and not allowed to sit up at any time. By rest alone the rate of the heart beat is materially slowed, and this is favoured also by the reduced diet. The artery, in consequence, is distended less and less often and is submitted to less pressure. The exact treatment recommended by Tufnell is as follows:

Tufnell's Diet

Breakfast.—Two ounces of bread with a little butter and two ounces of milk.

Dinner.—From two to three ounces of meat without salt and four ounces of milk; for a portion of the milk an ounce or two of claret may be substituted.

Supper.—The same as the breakfast.

This extremely rigid diet is apt to be rebelled against by most patients, but it serves as a basis for the commencement of other treatment, and if it be found impracticable to adhere to it, the quantity of food will have to be slightly increased. It may be necessary to double the quantity of milk and increase the amount of bread or vary it with crackers or some light form of starchy diet. The fluid, however, is in all cases to be restricted as much as possible. Patients usually complain bitterly of thirst, and while it is more desirable to restrict the fluids than the solids in the dietary, the thirst may be alleviated somewhat by the use of acidulated drinks, such as sour lemonade, dilute phosphoric acid in cinnamon water, etc. The danger which menaces the patient and the object of his treatment should be clearly explained to him and his co-operation secured in the effort for his relief. It is customary to employ iodide of potassium and morphine in moderation for their sedative action upon the circulation and the system generally. Many cases are of syphilitic origin, and they are particularly benefited by the potassium iodide. Upon this reduced diet improvement in physical signs of the aneurism—such as diminished pulsation and intensity of bruit and lessened pain—is occasionally quite decided. In favourable cases improvement may be looked for at the end of a week, and if the dietetic treatment is persisted in for six weeks, the benefit may be considerable. Tufnell himself reports several cases in which the aneurismal sac became lined with a thick coating of fibrin.

There are many cases of aneurism outside the province of surgical treatment which are incapable of relief from any diet, but the method above described is decidedly worth a trial in an otherwise hopeless condition. I have several times known it to produce considerable lessening of pain, dyspnœa, and other symptoms, but it requires firmness and perseverance to carry it out successfully. The curative results have, unfortunately, not verified Tufnell's original claims, and as pointed out by Loomis, if the method is too rigidly and too long enforced—for six or eight weeks—an extreme degree of anæmia may develop and leave the patient worse off than before.

If the Tufnell diet is not prescribed, non-stimulating food only should be allowed, consisting chiefly of simply cooked fresh vegetables and fruits, with but little meat. Anything likely to produce flatulency or gastric dyspepsia should be carefully avoided, and strong alcohol must be forbidden.

Anæmia—Chlorosis

Pathological Physiology.—The proper nutrition of all the tissues of the body is directly dependent upon the quality of the blood plasma and of the amount of oxygen conveyed by the corpuscles. A very slight departure from the average composition of these elements will sooner or later result in diminishing the nutrition and functional activity of all the organs in the body, notably those of the digestive system.

Anæmia, whether acute and due to hæmorrhage or disease, or chronic from any cause, by depleting the cellular elements of the blood, interferes with the proper oxidation of food after absorption. On the other hand, a diet which is insufficient in amount or inappropriate in quality, if long continued, is certain to produce an impoverished condition of the blood with a diminution in the number of corpuscles; hence there is a double relation existing between the power of the blood to insure complete absorption and metabolism, and of the food itself to maintain the normal balance of the ingredients of the blood. Anæmia, therefore, demands special feeding, the basis of which should be an effort to restore as soon as possible the proper number of red corpuscles and the normal quantity of other ingredients of the blood by a diet which is nutritious and abundantly rich in nitrogenous food given in some easily assimilable form. When proteid food is excluded from the diet for some weeks the hæmoglobin of the red blood corpuscles is considerably reduced in amount and hydræmia ensues, but the pigment is always increased by an excess of nitrogenous food.

Anæmia and chlorosis are most common at the age of puberty, and immediately thereafter, among young girls who are growing or who are overworked at school or in factories while beginning menstruation, and who are improperly fed. The diversion of considerable nervous energy for other functions than those of the circulation at this time may interfere somewhat with the nervous mechanism of digestion and absorption. In other cases there is a constitutional or hereditary weakness of the digestive system, which is aggravated by an exceptional strain or overwork of the nervous system. The phenomena of growth and development of the different organs necessitates the consumption of a relatively larger quantity of good food than is needed later in life for merely maintaining the equilibrium of the tissues and restoring the balance of material used in the production of energy. Growth implies the building up of new material and a renewal of the old as well. At the period of growth, therefore, there are always unusual demands upon the nervous system, and overstrain at this time is to be especially guarded against.

Symptoms.—Among the many symptoms referable to the nervous system which occur in the course of protracted anæmia are languor, vertigo, various forms of neuralgia and megrim, with indefinite muscular pains, which to some extent are produced by enfeebled circulation, which allows waste material produced by muscular action to accumulate in the tissues. Depression of spirits and drowsiness are also observed, and palpitation is easily excited. The poor circulation may result in the production of fainting, or of œdema in the lower extremities. In advanced anæmia it is found that not only is the normal rate of tissue metabolism impaired, but there may be modifications in the relative consumption of certain foods by the tissues. A large excess of urea is commonly observed, which indicates an active combustion of nitrogenous substances. The view is widely held that owing to the small number of the red disks, or oxygen carriers, the final oxidation of fatty matter is retarded, and it is for this reason that anæmic subjects very often appear plump or even corpulent from the deposition of a large amount of fat derived from incomplete combustion of fats and starches, whereas their muscles, from the increased nitrogenous waste, are reduced in size and are weak. Van Noorden, Kraus, Bohland, and others dissent from this argument and believe that chlorotic patients feel tired, sleep long, and are disinclined to expend energy in muscular exertion, and less energy than usual goes into heat production, and as they sometimes eat abundantly of sugars and starches, they necessarily store up fat.

Rest, Exercise, and Air.—In many cases of extreme anæmia, found especially among young chlorotic girls, the dietetic treatment must be accompanied by careful regulation of all hygienic conditions. Sufficient rest for the tissues, and especially for the digestive organs, must be secured. These patients, who appear so well nourished, may in reality be quite feeble, and it is a great mistake to compel them to rise early and perform tasks and indulge in exercises of the same character and degree with those of healthy children. For many patients it is well to insist on prolonged and continuous rest in bed. For others it will suffice to restrict the activities of the day by permitting the patient to rise shortly before noon, and to insist upon rest being taken on a lounge both before and after meals in order to secure more perfect digestion. These patients must be cautioned against allowing themselves to become unduly fatigued. They are often able, under the influence of stimulants and excitement of various sorts, to perform feats of exercise or endurance which are equal to those of healthy persons, but a strong reaction is certain to follow, and a steady but slow progress will often be checked for several weeks by infringement of necessary regulations. In such cases, however, as soon as decided improvement is evident, and in all the milder cases, it is desirable to enforce rules for *gentle* exercise in the open air, and the patient should be outdoors nearly all the time whenever the weather permits. The exercise should be supervised and slowly increased in stout subjects, so that they gradually consume their superfluous fat. If the climate is unfavourable the cure will be much more rapid if the patient can be moved to a more salubrious locality. Fresh air is more important than exercise, for an abundant oxygen supply increases the appetite and distinctly favours the assimilation of the food.

Dietetic Treatment.—The dietetic treatment of anæmia requires, in the first place, that the most nutritious food should be supplied; secondly, care must be taken to insure its complete digestion and absorption. In all cases of anæmia the impoverished and watery condition of the blood reacts unfavourably upon the character of the digestive secretions and diminishes their organic elements. The secretions are therefore unable to digest the food with the necessary vigour, and it is often desirable to re-enforce them by the use of artificially prepared ferments or to give predigested food, making use of pancreatin, in the preparation of animal food, and diastase or malt extracts for the predigestion of amylaceous food (see pp. 358, 359).

At the commencement of treatment rest and a small amount of food may be required, but with improvement of the digestive organs the quantity of food must be rapidly increased, and four or five meals a day may be given. At first, if milk is well borne by the enfeebled digestive system, and if it is not distasteful to the patient, it should be the principal food. It may be drunk between meals, and especially at night on going to bed. Some of these patients who cannot digest milk with facility are able to take a mixture of equal parts of cream and hot water with ten grains of bicarbonate of soda and a teaspoonful of brandy to the tumbler (Yeo). Eggs in all forms which are of fairly easy digestion are an excellent food for anæmic subjects, and rare meat should be given in considerable quantities two or three times a day. Sandwiches made with pounded meat or beefsteak almost raw, which is placed between thin slices of bread and butter, may be taken with meals, or as a light lunch in the middle of the morning and afternoon. Inserting a crisp lettuce leaf in each sandwich makes it still more palatable and wholesome. Patients of this class often object very strongly to eating meat, and prefer pastry and sweets, but with tact and persuasion they can usually be induced to take it in some form. Meat broths and *consommés* may be thickened with scraped meat, or raw scraped beef may be added to chocolate or Burgundy, or may be eaten in any manner agreeable to the patient. In this way large quantities of meat in an easily digestible form may be taken without tiring of it, as fat anæmic women are very apt to do. Young chlorotic girls should receive at least five or six ounces of albumin per diem. Sée gives as much as fourteen ounces of raw meat daily in some cases of chlorosis, and finds it especially serviceable for those patients whose weak stomachs rebel against the use of the different preparations of iron.

Anæmic patients often feel worse during the first half of the day. They then complain most of headache, languor, and anorexia, but they should be encouraged to begin the day early with nourishing albuminous food to counteract this condition. Van Noorden's system at the Berlin Charité is excellent, and he describes it as follows:

"I recommend chlorotic girls to drink slowly half a litre of milk of the best quality while they are yet in bed in the morning. They must take time, and occupy at least a quarter of an hour in consuming this quantity. They ought to rise half an hour later, and they should be rubbed briefly with a dry rough woollen towel. This is to be followed by the breakfast, consisting of a small cup of tea, one or two slices of buttered toast, and plenty of meat. I consider it extremely desirable—the physiological reasons for this are easy to defend—that these patients should take in at breakfast, before the daily work commences, as much albumin as possible. Two and a half hours later some bread and butter and two eggs are to be eaten, followed immediately afterwards by drinking a quarter of a litre of milk. If considered advisable for special reasons, a small glass of sherry is now permissible."

If the large quantities of meat recommended are not perfectly digested and absorbed, it is well to prescribe some preparation of pepsin with dilute hydrochloric acid. A concentrated meat diet almost always produces constipation if this condition does not already exist as a result of the anæmic and atonic condition of the intestinal wall, or the giving of iron. It is well to counteract this tendency by the use of draughts of hot water and of *purées* of fresh vegetables, whole-meal bread, oatmeal, and such fruits as stewed prunes, apples, and the juice of oranges and grape fruit. (See Constipation.)

The various Italian pastes, such as macaroni, vermicelli, and polenta, with meat gravies, are suggested by Yeo. But with those patients in whom there is a tendency to overproduction of fat, withholding of hydrocarbons from the diet is highly desirable.

For others who, besides being anæmic, are thin and poorly nourished, it is well to add some simple forms of starchy food and a good deal of fat with the meals. Van Noorden says:

"For a well-nourished, moderately fat, chlorotic girl, weighing sixty kilos, I would consider the following diet as eminently suitable:

"120	grammes	albumin	=	492 calories.
60	"	fat	=	558 "
270	"	carbohydrates	=	1,110 "
		Total..................		2,160 "

(i. e., 36 calories per kilo of body weight.)"

The eating of fats is to be encouraged to the limit of toleration. Cream and large quantities of butter are recommended when easily digested, and they can be made to replace cod-liver oil when the patient is unable to take this form of fat. Many patients can digest broiled fat bacon with ease. Two or three eggs beaten with boiling water or milk, with the addition of sugar and spices and a tablespoonful of brandy or sherry, make a useful form of eggnog, which can be given two or three times during the day between meals.

The use of glycerin extracts and of emulsions of bone marrow has been advocated for anæmia, but the results have not been markedly satisfactory. The method of preparation of the marrow is described on p. 199.

The condition most improved is chlorosis, but it is claimed that some cases of pernicious anæmia have been helped.

Most anæmic patients have no appetite, or lose it, during the early part of the day, and careful attention should therefore be given to making all their food as agreeable to them as possible in taste and manner of serving. Meat should be prepared so as to require the least possible effort in mastication, and much more food can be consumed in a fluid and semisolid form.

Condiments are serviceable, for they render simple food more agreeable and stimulate the enfeebled gastric secretion. Moleschott insists on the free use of salt by chlorotic patients on account of its supposed favourable action in restoring the blood corpuscles and plasma. Vinegar, pickles, gravies, and sauces should be avoided.

Alcohol is not indicated for all, but there are some patients who are benefited by its use, and the best form of alcoholic tonic for an anæmic patient is a good rich claret, Burgundy, or Madeira. Some of the milder cases, especially in women in whom the digestive organs are not particularly disturbed, do very well on porter or stout, or one of the various malt preparations, which may be taken with the noonday meal or at bedtime with a few crackers or a raw-beef sandwich. The latter is a prescription very serviceable in those cases in which insomnia is a harassing symptom. There is no apparent connection whatever between the absorption of alcohol and the formation of new blood cells, although there is a popular idea to the effect that red wine produces red blood. Alcohol, however, often does promote the accumulation of fat, and this is most undesirable in anæmic subjects who already possess that tendency.

PERNICIOUS ANÆMIA

Hunter argues for the use of an exclusively farinaceous diet for pernicious anæmia, on the ground that in health a proteid diet causes more extensive destruction of the corpuscular elements of the blood than a farinaceous one, and in this disease, on account of putrefaction in the intestine, the blood destruction is increased by nitrogenous diet. This theory is in opposition to all others, and the most satisfactory and rational treatment consists in giving predigested milk, eggs, beef broth and juice, etc., in as large quantities as both stomach and rectum will absorb.

There is defective assimilation of proteid foods, and hence they should be thoroughly predigested (see p. 113).

DIET IN DISEASES OF THE URINARY SYSTEM

Modifications in the Urine caused by Food

The quantity as well as the composition of the food eaten exercises an important influence over the composition of the urine. Animal food increases the acidity of the urine and naturally also its nitrogenous elements, urea, uric acid, and urates, and vegetable food increases the carbonates and earthy salts. A concentrated diet restricted in fluids as well as solids reduces the water of the urine, and makes it relatively more acid, although the absolute quantity of acid may not be increased. Conversely, watery foods, milk, succulent fruits and vegetables, and all beverages increase the quantity of urinary fluid and tend thereby to lessen its acidity and density. Cantani dissents from the common view that the organic acids, such as fruit acids, form carbonates which promote alkalinity of the urine, and says that this is true of small quantities, but that larger amounts or the continued administration of these acids makes the urine strongly acid. Phosphaturia or the excessive deposit of phosphates in the urine is best treated dietetically by the use of meats, eggs, cheese, cereals, and legumes. Potatoes, fresh green vegetables, and fruits should be avoided.

A diet rich in fatty food, or an excess of cod-liver oil, may sometimes give rise to fat in the urine, or lipuria. The volatile fatty acids may similarly be present. The presence of the fat makes the urine somewhat turbid, and oil globules and fat crystals may sometimes be seen under the microscope.

A milk diet makes the urine alkaline, and increases the indican.

Foods producing oxaluria are described under Oxaluria.

The odour of asparagus in the urine is explained on p. 175.

Acute Nephritis

Symptoms.—Acute nephritis is an inflammation of the kidneys, which is principally caused by exposure to cold and wet, by certain medicinal poisons, or by the toxins developed in the course of acute infectious fevers, especially the exanthemata and diphtheria. It is unnecessary to discuss its varieties here, as the dietetic treatment is the same for all.

Among the important symptoms are anæmia and a scanty secretion of urine containing abundant albumin with casts and blood. Anasarca and effusion into various serous cavities, such as those of the pleura and peritonæum, may occur. The arterial tension is increased. The patient must be kept in bed to insure a uniform temperature of the body, and facilitate the use of measures to promote perspiration.

Dietetic Treatment.—The dietetic treatment must be adapted to prevent overloading the digestive organs, which are easily deranged, and to prevent overworking the kidneys. A light diet is therefore necessary. The patient will do best to live exclusively upon milk for some days, until the functional activity of the kidneys is restored. The importance of this should be explained to him and insisted upon. Between four and seven pints are to be taken daily, diluted with Vichy or carbonic-acid water. If the bowels are loose, lime water may be added instead; or if constipated, magnesia solution. If the liver seems inactive, skimmed milk or buttermilk may agree better. Milk sometimes causes gastric oppression. If sipped slowly, or taken with a teaspoon, this may be overcome, for it is then diluted with the saliva.

If milk is strenuously objected to or actually disagrees with the patient, other simple foods may be allowed, such as koumiss, buttermilk, and gruels of oatmeal, groats, rice, barley flour, or arrowroot. These forms of starchy food should be prepared without much sugar, but a little cream may be added or, if preferred, the juice of a lemon, but no vegetables are permitted. If the patient is feeble, strong beef tea or beef or chicken broth are sometimes to be recommended, but, in general, so long as the symptoms are at all acute it is necessary to withhold all meat preparations from the diet. This is especially true in the case of young children. Animal broths dissolve substances from meat which may develop into toxins and irritate the kidneys.

When the kidneys become more active and the character of the urine improves, the diet may be increased by such articles as bread and butter, plain puddings, lettuce, or water cress with plain French dressing, stewed apples, grapes, oranges, etc., but whenever possible the food should consist largely of milk for a long period. Later, eggs and even meat broths may be allowed, and finally a little white meat of poultry.

Any return of the albuminuria should be immediately met by a reduction in the diet to its original simplicity—chiefly milk.

A patient may lose thirty or forty grains of albumin in twenty-four hours without serious harm, but if three hundred to four hundred grains are lost the condition is in itself alarming, for he is losing from one fifth to one fourth of his total albuminous food through leakage of the kidneys—i. e., he is passing daily in the urine one twelfth of the nutrient matter of his blood (Granger Stewart). A pint of milk supplies about an ounce of albumin and casein, thus replenishing the waste.

The lactose of milk is sometimes given separately for its diuretic action. Sée gives it up to three ounces in twenty-four hours, to be drunk in two quarts of water, and he believes it acts best when cardiac dropsy is also present and the quantity of albumin is not large. I have found it difficult to push its use to such a degree without causing dyspepsia and a decided dislike for it. Milk is undoubtedly a good mild excitant of renal activity, but this is due to its water as much as to any other ingredient, and the diuretic effect of lactose is much overrated.

Should vomiting occur at any time, the diet must be again reduced, or it may be advisable to give the stomach complete rest for ten or twelve hours. To increase the activity of the skin and wash the casts and *débris* of granular matter and blood corpuscles from the renal tubules, the blood volume must be raised by the ingestion of abundant fluid, provided the tendency to dropsical effusions is not great. Water, alkaline, mineral, or effervescing waters, soda lemonade, or cream-of-tartar lemonade should be drunk freely, the latter especially if there is constipation (Dickinson). Osler recommends the following: A drachm of cream of tartar in a pint of boiling water with the addition of the juice of half a lemon and a little sugar. To be drunk cold.

It is a general rule to exclude all foods and drinks which may in any way irritate the kidneys, and the following are especially forbidden: Grills, roasts, sauces, pastry, spices, very acid foods, strong alcoholic drinks, tea and coffee. Strong wines, sweet wines, and all sorts of liquors are absolutely prohibited. If alcohol seems necessary for the stimulation of the heart, a little weak claret, white wine, or diluted whisky and some effervescing water may be given.

ACUTE NEPHRITIS IN CHILDREN

When the disease occurs in children, as often happens during or after acute infectious diseases, such as scarlatina and diphtheria, the diet must consist wholly of milk. During the most acute stage of nephritis the milk may be diluted one half with Vichy or water for its diuretic influence. It should be given in moderation, but often—say at least once in two hours. As the acute symptoms subside milk is to be ordered in full strength.

Gradually other articles may be added, such as crackers, toast, porridge, rice pudding, cornstarch, junket, and blancmange. Orange juice may be taken freely, and an occasional baked apple with cream or a few stewed prunes will act favourably upon the bowels.

It is best, as in the case of adults, to forbid meat broths, and eggs and meat in any form must be withheld for three or four weeks after the urine has regained its normal composition. Subsequently a *menu* may be composed from such articles as a chop, the breast of a chicken or partridge, a little broiled whitefish, a poached egg, oysters, custard, a baked mealy potato with fresh butter, stale bread, wine jelly, and fresh ripe fruits.

ALBUMINURIA—FUNCTIONAL ALBUMINURIA

Pathological Physiology.—Albuminuria may be produced by alterations in the composition of the blood and by structural or functional changes in the kidney itself, or by both. The albumin is derived from the blood serum, which in turn comes from the protein of the food. Under ordinary circumstances proteid matter in passing through the body undergoes several transformations which affect its degree of solubility and its ability to osmose or go through animal membranes such as line the alimentary canal, the blood vessels, and the tubules of the kidney. Most protein taken into the body as food is not readily absorbed until converted into some form of peptone or albumose. These substances diffuse very easily, and their presence in the blood would render them liable to constant osmosis from the vessels into the lymph spaces or tissues almost immediately after absorption, but in their transit through the intestinal villi they are reconverted into serum albumin, which does not osmose easily, and which therefore remains in the vascular system. A certain amount of albuminous material, however, must pass by osmosis from the blood vessels into the lymphatic channels, and thence into the tissues which surround them or which they penetrate. For serum albumin to pass into the urine it must osmose through two layers of cells—namely, the capillary wall of the blood vessel and the epithelial lining of the tubules of the kidney. Variations in the density of these walls, and probably also alterations in the functional activity of the epithelial cells which compose them, will modify the rate of osmosis so that it may be completely checked, or it may be allowed to take place unhindered. The conditions of osmosis also depend upon the relative density of the fluids on either side of the membrane, hence alterations in the composition of the blood plasma may allow of the osmosis of serum albumin into the tubules of the kidney. It is important to observe that the presence of serum albumin in the urine in excess not only indicates a functional or structural weakness in the kidneys themselves, or in the composition of the blood, but it represents actual loss of substance from the body—i. e., of material which is not yet converted into waste matter, but which is capable of furnishing nutrition to the tissues—in other words, there is a leak of nutrient matter from the kidneys.

From the foregoing statements it might seem feasible to disregard the leakage and increase the amount of nitrogenous food sufficiently to counterbalance the loss sustained. The same plan might theoretically be thought to be of benefit in cases of diabetes, where it would seem quite possible to counterbalance the loss of saccharine material from the kidneys by ingestion of much larger quantities of starches and sugars; but this is a fallacious comparison, for excess of sugar is really a foreign body in the blood, while albumin is not (Granger Stewart). Clinically, however, it has been found that when either of these conditions of loss of substance from the blood exists in the kidneys it is better to withhold as much as possible the particular variety of food which is leaking through them and reduce the work of these organs, hoping by rest, combined with other appropriate means of relief, to cure the faulty condition.

Functional Albuminuria.—Temporary functional albuminuria is now recognised as occurring in many individuals without the significance of any structural or organic lesion of the kidney. This subject has been exhaustively investigated by the medical examiners of life-insurance companies, for it is of great importance not only to discover the presence of albuminuria early, but to assign the proper significance to its presence. It is not many years since the detection of albumin in the urine was regarded as an infallible indication of some form of renal disease, but the fact is now established that errors in diet and faulty assimilation produced by mental and nervous strain, overwork, and worry, and more particularly by the exhaustion of very rapid growth of the body in the later years of childhood and early youth, may occasion albuminuria.

A solution of meat albumin experimentally transfused into the venous circulation of a dog, injected either subcutaneously or into the rectum, reappears unaltered in the urine, but serum albumin similarly injected is retained by the blood and does not cause albuminuria, although the percentage of albumin in the blood plasma has been considerably raised above the normal. Moreover, if a man in health eats eight or ten raw eggs in the course of five or six hours, traces of serum (not egg) albumin may appear in the urine. The matter is of interest in connection with the diet for chronic Bright's disease (p. 505). Albuminuria thus produced is purely temporary, and is directly dependent on the nature of the food. So much of this proteid has been eaten that a portion of it is absorbed directly into the blood without the formation of intermediate products of digestion. Similarly this albumin will osmose through the kidney. But if the digestive activity in the stomach is very great, a large number of raw eggs may be eaten, and as many as nineteen have been taken in thirty-six hours (Dolradin) without the appearance of albuminuria. It is no doubt true in such an instance, as suggested by Yeo, that the vigour of the digestion converts egg albumin into peptones, which finally form serum albumin, whereas with a slower digestion more of the egg albumin is absorbed unaltered.

According to the experiments of Stokvis, coagulated egg albumin cannot be made to reappear in the urine of healthy animals, but raw egg albumin can.

Oertel (Therapeutics of Circulatory Derangements, in von Ziemssen's Handbook of General Therapeutics), as a result of numerous experiments upon man and animals in opposition to the above view, declares that "egg albumin, given in whatever quantity, is not normally excreted as such by the kidneys, and does not cause albuminuria." The albumin absorbed is all destroyed in the blood or tissues and excreted as urea from the kidneys. He further says that "a great increase of albumin supplied to the blood causes no increased excretion of albumin by the kidneys, and, in particular, that egg albumin gives rise to no irritation of the renal vessels and no albuminuria (nor does it increase an existing albuminuria)."

This statement, if corroborated by further observation, would considerably alter the prevailing notions in regard to the advisability of giving eggs to patients with chronic Bright's disease.

Of all the varieties of albuminuria, those which are most amenable to dietetic treatment are the functional form and that which accompanies chronic Bright's disease. The functional albuminuria which is produced by eating an excess of protein or by muscular fatigue, which results in the accumulation of large quantities of nitrogenous waste matter and interference with normal oxidation processes, is usually curable by ascertaining and removing the cause.

It seems to be almost impossible to produce functional albuminuria in the lower animals, such as dogs, by overfeeding them with a very large excess of albuminous food. Voit caused a dog to absorb within twenty-four hours six times the amount of albumin contained in the blood plasma without exciting albuminuria.

In the instance given above of albuminuria caused by eating large numbers of eggs, it was emphasised that the proteid in the urine is egg albumin and not serum albumin. It is stated, however, that occasionally serum albuminuria may be produced in man by eating large quantities of meat. If true, this is certainly very unusual, and this form of albuminuria is by no means as readily induced as the glycosuria caused by an excess of starches in the food. But if albuminuria already exists, certain forms of nitrogenous food will greatly increase the amount eliminated by the kidneys.

It is probable that some persons inherit a special weakness of the kidney structure or an abnormal irritability of the renal cells which favours the occurrence of albuminuria from slight provocation. Granger Stewart (Lectures on Important Symptoms of Albuminuria) states that he has observed in certain persons that cheese, pastry, and eggs are substances capable of producing temporary albuminuria. In one case this symptom was accompanied by œdema of the eyelids.

In regard to the production of functional albuminuria from dietetic errors Yeo argues, and I think correctly, as follows: " May not the true explanation be that the ingestion of so large an excess of albuminous material may throw upon the kidneys such an excess of nitrogenous waste (to be secreted) that a temporary functional hyperæmia of the kidneys is excited, and that this leads to a slight escape of albumin from the blood? It appears to us that this is a sound physiological explanation of what is observed to occur, and accounts for its occurrence in fever or disordered constitution, and not in the perfectly sound and vigorous."

Albuminuria also results from passive hyperæmia of the vessels of the kidney, as well as from active congestion and inflammation.

In functional albuminuria, when traces of serum albumin appear from time to time in the urine, it is found that the amount is proportionately increased by any special fatigue or exhaustion. It is possible, although it is by no means proved, that nerve currents supplying the epithelial cells of the renal tubules or the walls of the renal capillaries may cause a functional alteration in the activity of these cells, which compels them to exercise a selective action upon the albumin of the blood serum, and favours its osmosis. The theory is advanced by Mills, of Montreal, that the epithelium of the capillaries possesses some at least of the functions of glandular epithelium, and that it is capable of controlling and varying the quality as well as the quantity of such substances as may pass through the minute capillary walls.

Albuminuria is very common as a result of elimination of irritant poisons from the kidneys, and it is believed that the albuminuria usually present in diphtheria and the exanthemata is produced by the irritant effect upon the kidneys of toxins developed in these diseases which are being eliminated in the urine.

Dietetic Treatment.—The frequent return of functional albuminuria should be regarded as an indication of special weakness of the kidneys in the same way that frequent glycosuria invites suspicion of the strength of the digestive power of the liver, and it demands a careful regulation of the diet. Meat should be reduced in quantity, or temporarily forbidden, as well as all forms of alcoholic drinks or other substances liable to produce renal irritation, and the diet should consist chiefly of fruits, vegetables, and milk. Careful attention must be paid to increasing the activity of the bowels. When functional albuminuria is observed in children and adolescents, it is not necessary, nor is it advisable in ordinary cases, to wholly exclude nitrogenous food, but it should be restricted, especially in regard to eating butcher's meat and eggs, and the evening meal should be made very simple, consisting of food such as bread, crackers, rice or porridge, and milk.

Chronic Bright's Disease

Causation.—Chronic interstitial nephritis may be of primary origin, or it may occur as a result of arterio-fibrosis and other conditions. It is usually a very slow process, and is often provoked by chronic alcoholism.

Urine of a low specific gravity is passed in greater amount than normal, and thirst is increased. The arterial walls are thickened and their tension is high.

That an exclusive meat diet is not the cause of chronic Bright's disease is proved by the fact that Eskimos and other races, who subsist altogether upon it, are not especially liable to the disease, although in the long sunless winter they live under very bad hygienic conditions. (See the relation of proteid food to albuminuria, p. 501.) It is nevertheless a fact that the disease is very prevalent in this country among men past forty years of age who for years have been overworked with business cares, and who have neglected to take sufficient exercise and care in eating. In the early stages of the disease much may be accomplished by dietetic treatment. Osler says that " care in food and drink is probably the most important element in the treatment of these early cases."

Whatever views may be entertained in regard to the causation of albuminuria, it is agreed by all that cooked meats, eggs, and highly seasoned food in general are injurious in all cases of existing albuminuria. One should be cautioned against regarding the amount of albumin present in the urine from time to time in the course of chronic albuminuria as an exact indication of the extent of the renal disease. The fluctuations observed are often due to diet merely, and the albumin may occasionally be considerably reduced in quantity, or actually absent temporarily from the urine, although the lesion of the kidneys is making uninterrupted progress. The volume of albumin in the urine must not, therefore, be estimated alone as an indication for dietetic treatment; it is merely one of many symptoms incident to the course of chronic Bright's disease which are benefited by a strict regimen.

Extensive disease of the excretory surface of the kidneys always interferes with the normal elimination of nitrogenous waste matter which accumulates in the system until it finally produces toxic or uræmic symptoms of a most serious character. If the alimentary canal is overloaded with food above the actual requirements of nutrition, or beyond the capabilities of the system for oxidising food products, toxic symptoms are sure to follow. For these reasons the diet in chronic Bright's disease must be definitely regulated, and a mean must be maintained between overburdening the digestive apparatus and withholding food which is needed to support the bodily strength. This applies especially to the waste of nitrogenous food, which passes off through the kidneys, whereas the waste of farinaceous food is eliminated largely from the lungs and skin in the form of water and carbonic acid.

Milk Diet.—In many cases of chronic Bright's disease the effect of feeding the patient for six weeks, or even two or three months, upon an exclusive milk diet is remarkably gratifying. The quantity of urine, urea, and extractives increases, while the albumin diminishes, and œdema and general anasarca disappear. The patient's strength and general condition improve, the pulse is strengthened, and if dyspnœa pre-existed it subsides.

The quantity of milk to be prescribed for an exclusive milk diet in Bright's disease must depend on the age and size of the patient, as well as upon his ability to take exercise and use up force in muscular energy. If the patient is invalided so as to be confined to his room or the house, from five to seven pints of milk daily are quite sufficient. Seven pints of milk contain 216 grammes of albumin and casein, 172 grammes of fat, and 161 grammes of lactose; whereas, according to Pettenkofer and Voit, a healthy adult requires 137 grammes of dry albumin, 117 grammes of fat, and 352 grammes of carbohydrates (see p. 290). The milk diet is therefore deficient in carbohydrates, but the latter are estimated in Voit's table for a person taking active exercise, and requiring the development of more muscular energy and heat than the invalid. If the patient loses weight on a milk diet, although it otherwise agrees with him, it may be well to add farinaceous food in the shape of rice or bread. Many patients will live contentedly with no other food than a bowl of bread and milk four or five times a day. In some cases it is inadvisable to commence the milk diet immediately, and a good result can be best attained by cutting off one article of solid food after another and replacing the loss by an additional tumbler of milk. Where it is expected to employ a milk diet for many months, as in an advanced case of Bright's disease, it is usually found that the milk is better borne if taken fresh at a natural temperature and without flavouring of any kind. Although the treatment may seem severe at first, if the patient understands the gravity of the situation he is usually willing to accept it, and after a few days seldom complains of the monotony of this most restricted form of feeding. In the worst cases it is desirable to give the milk at brief intervals, in quantities of six ounces, once an hour during the daytime, with an extra tumblerful at night, and on awakening in the morning. Ordinarily, however, it is tiresome to have to drink milk so often, and the quantity may be so regulated as to give the requisite amount once every three hours. The quantity of milk necessary to support life for any length of time and maintain good nutrition, especially if the patient is exercising at all, is considerable, and he must take from fourteen to eighteen, or even twenty-two six-ounce tumblerfuls of milk in the twenty-four hours. It is usually impossible to commence at this rate without producing gastric disturbance from souring of the milk in the stomach, and possibly diarrhœa. The latter symptom is an almost certain indication that the milk is being imperfectly digested, and a temporary reduction in its quantity is advised.

It is very important to thoroughly cleanse the mouth after drinking the milk, in order to avoid coating of the tongue and the disagreeable taste which destroys the appetite and interferes with the efficacy of the treatment. For a full discussion of this subject the reader is referred to the article on milk diet in typhoid fever (p. 432). Obstinate constipation, which almost invariably results from a long-continued milk diet, must be met by medicinal treatment, or the use of glycerin suppositories or enemata. As a rule, the milder laxatives are the only remedies necessary; a glass of citrate-of-magnesia solution, a half tumblerful of bitter water taken on rising in the morning, a drachm of the compound-licorice powder, or a two-grain pill of extract of cascara sagrada at night, will prove sufficient. There is, however, no objection in most cases to allowing the use of a few stewed prunes or the soft part of two or three baked apples.

It will be observed that whereas the normal average quantity of urine for an adult male is fifty-two ounces for the twenty-four hours, the milk diet under discussion requires the ingestion of upward of one hundred ounces of fluid. This necessitates greatly increased activity of the kidneys, but the polyuria usually results in the removal of the anasarca which frequently exists. The body weight may remain normal, or even be slightly increased on this treatment. It is not infrequently diminished, however, but much depends upon the condition of the patient at the time when the milk diet was inaugurated. The abundant urine is of a pale-yellowish hue, which is somewhat typical of the milk diet. The specific gravity is low, and the reaction may be neutral or faintly acid on account of the great dilution of the fluid. The albumin, which at first may be present in considerable bulk—sufficient when coagulated to almost solidify the contents of the test tube—gradually diminishes, and the urea and salts increase. In mild cases this milk diet should be continued from four to eight weeks, after which a slight variation may be allowed in the shape of farinaceous food, fresh vegetables, and fruit, such as oranges and lemons. In other cases it may be necessary to prolong the treatment for several months, because it will be found that any attempt to materially alter the diet is followed by an increase in the albumin and dropsy, with return of other symptoms. In such patients the lesion of the kidney is far advanced and incurable, and the most that can be hoped for from any treatment is an amelioration of the worst symptoms, and it is found that in many cases this can be best secured by milk diet. For the class of cases in which this treatment is found for any reason to be impracticable, either from the persistent refusal of the patient to take milk or from any other cause, before giving up its use efforts should be made to modify its preparation in various ways, tempting the patient with different flavours and with light farinaceous foods, of which milk forms an important basis, such as bread and rice puddings. A good deal of milk may be taken in very weak coffee or tea, or in the form of soups and *purées* made with celery or potatoes, or gruels may be given, or milk thickened with tapioca, vermicelli, sago, or rice, and flavoured with a little lemon or orange peel, cloves, or allspice. It is not desirable to use much high seasoning for fear of irritating the diseased kidneys.

As the patient improves, the milk diet may be given up, but it should never be too suddenly abandoned. A sudden restriction of fluids in chronic nephritis is always injurious, and their quantity should be regulated by the vascular tension. In adopting any other diet it is a good rule never to let the nitrogenous food bear a greater proportion to the non-nitrogenous than one to four. The former increases the proportion of urea in the urine, the latter reduces it. A purely vegetable diet has often been tried for albuminuriacs, but it causes too pronounced anæmia if its use is persisted in, and a minimum of animal food must therefore be prescribed. Granger Stewart says, in speaking of the very chronic albuminuria of Bright's disease, " In the more advanced stages the diet should be as nutritious as possible, and then certainly fresh meat is by no means injurious." With failing cardiac compensation the heart muscle may give out unless meat be eaten.

When, after a milk diet, the change is to be made to a more liberal *menu*, the hours of taking the milk may be reduced in frequency, and some of the milk may be replaced by boiled fish, chicken, or game, and fresh green vegetables, potatoes, cream, butter, and bacon. Cereal foods may be eaten *ad libitum*, such as hominy, corn bread, oatmeal, sago, tapioca, rice, vermicelli, bread pudding, and macaroni. Cheese may be eaten occasionally. The urine should still be periodically examined, and if it is found that the eating of meat is followed by an increase in the albuminuria the patient must return to the milk diet.

It not rarely happens that strict adherence to a milk diet for several weeks produces more lasting improvement in the action of the kidneys, so that a diet to which steak, roast beef, chops, and eggs are admitted may not only be well borne, but may increase the strength of the patient. This is a matter which obviously cannot be regulated by fixed rules. If the general principles of the treatment are understood, it is within the province of any intelligent physician to apply them to individuals. In cases in which it is found after trying all methods that milk cannot be assimilated in any form, the patient must live upon a carbohydrate diet, consisting of fresh vegetables and fruits, with butter, cream, and olive oil. Dujardin-Beaumetz allows pork and ham to be eaten by those who refuse to relinquish meat entirely.

Senator believes that whenever serious albuminuria is present egg albumen and meat should be withheld, although a little fish or flesh, like that of chicken or veal, may be given if necessary, but he prefers to prescribe only vegetables, salads, and fruits, or an exclusive milk diet of two litres per diem.

Semmola recommends the use of the following drink, which may be mixed with milk, and which possesses a decided diuretic action:

Sodium iodide	15 grains.
Sodium phosphate	30 "
Sodium chloride	90 "
Drinking water	36 ounces.

In general, the patient had better leave alcohol alone, especially in the form of malt liquors. If habituated to its use, a feeling of dulness and drowsiness after a glass of wine is a strong reason for giving it up. An occasional " spree " may do the patient less harm than continued drinking in smaller quantity. For a non-alcoholic subject, if weak and anæmic, as he improves, a little light wine or claret diluted with Seltzer water or Apollinaris may be ordered as a beverage. Tea, coffee, and cocoa are permissible.

The effect of dietetic treatment will be much enhanced by securing systematic outdoor exercise, and freedom from worry and anxiety, and particular attention must be paid to keeping the bowels open, for which laxative fruits may be taken freely. The patient must be cautioned against overeating, and all food must be thoroughly masticated.

PYELITIS

Most cases require abundant fluid, such as alkaline mineral waters, for the purpose of washing out the pelvis of the kidney, and if there is much irritation or painful micturition, it is well for the patient to be put on an exclusive milk diet after the manner described above for treatment of nephritis in the preceding section.

OXALURIA

The condition of oxaluria may be unsuspected by the patient, or it may attract his attention by a sensation of burning in the urethra, desire for frequent micturition, headache, "nervousness," etc.

Causation.—The occasional presence of a trace of calcium oxalate in the urine need not be considered as abnormal, but the continued presence of this substance in excess is mainly caused by eating certain kinds of food and by dyspepsia and perverted nutrition, involving incomplete oxidation in the system of starchy, saccharine, and fatty foods.

Ellis says that "oxalic acid is very readily prepared in the chemical laboratory by the action of reagents upon sugar, starch, and cellulose. This fact would seem to render probable the possibility of its formation from the imperfect oxidation of these substances in the body," especially from bacterial fermentation in the alimentary canal.

Flügge has shown that bacteria can form this acid, and its crystals occur in the intestine and are often found in the fæces. Oxaluria is common in connection with dyspepsia, and it is not altogether improbable that some of it may be derived from imperfect digestion of food in the intestine, and be absorbed into the blood just as ptomaines are.

Cantani finds that oxaluria is frequently present among those who indulge too freely in saccharine and amylaceous foods. Beneke holds quite an opposite theory, and attributes the condition to imperfect metabolism of proteid foods. Even fasting animals may still show traces of calcic oxalate in their urine, and both increased and diminished oxidation have been held accountable for oxaluria.

Vegetables and fruits containing oxalic acid and its salts, and which may cause oxaluria when eaten in excess, are rhubarb, tomatoes, turnips, onions, sorrel, spinach, figs, strawberries, apples, pears. Many other fruits and vegetables contain traces of oxalic acid, but this fact is of little or no dietetic importance. Raw fruits and vegetables which contain citric, malic, and other organic acids seem to bear close relation to the formation of oxalic acid. The latter is not necessarily ingested with the food, but is produced in the body from a variety of substances.

Dietetic Treatment.—The diet should consist of animal food—fish, poultry, game, and meat—with stale bread or toast with a minimum of butter. Tea, coffee, carbonic-acid water, and alcohol should be temporarily forbidden. Hot water (three quarters of a pint) should be sipped half an hour before each meal, and before breakfast a drachm or more of Carlsbad salts may be taken in constipated cases. Dilute mineral acids, hydrochloric or nitro-hydrochloric, are beneficial if taken immediately after meals in doses of fifteen or twenty minims in water.

CALCULI, RENAL AND VESICAL

Beverages.—When the presence of vesical calculus has been demonstrated it becomes important to regulate the diet so as to prevent, if possible, aggravation of the trouble. Not much is to be hoped from the action of any solvents, such as the alkaline waters or lithia salts, upon a large stone already formed, but diuretics may certainly do much to prevent recurrence of the formation by controlling vesical catarrh, and the production of mucus which forms the nucleus, and sometimes a considerable part of many stones. As White observes: "Our object should then be to make the urine as bland and abundant as possible, and for this purpose there is nothing better than milk and the free use of water between meals. The particular kind of water to be used is of minor importance, as the most noted waters in the treatment of stone seem to have purity as their chief recommendation."

The still spring waters, such as Poland, Londonderry, or Bedford, may be prescribed, or the waters of Vichy, Saratoga, or Ems, on the principle that many patients will drink more fluid which bears the name of some reputed "Spring" than they will if it be plain water.

Paget was fond of trying the effect of an exclusive milk diet before advising lithotomy. The milk is soothing, and while it is a good diuretic, it lessens the desire for frequent micturition which is often such an annoying symptom of vesical stone.

The occurrence of vesical calculus in children is believed by Cadge, White, and others to be directly proportional to the difficulty of getting abundant milk. It is therefore much commoner among the children of the poor. White believes that "diet and regimen, at least in cities, have much more to do with the production of stone than heredity, climate, water, soil, etc."

Young infants should not be given lime water indefinitely with their milk.

It is best for adults to relinquish the use of alcoholic stimulants, but if this is not feasible light Rhine wine or still Moselle is admissible, especially if neutralised by some alkaline table water (Yeo). Lager beer is not harmful, and a little dry champagne or a light hock or white wine may be taken. All the heavier clarets, Burgundy and sweet wines of every sort, port, sherry, strong beer, ale, porter, and stout are forbidden. Weak tea and coffee may be drunk. Only such beverages should be allowed as contain no free acids and no sugar, and those having the greatest diuretic effect are the best.

Foods.—All highly seasoned and irritating articles, like vinegar, pickles, strong condiments, such as mustard, should be rigidly forbidden, as well as anything prone to excite acid dyspepsia.

Among patients who have calculi of various kinds a considerable number are at the same time afflicted with obesity. Such persons must be especially abstemious in regard to the use of fats and sugars. Less corpulent persons may be allowed a little more laxity in this regard.

Other substances to be avoided are puddings made with eggs and sugar, and containing rice, sago, or other farinaceous foods, suet puddings, pastry of all kinds, meat fat, and fat pork.

Bread, oatmeal, hominy, cracked wheat, cornmeal bread, custards, blancmange, boiled fish, and eggs are all admissible.

In many cases total abstinence from animal food for a week or ten days is followed by marked improvement, the patient living meanwhile on green vegetables, salads, and cooked fruits which are not too acid, such as apples, not sweetened, but flavoured with some bland aromatic, like cinnamon, nutmeg, or cloves. In other cases it may not be necessary to withhold meat completely, but it should always be taken in moderation, not more than once a day, and it should be rare, lean, and thoroughly masticated. White meat of chicken may be eaten.

The Carlsbad dietary, in which butter and sugar in all forms are rigidly proscribed, is found to benefit calculus cases even more than the total withdrawal of meat.

The above directions apply to the treatment of most varieties of calculi, and not to any one kind alone.

In elderly people, in whom such disorders are relatively common, the functional elimination of waste from the body is considerably impaired. For such persons, as well as for those who live sedentary lives, it is important to abstain from overeating and especially from the use of animal food in excess.

LITHÆMIA—URIC-ACID DIATHESIS—GRAVEL

Symptoms.—Lithæmia is a condition in which the blood contains an excess of uric acid or its salts, and is usually productive of such symptoms as insomnia, vertigo, tinnitus aurium, disagreeable fulness of the head, and general "nervousness." The urine becomes loaded with nitrogenous waste.

When uric acid appears in excess as a sediment in the urine it is very desirable that its formation should be checked, if possible and that any crystals already deposited in the kidneys and bladder should be dissolved and eliminated. If the accumulation continues, the presence of crystals ("gravel") gives rise to attacks of renal or vesical colic, causing intense agonising pain, and often hæmaturia. A majority of the different forms of calculi are composed wholly or in part of uric acid, and they may be formed in any part of the urinary system, which, in addition to the other symptoms, may possibly cause ulceration and inflammation of the mucous membrane or serious obstruction to the outflow of the urine. The exact mode of production of uric acid in the body is still a matter of uncertainty, but it is undoubtedly associated with nitrogenous metabolism. Nucleins are derived by digestion from peculiar nucleo-proteids which are contained chiefly in the thymus gland, liver, and spleen, but also in slight proportion in meat and meat extracts. Nucleins appear to be at least one of the principal sources of uric-acid formation. Tea, coffee, and cocoa are believed to aid in the process of uric-acid formation in some manner in the body, whereas milk, cheese, and eggs do not have that effect. The final destination of uric acid is its conversion into urea, but from lack of perfect oxidation in the tissues this process is checked.

Dietetic Treatment.—The indications for dietetic treatment are clearly, therefore, to reduce the animal foods in amount or temporarily withhold them altogether, while giving large quantities of plain water and of waters containing potassium or lithium salts to aid in dissolving the uric acid already existing in the kidneys or bladder, and promote its conversion into urea and hippuric acid.

Although the acidity of the urine is not caused by uric acid, but by acid sodium phosphate (Na_2PO_4), the deposition of uric acid is accomplished in an acid menstruum, and it is well to reduce the urine temporarily to a neutral or even somewhat alkaline reaction.

Animal food, except milk, tends to make the urine acid, whereas milk and vegetable food favour alkalinity. In speaking of the lithic-acid diathesis in children, Fothergill wrote that "lean meat, raw meat minced, and beef tea are so much poison." Lithæmic headaches will often cease when the patient stops eating butcher's meat, cheese, etc., if excessive indulgence in animal food has been the previous habit. Peptonised food is worse, for the dyspepsia which often accompanies lithæmia is in a way a conservative process, checking the digestion of animal foods, whereas the predigested foods are more promptly and easily carried to the overburdened liver. Some lithæmic patients cannot take meat well in hot weather, but can do so at other seasons. But an excessive meat diet cannot be regarded as the sole cause of lithæmia; other factors are concerned, such as overeating and the abuse of saccharine food, which causes malfermentation, deranges the functions of the liver, and alters the composition of both blood and urine.

Murchison declared that "habitual lithæmia often results from the patient taking more food than can be converted into tissue or disintegrated in the liver," and Sir Henry Thompson expressed his views in regard to sweets thus forcibly: "Sugar, in all its forms, at every meal, and wherever met with, forbid it altogether, . . . let fatty matters, butter, cream, and the fat of meat, whether simply cooked or in combination to form pastry, be taken very sparingly." This is the practice at Carlsbad also, and it reduces the work of the liver and kidneys. For some patients—especially the obese—it is more important than wholly eliminating meat from the regimen.

Murchison, who was among the first to advocate a rational dietetic treatment of habitual lithæmia, forbade all saccharine and oleaginous food, especially "made dishes," and highly seasoned foods, sauces, rich gravies, etc. In severe cases he advised giving up amylaceous foods as well, and forbade the eating of potatoes, rice, sago, fruits, etc., and bread was allowed only in moderation.

Many acids contained in fresh fruits, such as benzoic or quinic acid, have a favourable solvent action. These acids are found in the external cuticle of fresh fruits and vegetables, which may be eaten in cases of gravel. According to Lyman, eating raw, unpeeled apples in considerable quantities supplies potassium salts, which tend to increase the alkalinity of the blood, but sweet fruits, pears, grapes, plums, strawberries, etc., must not be indulged in.

Patients may eat abundantly of oatmeal, wheaten and Graham bread toasted, macaroni, fresh young peas, string beans, Lima beans, rice, spinach, asparagus, celery, lettuce, and other salads, except tomato (without oil). Meat should not be eaten oftener than once a day. Fresh fish, sweetbread, poultry, and game may be taken sparingly. No diet can be rigidly enforced in every case alike. Alexander Haig (Diet and Food) classifies as "uric-acid-free" foods, milk and its products, breadstuffs, cereals and glutens, nuts, vegetables, and fruits.

If lithæmia is present in young children after three or five years of age, they require a larger proportion of fat. They may have bread and butter with a little fat bacon, or a baked potato with butter, and puddings of bread, crackers, rice, or sago, but not of raw flour. They must not be offered sweets. They have poor appetites, and some variety must be prescribed, or they will lose weight and strength.

Some writers are disposed to attach less importance to dietetic errors as influencing lithæmia, and the cooking is far more important than the composition of the food. Reasonable variety, including proteid food, should be allowed, for "lithæmics do best on plenty of well-prepared food in the greatest variety according to the seasons" (L. C. Gray).

Beverages.—Various alkaline mineral waters are constantly prescribed for adults, and patients who can afford to take the course are benefited by the baths of Carlsbad, Vichy, Neuenahr, Ems, etc., but for those to whom travel is an impossibility and whose means do not allow them to purchase artificial mineral waters, very good substitutes are to be made by dissolving sodium carbonate or sodium phosphate in soda water or sour lemonade, or in plain water, in the proportion of from one to two drachms in three or four pints, to be taken in the course of the twenty-four hours, or two to five grains of the carbonate of lithium may be employed in the same way. Effervescent lithium tablets are now sold which may be added to a tumbler of water at the table and taken with meals.

Solution of the deposits, or at least the prevention of their increase, is aided by the free drinking of Londonderry, Buffalo, or other lithia waters, Vichy, Waukesha, etc., although it must be said of most so-called lithia waters that their use is chiefly that of pure water, for a barrelful would have to be drunk to obtain an ordinary medicinal dose of lithium.

Most patients do better without alcohol in any form. They may feel the loss of accustomed stimulation for a few months, but they should make a strong effort to give it up completely. Malt liquors and sweet wines, champagne, and spirits had better be absolutely forbidden, but if necessary, a little good sound claret or Scotch whisky in water may be drunk.

Gravel is much less common among habitual beer drinkers than among those whose daily beverage is wine. This is attributed by Moleschott to the greater acidity and larger proportion of alcohol in the latter. On the contrary, Ebstein holds that beer is not injurious in lithiasis, and tea also has some reputation in checking the deposition of uric acid. Coffee does no harm.

Gonorrhœa

The dietetic treatment of gonorrhœa consists in avoiding all alcohol and stimulating food and drinking bland diluents.

In severe cases, and in cases among young children who have in some manner been infected, a skimmed-milk diet should be ordered at first. Later, light farinaceous articles, stale bread and butter, milk, and rice puddings should be added. Patients, for fear of attracting attention to their ailment, are often unwilling to restrict their meals, but they must avoid acid fruits, all highly seasoned and fried food, condiments, and pastry. Alcoholic drinks in all forms are absolutely prohibited. Malt liquors are especially bad, as they are in all diseases of the urethra, bladder, or prostate. No late meals should be taken. By observing these directions troublesome chordee and ardor urinæ, so apt to appear in the first fortnight, may be prevented. Large quantities of such waters as soda, Seltzer, Apollinaris, and two or three quarts of plain water should be drunk. The fluid dilutes the urine, diminishes the danger of cystitis, and has the additional advantage of decreasing the appetite.

DIET IN DISEASES OF THE ALIMENTARY CANAL

Diet in Abnormal Dentition

In abnormal dentition in children the food is imperfectly masticated, and gastric dyspepsia or gastric catarrh may follow. If dentition is delayed and the teeth are imperfect, as in the case of rickets, scrofula, tuberculosis, or any protracted disease involving nutrition, the diet should be made as nourishing as possible, and meat, eggs, milk, cream, and broths should be given in addition to cereals. Cod-liver oil is usually prescribed with benefit. There is no one food of special value for retarded dentition on account of its containing the lime salts of the teeth, and the chief reliance for this purpose must be placed in building up general nutrition.

In all cases of dyspepsia, gastric catarrh, rickets, or syphilis the teeth must be carefully examined before prescribing special dietetic treatment.

If the teeth are broken or irregular all solid food should be carefully prepared by mincing or otherwise reducing it to a form requiring but little mastication. In a young child a sore mouth from swollen gums is often overlooked as a cause of anorexia.

The perfection with which false teeth are now fitted has done much to improve the digestion of adults and to add to the comfort and, no doubt in some instances, prolong the life of the aged. Their use enables solid food to be eaten, and the act of mastication increases the flow of saliva, which not only digests starchy food but tends to neutralise a too acid gastric juice, if the latter be present.

Catarrhal Stomatitis

Catarrhal stomatitis is a simple inflammation of the mucous membrane of the mouth which, among other causes, may be excited by taking food or drink at either extreme of temperature.

Food which is very acid or too highly seasoned with condiments may cause it, so also may excessive drinking and smoking.

No special diet is required beyond giving food which is easily swallowed and which is free from the above objections.

When the disease occurs in infants their diet must be regulated according to the directions for feeding detailed under the heading Infant Feeding.

In gangrenous stomatitis the mouth may become too sore to admit of swallowing, in which case food must be given by the rectum. (See Nutrient Enemata, p. 414.) Otherwise small quantities of fluid food must be ordered at frequent intervals. Concentrated meat broths, egg albumin, meat juice, and milk are to be taken at hourly intervals. If the stomach is irritable this food should all be predigested with pancreatin. Alcohol, preferably in the form of brandy, should be frequently given to the limit of toleration.

The above directions apply also to cases of inflammation of the mouth and pharynx caused by corrosive poisons, such as carbolic acid, ammonia, etc.

Tonsilitis and Quinsy

These diseases require no special care in the acute stage beyond giving food in such fluid form as can be most easily swallowed. The pain caused by this act is often so extreme that it is advisable to concentrate all food, to lessen the number of necessary acts of deglutition. Meat juice, peptonoids, beaten eggs, and brandy may be added to good milk. Plain vanilla ice cream may be given. Its coldness is sometimes soothing to the pharynx.

Holding cracked ice in the mouth before swallowing will sometimes annul the pain momentarily, or in extreme cases the pharynx and tonsils may be sprayed with cocaine, and the period of temporary anæsthesia may be utilised for swallowing considerable nourishment. This is rarely necessary, for unless the patient is emaciated by previous serious illness, he is not apt to be in need of much food for a day or two. In bad cases of suppurative tonsilitis the strength suffers more, and stimulants may be given by the rectum if deglutition is impossible.

After all forms of tonsilitis there is apt to be considerable anæmia, and the patient for a week or two should eat abundantly of animal food. Eggnog and milk punches are often needed for the first few days of convalescence.

Dysphagia

When the normal mechanism of swallowing the food is disturbed the condition is called dysphagia. It is commonly due to one of the following causes: Spasm of the muscles of mastication (trismus);

inflammations of the mouth, tongue, pharynx, or tonsils; diphtheria; tubercular, cancerous, or syphilitic pharyngeal disease; retropharyngeal abscess; stricture or carcinoma of the œsophagus; paralyses (sometimes of central origin); operations upon or near the pharynx; or the wearing of an O'Dwyer tube in the larynx.

The devices employed to enable the patient to overcome pain or difficulty in swallowing his food should include reduction of the efforts at swallowing to a minimum. A raw egg or oyster may sometimes be gulped down by a single act when the dread of pain from more repeated effort deters the patient from taking other food. Whatever is given should therefore consist of concentrated nutriment in a smooth, semisolid or gelatinous form. Wine jelly may be re-enforced with beef peptonoids or egg albumin, and custards may be thickened with farinaceous material to a consistence which will enable them to be quickly swallowed.

When patients are unable to swallow, an œsophageal tube is inserted for feeding, which, however, should be a catheter of small calibre (English 8 to 18), and which need not be passed very far down into the œsophagus. If necessary, a 2- or 4-per-cent solution of cocaine may be first applied to the pharynx to relieve pain and irritation. The fluid food—eggnog, broths, thick gruels, milk, etc.—is poured into the tube through a funnel.

When the tube feeding cannot be practised, it becomes necessary to resort to rectal enemata, or both methods may be employed in order to reduce the number of feedings through the painful throat.

Delavan calls attention to the important fact that the point of greatest irritation is often the palatine arches, and by passing the tube through the nose into the pharynx behind them this difficulty is neatly avoided.

In hopeless cases of cancer or of tubercular ulceration of the epiglottis, tonsils, etc., which are so intensely painful, it may be justifiable to perform gastrotomy in order to place food directly in the stomach. This is certainly preferable to letting the patient starve to death because he finds the agony of swallowing is even worse than the pangs of hunger.

Stricture and Carcinoma of the Œsophagus

In diseases of the œsophagus which render swallowing difficult all food must be given in semisolid or fluid form. Many vegetable substances can be made into *purées*, which can be strengthened by meat extracts, peptonoids, or beef meal. Milk, in its various forms, is always soothing, and it may be the only food which the patient can take.

Richardson states that in œsophageal stricture cold food relaxes the circular fibres of the œsophagus and dilates its lumen, whereas hot food has an opposite effect. In some hysterical patients this may prove true, but in most cases of genuine stricture or occlusion the temperature of the ingested food makes but little difference. When the occlusion or the difficulty or pain in deglutition becomes so great that the patient suffers from inanition—as, for example, after corrosive poisons have been swallowed—he must be fed by nutrient enemata. Should the trouble not be overcome, a gastric fistula must be made, and the patient is to be fed by this means.

Feeding through a Gastric Fistula.—When a gastric fistula is made the wound may be left open with a drainage tube, or, what is better, a permanent hard-rubber or metallic tube is inserted, having a double flange, like a spool. The tube is nickel-plated to prevent erosion by the acid gastric juice. The lumen may be a third of an inch in diameter, and when not in use it is kept closed by a cork. When the patient is to be fed he must lie upon his back. The cork is removed, the tube cleansed with a syringeful of warm water, and through a glass funnel, to which is attached an inch or two of rubber tubing, fluid food and water is poured directly through the fistulous opening into the stomach. If desirable, lavage may be performed in a similar manner. Any kind of food may be given which the patient is able to digest. Even small pieces of chopped meat can be pushed into the stomach with a glass rod or forceps. Medicines are conveniently given through the same opening. When the fistula has been made for other cause than malignant disease the tube may be worn indefinitely with no other inconvenience than that attending the peculiar process of feeding. I have seen several patients who have worn such tubes for several years, and who go about like other men, excepting that they take their meals in private and feed themselves while lying on the back. One of these patients, who was operated upon in Bellevue Hospital by F. S. Dennis for a benign stricture of the pylorus following typhoid fever, first masticates his food, then expectorates it and pushes it into the tube with a glass rod. He maintains robust health.

FOREIGN BODIES SWALLOWED

When foreign bodies have been accidentally swallowed, such as coins, buttons, safety or other pins, large cherry, plum, or other fruit stones, fish bones, chicken bones, or pieces of clam or oyster shells, if the patient is seen within two or three hours, the object having passed beyond the reach of the finger or œsophageal probang, an emetic may be given. If this fails to return the foreign body from the stomach, the patient should eat large quantities of bread, oatmeal, or potatoes. The plan of this treatment is to furnish a bulk of fæcal matter, which in the intestines may envelop the pin or bone, and prevent its sharp or roughened ends from injuring the mucous membrane. Six or eight hours later a dose of castor oil should be given. By this means many dangerous objects may be safely voided. If the foreign body does not appear after the oil has acted, the treatment should be repeated next day, and the stools must be carefully watched until it is recovered. Experience has shown that the search should not be abandoned for at least eight or ten days. Men who earn a precarious livelihood by publicly exhibiting themselves as possessing "iron stomachs," and who swallow broken glass, coins, nails, etc., take considerable risk from exciting grave injury or peritonitis, but by eating the foreign bodies only when the stomach is nearly full, and by following the treatment outlined above, they manage to escape death.

Indigestion and Dyspepsia

Symptoms.—Indigestion and dyspepsia are terms which refer essentially to functional slight and often temporary derangement of the digestive system, although these conditions may result from many varieties of disease, especially from fever due to almost any cause. The terms are used somewhat vaguely to include a number of minor symptoms, such as weight and oppression at the epigastrium and præcordium, eructations, "water brash," palpitations, vertigo, headache, modified taste and thirst sensations, loss of appetite or morbid craving for certain indigestible articles of food, flatulency, hiccough, and sometimes nausea, heartburn, pain referred to the cardiac end of the stomach, lassitude, irritability, drowsiness or restlessness, and despondency. As Sir Henry Thompson said: "The word indigestion denotes not a disease, but an admonition."

Fothergill wrote: "If it were not for the protection of indigestion, of which many so bitterly and ungratefully complain, the lives of a large number of individuals would not attain their furthest potential expansion."

Many of these symptoms, especially those referable to the nervous and vascular systems, are explained by the belief that morbid products which closely resemble poisonous alkaloids in their action (as indeed in their composition), and which are called ptomaines or leucomaines, are easily absorbed, and produce effects varying in intensity from slight headache to the collapse of violent ptomaine poisoning (p. 379). Other symptoms are doubtless due to imperfect elimination of waste matter of food or "ashes" from the system.

Bauer says: "It is beyond doubt that insufficient secretion is the essential cause of most dyspeptic symptoms as they appear in various disorders of the stomach."

In severe fevers and conditions of advanced anæmia or gastric catarrh the stomach secretes chiefly a ropy alkaline mucous fluid, with little or no true gastric juice.

As a rule, the acid gives out before the pepsin, and a deficiency of acid is a very common condition, especially in anæmia. Anæmia produced experimentally by repeated bleeding of animals will cause it.

Chronic hyperæmia and inflammation of the stomach excited by coarse irritating food have the same result, and the free acid, if secreted, is neutralised by abundant mucus.

Deficiency of hydrochloric acid in the gastric juice has a threefold effect: 1, Failure to digest proteids; 2, failure to arrest malfermentation or putrefactive changes in the food; 3, failure to excite gastric peristalsis, so that the food lingers too long in the stomach. Other causes of delay may be found in too large a bulk of food, lack of peristalsis, and obstruction through stenosis of the pylorus without corresponding increase in contractile power of the stomach.

Gases.—The normal gases of the stomach are those of atmospheric air; but food which is improperly fermenting is capable of evolving others, and those which have been determined by analysis of eructations are CO_2,H_2,$O_2$$N_2$,$CH_4$ (marsh gas) C_2H_4 (olefiant gas). Ewald reports a case in which sufficient marsh gas was evolved from the stomach to burn with a pale-yellow flame.

Some degree of lactic-acid fermentation may be a normal accompaniment of gastric digestion, but the process is easily carried too far; butyric acid develops, and gases are evolved. This action resembles that produced outside the body when decomposing albumin comes in contact with saccharine substances.

Distention of the stomach and intestine with gas interferes with the free play of the diaphragm in the respiratory movements, and since the heart lies upon its side, separated from the stomach only by the diaphragm, an inflated stomach compresses and displaces the heart, interfering with its rhythm and force and causing palpitations. The latter, in connection with impeded extent of movement of the diaphragm, produces dyspnœa, especially on exertion.

Pain is a very frequent accompaniment of dyspepsia. It is usually of a dull aching variety, but is sometimes sharp and acute. It is often erroneously referred to the heart, but it is due rather to hyperæsthesia of the stomach wall, excited by products of imperfect digestion.

In all diseases of the stomach the retention of any particles of undigested food gives rise to irritation and malfermentation, which still further complicates the diseased condition of the organ itself and interferes with its proper action upon fresh quantities of food. This may be occasionally relieved by vomiting or by the ingestion of some simple fluid which will aid in washing the stomach contents onward into the intestine.

Etiology, Idiosyncrasies.—Personal idiosyncrasy is a very potent factor in dyspepsia. Not only do individuals vary from one another in this regard, but the same person varies at different periods, in different stages of health, or at different ages. One not uncommonly observes persons who are most confirmed dyspeptics at home, but who when at sea are able to eat and digest all manner of richly cooked and thoroughly indigestible food without either nausea or discomfort, only to return to their dyspepsia on shore. On the other hand, many persons whose digestion is normal at home are made constipated and dyspeptic by the lack of exercise and by other conditions at sea, even though they be never "seasick." How often do dyspeptics who have been long kept upon a rigid regimen break away from all restraint and give astonishing accounts of the forbidden articles which they have suddenly discovered they can eat for a time with impunity! One who cannot digest the most tender mouthful of prepared meat or a crust of dry bread will thrive upon enormous quantities of nuts and oranges; another requires a preposterous quantity of pickles or of Cayenne pepper to stimulate the sluggish digestion into any sort of activity, and another lives largely upon raw apples!

Many people cannot eat strawberries without attacks of heartburn, dyspepsia, and angina, while for others they are very wholesome food. Some persons cannot eat cauliflower without exciting dyspepsia, and for others the use of melted butter invariably brings on such an attack, while butter spread upon bread does not. Others exhibit intolerance for twice-cooked meats, new bread, potatoes, sweet jams of any kind, etc. (See Idiosyncrasies in Regard to Food, p. 397.)

Other Causes.—Fats and greasy foods set up butyric-acid fermentation which causes heartburn, regurgitation, and a rancid disagreeable taste.

Sweets and raw or insufficiently cooked starches cause lactic-acid and other fermentations, with flatulence.

Combinations of certain foods almost always disagree, as, for example, sweets and acids, fruits and beer, ice cream and beer, milk and cherries, milk and crabs.

Dyspepsia is often caused by the continued abuse of irritants, such as alcohol and highly seasoned food, pickles, mustard, Cayenne.

Tobacco and strong tea and coffee have a depressing action upon the nervous force of the stomach.

To enumerate all the various substances which may at some time or other cause indigestion would be to include practically the entire list of foods. Each new case must be separately studied, and general rules admit of many exceptions.

Balfour concisely sums up the relations of food to enfeebled stomach digestion by saying: "Three things greatly disturb gastric comfort—too large a meal, too short an interval between the meals, and, lastly, the ingestion of food into a stomach still digesting."

Examination of the Patient.—It is important at the outset to understand all the patient's habits of daily life, the amount of sleep and exercise taken, the hours of meals and quantity and quality of food eaten, habits of drinking or smoking, the habit of the bowels, condition of the stools, and the nature of any irregularity—the habit of eating too fast or taking too much or too little fluid with the meals. The condition of the teeth and tongue and breath must also be observed, and in obscure cases the possible existence of sources of reflex irritation, like ovarian disease, must be investigated. The proper cooking of the food should be insisted upon. Thorough cross-examination in regard to all of these conditions may reveal habits not suspected by the patient to be injurious, and which may be easily corrected.

Slow Eating.—A simple explanation of the normal physiology of digestion will often interest an intelligent patient and secure his hearty co-operation in methods suggested for his cure, which otherwise he would find extremely irksome. He should understand that digestion commences at once in the mouth by the proper preparation there of all food and the digestion of starch in particular, and that the practice of slow eating gives time not only for more thorough mastication, but also for more abundant secretion of the necessary digestive fluids, saliva, and gastric juice. Very slow eaters are far less often dyspeptic than those who "eat and run." The sign "Quick Lunch," so commonly displayed in restaurants in business quarters of active American cities, has contributed much toward earning for Americans the title of a "Nation of Dyspeptics," for a meal quickly served is too quickly eaten as well. A dyspeptic child should be taught to count between his mouthfuls.

Solid food insufficiently masticated passes into the stomach too dry and in too large masses for the gastric juice to act upon it promptly, and stomach digestion is greatly retarded. In persons with feeble digestive power who eat hastily, pieces of meat and tough vegetable fibres often appear in the stools wholly unaltered. The sense of taste may be utilised in order to prolong mastication by savoury cooking. It also stimulates the secretion of saliva and gastric juice. In such cases, as well as in those in which the teeth are absent or defective, it is well to prohibit all food which is not completely subdivided or tender, as, for example, tough meats and stringy or fibrous vegetables.

Pain.—In nervous dyspepsia pain exists as a prominent symptom, and is often independent of the quality of the food—even a mouthful of water may cause it, but, as a rule, fatty and acid foods excite it, and must therefore be avoided. The appetite, too, varies greatly—it may completely fail at one time, and return in an exaggerated form at another. Decker reported the case of a patient who was uniformly awakened from sleep by such excessive hunger that he was obliged to take a hearty luncheon in the middle of the night.

EXAMINATION OF THE STOMACH CONTENTS

In all cases of protracted dyspepsia which do not yield readily to dietetic treatment and proper medication it becomes important to ascertain the exact condition of the stomach and gastric juice, and for this purpose several ingenious clinical tests have been devised. These tests are applied to ascertain—1. The degree of acidity of the gastric juice. 2. The vigour of peristaltic action of the stomach wall. 3. The rate of absorption from the mucous membrane.

To determine the acidity of the gastric juice, a fresh specimen must be obtained for analysis, and by far the best method is by siphonage. The stomach tube is inserted in the manner described for gastric lavage (p. 547), and the contents of the stomach are withdrawn in sufficient quantity to yield a satisfactory analysis.

Some hysterical dyspeptics vomit so readily that the gastric juice may be obtained from the ejecta at any time.

TEST MEALS

The composition of the gastric juice is best determined by following lavage by a test meal. After a definite period the stomach tube is again introduced and a sample of the stomach contents is withdrawn, filtered, and examined for hydrochloric acid and pepsin. If desired, other tests may be made for rennet ferment, carbohydrates, peptones, albuminoses, lactic acid, phosphates, and fatty acids. The test for hydrochloric acid is the only one commonly applied for clinical purposes, and to aid the selection of proper diet, the others belong rather to special research.

The best test meals are Riegel and Leube's test dinner, and a modification of this, known as Ewald's test breakfast, which is easier to eat and does not obstruct the stomach tube, although it stimulates the digestive activity of the stomach somewhat less. The stomach contents should be withdrawn for examination one hour after the breakfast, but between four and five hours after the dinner.

Riegel and Leube's test dinner consists of—

Beef soup	400	cubic	centimetres.
Beefsteak	200	"	"
White bread	50	"	"
Water	200	"	"

Ewald's test breakfast is 35 to 70 cubic centimetres of wheaten bread (one or two white coffee rolls) with 300 cubic centimetres of water or weak tea without sugar or milk. When the contents of the stomach are withdrawn one hour after ingestion of this meal its total quantity should be found reduced to 20 to 40 cubic centimetres.

In withdrawing the contents of a stomach after a test meal the same tube is used, and in the same manner as that employed for lavage, described on p. 538. It is important that its introduction should not be accompanied by violent retching, for when this takes place bile is very apt to be regurgitated into the stomach and neutralise its acid contents, rendering subsequent tests useless. The retching may be overcome by painting or spraying the pharynx with a 2- or 4-per-cent solution of cocaine, or, as Stewart recommends, by allowing the patient to swallow a few drops of the solution, to anæsthetise the œsophagus. The use of a rather stiff tube, quickly inserted, diminishes the liability to retching. The tube should not be lubricated when used for the test meals, but it may be wetted. The gastric contents may be forced out through the tube by directing the patient to forcibly expire, thereby compressing the stomach by the abdominal muscles, and simultaneously the epigastrium should be firmly compressed by the hands. It is also obtained by attaching to the stomach tube the bulb of a Davidson syringe or a suction bottle such as that in common use for aspirating the thorax or abdomen. If no fluid flows, a little air or warm water may be forced through the tube to cleanse the obstructed fenestra.

Dujardin-Beaumetz gives a test breakfast of coffee or tea with milk and a little sugar, and one or two plain rolls; no butter. The fluid must not exceed a pint. The normal stomach digests such a meal without sensation. If within two hours there is a sensation of heat in the stomach or burning and acidity, hyperacidity is present. If there is eructation of gas, fulness and weight at the stomach, then there is diminished or *hypoacidity*.

If pain occurs within fifteen minutes with increasing intensity there is probably some organic lesion. In hyperacidity, moreover, Beaumetz says that the burning is worse three to four hours after eating, and is commonest in the middle of the night. It is often relieved by ingestion of food, which temporarily dilutes the acid. He urges dyspeptics to sleep on the right side, to aid the passage of food through the then dependent pylorus.

TEST FOR TOTAL ACIDITY OF THE GASTRIC JUICE

Before testing for the presence of free hydrochloric acid, the total acidity of the stomach may be obtained, which is the combined acidity produced by HCl and lactic or other organic acids commonly developed by malfermentation. This total acidity should equal normally 40 to 65 (Ewald), which represents "the number of cubic centimetres of test solution required to exactly neutralise 100 cubic centimetres of gastric filtrate" (D. D. Stewart). The test solution is prepared as follows:

"Four grammes of NaOH dissolved in one litre of distilled water is used for neutralisation; each cubic centimetre of this solution will exactly neutralise 0.00365 gramme of absolute hydrochloric acid. The number of cubic centimetres so used multiplied by 0.00365 equals the percentage of HCl contained in 100 cubic centimetres of the gastric filtrate" (Stewart).

CHEMICAL TEST FOR FREE HYDROCHLORIC ACID

A number of chemical tests have been devised for the detection of hydrochloric acid.

Günzberg's Test for Free Hydrochloric Acid.—

Phloroglucin	2	
Vanillin	1	
Absolute alcohol	30.	Mix.

Two or three drops of this solution are placed on a white porcelain dish and allowed to slowly flow in contact with a similar quantity of filtered gastric juice. The dish is very slowly and gently heated over a spirit flame or Bunsen burner, and if hydrochloric acid is present, a faint rose-red hue appears at the line of contact, which deepens as evaporation continues into a brilliant cherry red. If the acid is abundant, minute cherry-coloured crystals will form. If the acid is feeble, it is best to concentrate the stomach filtrate upon a water or sand bath to about one tenth of its original bulk.

When merely a faint trace of the free acid is present the appearance of the colour should be carefully watched, for it is very evanescent.

Günzberg showed that one drop of the normal gastric juice—i. e., juice containing 0.2 per cent of free hydrochloric acid—when diluted ten times, should still give the colour. If it appears when the dilution is carried beyond this limit, hyperacidity is present.

This is, on the whole, the most reliable clinical test which has yet been devised, and the ease and quickness of its application for diagnostic purposes has much to recommend it. It requires no special skill, and should always be made, to test the progress of the treatment, while lavage is being performed.

The Boas Test for Hydrochloric Acid.—The Boas test is performed in a similar manner to the Günzberg test, but the colour produced varies from rose to vermilion, and the solution is made as follows:

Sublimed resorcin	5	
Sugar	3	
Dilute alcohol	100.	Mix.

Both tests are only of value from a positive standpoint—i. e., if the colour reaction occurs, free hydrochloric acid is surely present, They are, however, of little or no value as negative tests, for the reason that if peptones or certain other substances are present in the stomach contents the reaction may be entirely obscured. The latter difficulty is met by application of the calcium-carbonate test, which is uninfluenced by other substances likely to be associated with the gastric juice, with the single exception of an excess of acid phosphates.

The Calcium-carbonate Test.—This is conducted as follows: A sample of gastric contents is heated to remove fatty acids, and shaken with ether to remove any lactic acid present, and blue litmus paper is dipped in the fluid. Another blue litmus paper is dipped in a fresh sample of the gastric contents which has been neutralised by the addition of dry pure $CaCo_3$. The redness of the first paper when compared with the second will declare the presence of free hydrochloric acid.

A strong Günzberg reaction usually indicates normal reaction or hyperacidity. Its absence when hydrochloric acid is revealed by the $CaCo_3$ test indicates subacidity. If the latter test fails, then no free acid is present.

Acid Salts.—If the litmus dipped into the gastric juice neutralised by $CaCo_3$ is reddened, the presence of acid salts (phosphates) is indicated.

The normal gastric free hydrochloric acid maintains a remarkable uniformity in strength, very rarely exceeding 0.2 per cent.

It has been shown by Ewald and Leo that it is not secreted during fasting, but enters the stomach as soon as the stimulus of food is felt. At first it replaces the acids from lactates and phosphates, setting these acids free and forming chlorides with their bases. The hydrochloric acid also unites with albuminoids. For these reasons free HCl is not apparent in the gastric juice until the combinations mentioned have been all saturated, after which it increases in strength to the normal standard of 0.15 to 0.2 per cent. If alkalies are ingested, more HCl is secreted; but if acid be taken, the further secretion of HCl is checked, so that the average strength is preserved.

These conditions explain why it is that within fifteen minutes after ingestion of an Ewald test breakfast lactic acid may be found in the stomach contents, while free HCl may not appear for half or three fourths of an hour.

Lactic acid is obtainable for an hour, or until the full strength of free HCl secretion is reached. If a heavy meal of bread and meat and vegetables has been eaten, the lactic-acid reaction will continue for a couple of hours, but free HCl may not be demonstrated for from three to four hours.

This is an observation of considerable practical importance; for in the early stage of digestion, the acidity being low and due only to organic acid, the ptyalin digestion of starches still continues, but it must cease as soon as any appreciable quantity of HCl is present.

Free hydrochloric acid checks further development of organic acids, such as butyric, acetic, or lactic. The *Bacilli acidi lactici* fail to act in its presence, and other bacilli, like those of typhoid fever and cholera, are destroyed by the antiseptic action of the HCl.

HYPERSECRETION

Hypersecretion of gastric juice is determined by withdrawing the contents of the stomach in the morning after lavage the previous evening. If more than fifty cubic centimetres are obtained, hypersecretion may be said to exist, the exact nature of which is to be determined by the Günzberg test (p. 525). Suggestions for the diet of such cases are given on p. 534. Gastric atony is determined by finding in the morning washing of the stomach undigested particles of food eaten the night before.

The microscopic examination of the washing will exhibit bacteria, sarcinæ, and saccharomyces. The treatment of this condition is given under Chronic Gastric Catarrh (p. 540) and Dilatation of the Stomach (p. 546).

TEST FOR PEPSIN

The presence of pepsin may be determined by digesting either egg albumin or blood fibrin, the latter being preferred. The fibrin is whipped from fresh beef blood and washed in water until it becomes white. A small piece is placed in a test tube with fifteen or twenty cubic centimetres of filtered gastric juice, and kept at a uniform temperature of 40° C. for two or three hours. If there is but little normal HCl present, a few drops more should be added. If no digestion occurs after some hours, pepsin is absent and the fibrin will decompose. Quantitative or comparative tests may be made by using definite amounts of fibrin and gastric juice, and noting the time required for complete digestion.

TEST FOR RENNET FERMENT

The presence of the rennet ferment is easily demonstrated by adding a few cubic centimetres of the filtered gastric juice to a half-teacupful of fresh milk, and keeping the mixture for a short time at 40° C. A loose coagulum forms with a limpid yellowish whey if rennet be present.

CLINICAL VALUE OF THE CHEMICAL TESTS OF GASTRIC CONTENTS

It is extremely important not to place too much reliance upon a *single* gastric juice analysis, for the following reasons: (*a*) The test meals are usually not sufficiently appetising to stimulate copious secretion. The gastric secretion is stimulated into activity in part through the senses of smell and taste, in part through the mechanism of deglutition, and in part by the mechanical and chemical influences exerted by the food when in the stomach. A roll and glass of water or cup of weak tea may entirely fail to promote secretion through these means. (*b*) The mechanism of secretion is further complicated by the extensive nerve influences which control it, and which may easily be made to inhibit it. Thus the nervous dread of the passage of the stomach tube, or the disagreeable choking sensation induced by its first passage, may readily modify, if they do not wholly inhibit, gastric secretion. I have a large number of records of analyses made by Dr. William Armstrong at my clinic upon patients upon successive days, which show, for example, an acidity one day, hyperacidity the next, hypoacidity the next, etc. Such patients are often neurasthenic, but I have known patients in hospital with minor ailments who kept on eating full house diet and grew stout upon it, yet who were reported from the clinical laboratory as having entire absence of free hydrochloric acid and a mere trace of combined acid. For these reasons I think that little satisfactory conclusion is to be drawn in a given case unless the average be taken of at least half a dozen analyses made under varying conditions and with different kinds of test meals for comparison. For example, the Ewald test breakfast may fail to promote an acid secretion, which is obtainable promptly with a Leube test meal.

The presence of hyperacidity is somewhat more reliable than that of anacidity, and in general a better knowledge of the condition of digestion and of the stomach itself is obtained by tests of motility, inflation, and percussion, the microscopic examination of food contents, the search for mucus, fungi, bacteria, etc., than by purely chemical analyses.

The quantity of a test meal recovered by siphonage depends upon the motility of the stomach, as well as the activity of secretion, and percentage acidity is therefore a very imperfect index of the activity of secretion.

TEST FOR MOTOR POWER OF THE STOMACH

The motor power of the stomach is demonstrated in various ways.

Leube's Method.—Leube's method is to empty the stomach after the ingestion of a Leube's test dinner (p. 523), or Ewald's test breakfast (p. 523). If the stomach is empty three hours after the former and one and a half after the latter, hypermotility is present —i. e., the food is being too rapidly hurried into the duodenum. If undigested food remains six or seven hours after eating the Leube test dinner, the motility is impaired, and the diet must be regulated accordingly. (See Chronic Gastric Catarrh, p. 540, and Dilatation, p. 546.)

Ewald and Siever's Method.—Another method, that of Ewald and Siever's, is very simple, but not very reliable. Fifteen grains of salol are given in a wafer immediately after a meal, and the urine is tested for salicyluric acid, which is derived from salicylic acid formed in the alkaline intestine as one of the products of dissociation of salol. Salol escapes being acted upon by the gastric juice, and the salicyluric acid appears in the urine half an hour or an hour after it is swallowed if hypermotility be present—otherwise, not for several hours. The salicyluric acid is readily detected by the violet colour which appears in the urine on adding a drop or two of ferric-chloride solution. The chief difficulty in the performance of the test is in getting urine when wanted without catheterisation. Frequent catheterisation merely for the purposes of such a test is to be condemned, and patients cannot usually micturate every fifteen minutes. Brunner and Huber prefer to make the test dependent upon the disappearance of all trace of salicyluric acid after ingestion of one gramme of salol. Normally it can be detected for only twenty-four hours, but if the motor power of the stomach is impaired it may be obtained as late as forty-eight hours after.

Bourget found that the reaction time is delayed an hour or more by giving a dose of HCl with a meat meal, whereas it is accelerated by a less acid meal of which fruits and vegetables form a part.

Stewart, in referring to this experiment, points out that hyperacidity of the gastric juice, by neutralising the duodenal juices, might retard the salol reaction without the existence of motor insufficiency.

Klemperer's Method.—Klemperer has the patient swallow one hundred grammes of olive oil into an empty stomach, or the oil may be poured in through a stomach tube. It is left for two hours, and then the stomach contents are washed out. The oil is abstracted from the washing with ether, and the ether is separated. The oil is then measured. Between seventy and eighty grammes of oil should pass on into the intestine inside of two hours, but if it has not done so there is lack of motility.

Sahli has devised a test meal of a soup of butter, flour, salt, and water to test the mobility and other functions of the stomach, but its preparation and use is too elaborate for ordinary clinical purposes.

TEST FOR ABSORPTIVE POWER OF THE STOMACH

This test, as devised by Penzoldt and Faber, is very simple. Into an empty stomach are taken three grains of potassium iodide in a clean gelatine capsule, with a wineglassful of water.

The saliva is collected at two- or three-minute intervals in separate saucers, and with normal absorption from a healthy stomach iodine may be detected in the secretion in from six and a half to fifteen minutes, but in gastric catarrh it may not appear for several hours. The test is made by dipping a filter paper, previously soaked in starch paste, into the saliva, and adding fuming nitric acid. A blue colour appears if iodine is present. This test is not very reliable, for if the stomach is full of food the reaction is always much retarded, as it also is by fever and in most diseases of the stomach, notably ulcer, carcinoma, and dilatation.

DIETETIC TREATMENT OF DYSPEPSIA

The foregoing details of the clinical examination of the digestive power of the stomach have been given in this connection as a convenient place to summarise them. It is not intended to imply that every case of simple dyspepsia should be subjected to so complex an examination, but, on the other hand, there are many persons afflicted with chronic dyspepsia who waste much time, energy, and expense in taking medicines and diet "cures" which are entirely unadapted to their particular trouble because it has never been thoroughly investigated. The stomach is useful more as a receptacle for food than for its necessary digestion or absorption, for in cases of its total extirpation or total abolition of function digestion and nutrition may be fully maintained through the intestine. Hence it follows that in all gastric derangements it is desirable to impose as slight a burden upon the organ as possible. To this end food should be thoroughly masticated, or given only in a state of fine subdivision. The food should also be as concentrated as possible, and if necessary given in small quantities at frequent intervals.

The dietetic treatment of dyspepsia is so complex that it is easier for some persons to be put upon a very rigidly restricted diet for two or three weeks than to have to select for themselves appropriate articles at each meal.

It includes the study of all classes of foods, and for convenience they may be grouped into—

A. Foods forbidden in all cases.
B. Foods occasionally allowable.
C. Foods which are desirable.

A. **Foods forbidden in all Cases.—**

1. Rich soups, gravies, and sauces.

2. Strong condiments, pickles.

3. Fresh soft bread of any kind (which makes a tenacious bolus), hot breads, all kinds of pastry, cakes, griddle cakes, doughnuts, muffins.

4. Sweets, tarts, jam, confectionery and candies of every kind. Sugar in all forms, especially in coffee and tea with milk.

5. Raw vegetables, such as celery, radishes, cole.

6. Heavy vegetables—potatoes, sweet potatoes, corn, peas, beans, eggplant, cabbage, cauliflower, Brussels sprouts, turnips, carrots, parsnips (nearly all the roots and tubers).

7. Fat in quantity, all fried or greasy food.

8. Lobsters, crabs, shrimps, salmon, herring.

9. Dried, smoked, cured, potted, or "devilled" meats, fish, and pork in every form.

10. Corned beef, duck, goose, wild fowl, rabbit. Veal, except as broth.

11. Twice-cooked meats, hash (unless freshly made, without potatoes), stews, *ragoûts*.

12. Cheese of all kinds.

13. Very acid or very sweet fruits, nuts, dried fruits in general. All skins and seeds of fruits.

14. Tea, beer, and sour wines.

The excessive use of tobacco in any form should be forbidden.

B. **Foods Occasionally Allowable.**—There are foods which may be allowed to some patients but not to others, and many of them constitute exceptions to the foregoing general rules. Such are:

Vegetables.—Mealy, well-baked potatoes, not too young or new, raw tomatoes, spinach, thoroughly boiled onions, very young tender fresh peas, very young Lima beans, string beans, asparagus, stewed celery, celery plant (sea-kale).

Starchy Foods.—Where it is desirable to give starchy food in some form, macaroni, spaghetti, or rice may be allowed, or one of the prepared foods, such as Carnrick's or Mellin's. All starchy foods should be most thoroughly cooked, for salivary digestion is often feeble in connection with gastric disorders.

Fats.—Bacon, very fat, sliced thin and well broiled; cream, good fresh butter, olive oil.

Eggs.—Many patients find that eggs disagree with them constantly. There are a few who can take them with impunity if rightly cooked—that is, cooked very slowly and soft. They sometimes agree better when not given with other food, but as eggnog.

As a rule, sweet fruits disagree, though they can be eaten by some patients.

C. **Desirable Foods to be recommended in Ordinary Cases are:**

Cereals.—Wheaten bread, porous or aërated, stale or toasted; dry, unsweetened rusk or zwieback; soda crackers. (The bread from some bakers is easier of digestion than that from others.) Macaroni, sometimes oatmeal, but without sugar.

Fats.—In moderation only; butter to be very thinly spread and well rubbed in. Sometimes a thin rasher of bacon.

Vegetables.—Chiefly as *purées*, thoroughly cooked, made of tomatoes, asparagus, or sometimes potatoes or fresh peas. (Fresh green vegetables as in preceding list.) Lettuce.

Fish.—Oysters, fresh-boiled or broiled fish without rich sauces. They may be eaten with a little fresh butter and salt. (Some persons cannot eat fish at all.)

Eggs.—In any form if they are found to agree (except hard-boiled or fried).

Sweetbreads, Meats.—Broiled steak or chop, tender roast beef or mutton, chicken (roasted or boiled), boiled capon, roast partridge, grouse, woodcock, plover, prairie chicken, squab. All meats should be short-fibred and tender. They need not be very rare. Grilling is the best method of cooking them.

Fruit.—Baked or stewed apples or prunes. Occasionally a little fresh fruit in season, better eaten between meals to prevent constipation. Oranges, peaches, grape fruit.

Naturally, in bad cases the diet must be still further restricted, and a bread-and-milk regimen may have to be enforced until improvement occurs.

Beverages.—Tea is generally injurious, especially if drunk with meals, but weak tea taken clear in very hot water is sometimes beneficial by enabling patients to imbibe the fluid which they need. Strong tea is astringent; it precipitates pepsin and provokes constipation. Coffee, on the contrary, favours peristalsis, and is mildly stimulating to the nervous system. Drunk with milk and sugar it often excites dyspepsia and increases flatulency. Taken black after dinner it is an adjunct to digestion. If it produces insomnia or " nervousness " it should, of course, be discontinued. Yeo says that both tea and coffee may cause dyspepsia in those who are under mental strain, but not otherwise in the same individual. Light China teas are less injurious than the stronger Indian varieties. Coffee contains more tannin than tea, which has only a trace. It does not itself ferment, but the milk and sugar drunk with it does.

Cocoa (not chocolate, which is too sweet) may be allowed. An infusion of cocoa nibs often agrees.

Milk and Vichy or milk and Seltzer may be drunk as a beverage in non-flatulent cases.

As a general rule, malt liquors and beers of all kinds must be forbidden, although Fagge recommends the use of light, still, bitter ale or of porter in some cases; but he says, " Whatever causes flushing of the face after meals is bad." Alcoholic dyspepsia is only cured by entire cessation of drinking. This the patients are unwilling or unable to accede to unless very strongly influenced or frightened as to the probable outcome of continued indiscretion. In simple atonic dyspepsia the use of pure wine, or weak brandy, or whisky and water and drunk at meals may prove serviceable. Sometimes a little dry wine, claret, or hock may be allowed twice a day with meals.

Tobacco, smoked in moderation, in the form of mild cigars or in pipes (not cigarettes), promotes digestion by slightly stimulating the nervous system and increasing peristalsis.

Special Systems of Treatment.—The following systems of treating dyspepsia are condensed from the writings of several of the best-known dietists:

Dujardin-Beaumetz divides dyspepsia into three classes, and regulates their diet accordingly, as follows:

I. Dyspepsia with abundant gastric juice. *Diet*, fresh vegetables and fruits, farinaceous food, milk, no meat or wine.

II. Dyspepsia with deficient gastric juice. *Diet*, meat, broths, milk, peptonised food, weak brandy and water. No vegetables or saccharine food.

III. Dyspepsia with sympathetic affections, especially vertigo. *Diet*, purely vegetable food.

His diet of vegetable food is very liberal, and includes cereals as well as fruits. It contains such articles as dry bread crust, toast; farinaceous *purées* made of one of the following materials: Maize, flour, chestnut meal, oatmeal, pearl barley, potatoes, lentils, revalenta, macaroni (plain or buttered), vermicelli; *purées* of fresh vegetables, such as green peas, carrots, turnips; the vegetables of julienne soup; salads, spinach, sorrel, French beans, fruits, except grapes cooked as *compote*, lightly cooked eggs.

Germain Sée's treatment of dyspepsia is exactly the reverse of that of Dujardin-Beaumetz. He divides dyspeptics into two classes:

I. Those who have hyperacidity of the gastric juice, for whom he prescribes a nitrogenous diet with sodium bicarbonate after meals.

II. Those having diminished acidity, for whom he prescribes a purely vegetable regimen, with dilute hydrochloric acid after meals.

He directs in all cases to wash out the stomach and stimulate the gastric mucous membrane, for which he orders the alkaline sodium bicarbonate in a tumblerful of Vichy an hour and a half before eating.

Leube graduates dyspeptics into four groups according to the severity of their symptoms. The diet which he recommends is as follows, commencing with the severest cases:

I. Broth or clear soup, Leube's meat extract, milk, eggs (raw or lightly cooked), carbonic-acid water, Apollinaris, or Seltzer.

II. Boiled calves' brains, sweetbread, breast of chicken or squab, bread and milk, custard, unsweetened tapioca pudding.

III. The same as the two preceding, with the addition of raw ham [*sic*] and rump steak. The latter is strongly beaten, scraped, and roasted quickly before a hot fire with a little fresh butter.

IV. This diet, intended for the mildest cases or for convalescence, includes milk, rice, spinach, roast chicken, partridge, venison, rare beef, veal, macaroni, fresh green vegetables, salads, fruit *compotes*, stewed apples, and light wines. He sometimes allows fish, such as bass.

General Rules for Dyspeptics.—The following general rules are applicable to all cases of dyspepsia and indigestion:

1. Eat slowly, masticate thoroughly.
2. Drink fluid an hour before or two or three hours after meals, rather than with food.
3. Eat at regular hours.
4. If greatly fatigued, lie down and rest quietly before and after luncheon and dinner or supper.
5. Avoid as far as possible taking business worries or professional cares to the table.
6. Take systematic exercise in the open air. Bicycle and horseback riding are the best forms.
7. On rising, cold sponging and vigorous friction of the body is advisable.
8. The bowels should be kept open by laxative foods and fluids rather than by medicines.
9. Avoid too much variety at any one meal. Take meats and vegetables at separate meals.

RULES FOR SPECIAL VARIETIES OF DYSPEPSIA

Dyspepsia with Excessive Flatulency.—This often occurs in nervous women, and is especially annoying at night.

Avoid particularly all sweets and amylaceous food. Take no fluid with meals. Drink hot water, half a pint before meals, and again two hours after. Do not eat vegetables and meat at the same meal. Try cream instead of milk in coffee, and saccharin instead of sugar. Avoid tea and alcohol, especially malt liquors and effervescing water, with meals.

Dyspepsia with Hyperacidity.—The diet should consist largely of rare finely minced or scraped beef (one hundred grammes, or three and a quarter ounces, is ample), with two slices of stale bread or toast, or a few crackers with a little butter (thirty grammes). Later the patient may partake of the lighter fresh vegetables and subacid fruits. Milk may be useful, with 10 grains of sodium bicarbonate to the tumblerful. Vegetables should be thoroughly cooked and mashed or made into *purées*. Fruit must be stewed or, in the case of apples, baked. Alkaline Vichy may be drunk.

A few weeks' course of such a diet faithfully adhered to often results in cure.

Dyspepsia with Excessive Nervousness, Irritative Dyspepsia.—Avoid tea, coffee, much alcohol, tobacco, stimulating food of all sorts, condiments and pickles, and do not overeat. Eat slowly. Avoid eating when fatigued or worried. Take one or two extra meals a day, if necessary, especially a light one before retiring, to promote sleep. (See Insomnia.)

In the main, vegetable food will be better borne than proteids, unless flatulency is annoying.

Atonic Dyspepsia, Dyspepsia with Deficient Gastric Juice.—Take three meals per diem, and freshly cooked meat should be included in two of them. Beef, mutton, and poultry are recommended. Meat broths and soups, stale bread, toast, or crackers. All meats should be tender and simply cooked.

In purely atonic dyspepsia, with loss of tone in the muscular wall of the stomach and sluggish secretion, a diet which is too bland and tasteless fails to stimulate the stomach sufficiently, and it is better to offer a reasonable variety and a moderate use of condiments.

Dyspepsia in the Gouty.—Avoid particularly sugar in every form, malt liquors, sweet wines, and champagne. (See Gout.)

Dyspepsia with Bulimia.—A certain class of dyspeptics are always abnormally hungry, for hunger is a general sense, due to the needs of the tissues rather than to the purely local condition of the stomach. Suffering from indigestion, they fail to assimilate food properly, become hungry again soon after meals, and do not obtain the full nutritive value of what they do eat. They therefore overeat or eat between meals, and do not give the stomach sufficient time for rest. They must be taught to restrain the appetite and to stop eating short of satiety to prevent overloading the stomach, and a sufficiently long period should intervene between meals for the thorough digestion of the food. These patients sometimes have hyperacidity.

Dyspepsia with Anæmia.—Anæmic patients require abundant nitrogenous food, and well-seasoned, stimulating meat broths are recommended. Such patients may take an extra luncheon or two between the regular meals and before retiring. (See Anæmia, p. 494.)

DYSPEPSIA IN CHILDREN

Children vomit much more easily than adults when they have taken improper food, and often suffer less in consequence, although, if such food is retained, they may have a gastric fever with a greater rise of temperature and, perhaps, more alarming symptoms than occur later in life.

When vomiting occurs in infants the stomach should be rested by omitting the next feeding, and for the second feeding the milk should be diluted and reduced in amount. If vomiting persists, a little bicarbonate of soda or one or two tablespoonfuls of lime water should be added. Other substances, such as gelatin or one of the prepared infant foods, may be used to dilute the milk and prevent the formation of large curds in the stomach. In obstinate cases it may be well to change the diet completely and give up milk for a few days. In place of it a mixture may be used consisting of one part of cream and two parts each of whey and boiled (not boiling) water.

An overfed infant vomits soon after nursing or taking the bottle, and the stools contain milk curds. When an infant receives too little food, "the bottle is emptied quickly and ravenously; the child cries when it is taken away, sucks violently at its fingers, and cries before the next feeding is due" (Holt).

Older children should not be allowed to eat between meals, and must be forbidden the premature use of coffee, tea, spices, coarse vegetables (cabbage, turnips, etc.), and unlimited ice water, fruits, and sweets. (See Diet for Infants and Diet for Children.)

Acute Gastric Catarrh

Causation.—Acute gastric catarrh is commonly due to dietetic errors, although it is also excited in other ways. The dietetic causes are:

1. Food taken in too large quantity.
2. Food too hastily swallowed or "bolted."
3. Food in itself irritant or too highly seasoned with sauces, condiments, fats, etc.
4. Food which has undergone decomposition, such as "high" game or fish, overripe cheese, sour milk, or improperly canned vegetables.
5. Alcohol habitually consumed in excess and in concentrated form, or a combination of drinking beer and wine or liquor, or drinking beer in excess with improper food.

It may be caused by corrosive poisons. Many individuals appear to have special weakness or irritability of the stomach, so that attacks of gastric catarrh are excited in them by conditions which would prove insufficient in others.

Excessive consumption of food beyond the wants of the system and out of proportion to the gastric juice is often an exciting cause of gastric catarrh, especially in children. This food need not in itself be indigestible. Such cases may result, for example, from eating large quantities of meat hash or of ice cream. Favourable circumstances are also present in anæmia, nervous exhaustion, convalescence from protracted illness, and in fevers, in all of which conditions the gastric juice, and especially its hydrochloric acid, is apt to be diminished in amount or temporarily absent. In these cases digestion is retarded far beyond the ordinary limits, and the retained food decomposes by abnormal fermentation, thus becoming both a mechanical and a chemical irritant to the mucous membrane.

Symptoms.—The chief symptoms dependent upon the local inflammation of the stomach are severe vomiting, nausea, pain, weakness, and fever.

Dietetic Treatment.—Acute inflammation of any structure is best treated by rest, and the stomach forms no exception. Hence total abstinence from food and great reduction in the quantity of fluid imbibed is often curative after an interval of twenty-four or thirty-six hours. The irritation is maintained by ill-advised attempts to give food at frequent intervals with the object of supporting the strength. The attacks, from the very nature of their causation, often occur in robust people who can well afford to forego nourishment for a few hours or until the nausea and pain cease. To others who have been enfeebled by continued illness or in whom the acute attack produces alarming prostration, enemata and stimulants and predigested albuminous food must be given.

The vomiting and nausea are allayed by cracked ice, small quantities of iced champagne, carbonic-acid water, plain soda water, cold lime water sipped in doses of a tablespoonful at a time and at intervals of fifteen minutes. Strong black coffee is also serviceable. These symptoms may also be relieved by hot poultices and turpentine stupes, or spongiopiline soaked in hot water and sprinkled with a few drops of laudanum placed over the epigastrium (Fagge).

The thirst should not be met by large draughts of water, which only distend the stomach and excite vomiting. It may be relieved by sucking a piece of sliced lemon or by placing a few drops of mineral acid, such as dilute phosphoric or dilute hydrochloric acid, in a small tumbler of cold water and sipping it from time to time. Thirst may be lessened in some cases by holding water in the mouth for a few moments without swallowing it, for a certain amount of fluid is absorbed directly through the buccal mucous membrane. If large quantities of fluid have been vomited, a simple enema of salt and water (fifteen grains to the pint) may be injected into the rectum, where it is soon absorbed.

When nourishment is first taken by the mouth, it must be fluid and carefully prepared, so that it will either undergo prompt absorption or pass into the duodenum for digestion. It must be administered only in small doses—half an ounce or an ounce at a time. Pancreatinised milk, or cold milk diluted with an equal volume of lime water or soda water or alkaline Vichy, milk whey flavoured or added to beaten white of egg, beef extracts, peptone solutions, black coffee, expressed meat juice, and beef tea properly made, are all recommended. Most broths contain too much fat or oil. Milk given alone or undiluted soon curdles in the stomach, and is promptly ejected in large tough coagulæ. Many persons either actually cannot digest milk, or more commonly think they cannot, and avow a violent distaste for it, declaring that it leaves a perpetual bad taste in the mouth and causes headache and nausea. Their experience is usually based upon the use of undiluted and unprepared milk, and with tact and perseverance they can be got to retain and digest prepared milk very well. (See Milk Predigestion, p. 79.) Some patients prefer warm milk diluted with water and flavoured with a little cinnamon, a taste of coffee or caramel, or they may take barley water and rice water.

If patients cannot drink milk they may be allowed mutton, veal, or chicken broths from which the fat has been removed.

It is best to forbid all alcoholic fluids, even champagne, unless the patient is so exhausted that some stimulation becomes necessary, in which case brandy diluted with soda water may be given in small quantities, or it may be added to beef tea or arrowroot gruel. It is important always to aid the recovery of the digestive organs by absolute bodily and mental quiet.

Convalescence.—In convalescence the diet must be very slowly increased; otherwise relapses may follow very easily. After some degree of improvement has been reached, the gastric mucus accumulates with more butyric-acid fermentation, and the vomiting and other symptoms return.

At first but one article at a time should be added to the fluid food, gradually replacing it. Broths may be thickened by beaten or dropped eggs, crumbled toast, or scraped beef or chicken. Later plainly cooked meat, such as broiled tenderloin steak, chicken, a tender chop, squab, or a bit of broiled fresh fish with lemon juice may be allowed with dry toast and rice pudding.

It is well to give dilute hydrochloric acid (ten to fifteen drops) with two grains of pepsin after each meal. When the illness has been very severe the patient must be cautioned to be careful in eating for several weeks after the acute symptoms have subsided lest a relapse or gastric dilatation occur. Alcoholic subjects will probably not heed this warning, but it should be given none the less.

ACUTE GASTRIC CATARRH—GASTRIC FEVER IN CHILDREN

Acute gastric catarrh in infants is oftenest due to improper feeding. It is also excited, or rather promoted, by teething and other reflex irritations which interfere with the normal stomach functions. There is an acute inflammation of the gastric mucous membrane, accompanied by more or less fever, vomiting, local pain, and anorexia. This affection is comparatively rare among nurslings. When it does occur in them, the mother's milk should be analysed, and any errors in her own mode of life, diet, etc., must be corrected. If the breast milk continues to disagree, a wet nurse must be procured, and, failing this, the child must be weaned if the disorder continues.

Children just weaned acquire the disease from overfeeding and from improperly prepared food, and the number of meals must be carefully regulated according to the rules for infant feeding.

Older children who are allowed to come to table develop the disease from eating too rich or stimulating articles, such as pickles, sauces, spiced dishes, sweets, pastry, fried food, from drinking large quantities of hot or very cold fluid, from eating hurriedly without proper mastication, or from gorging themselves with enormous quantities of articles of which they are particularly fond, such as hash, cakes, etc.

If seen early, if vomiting has not already occurred and the stomach is full, it should be emptied by an emetic dose of ipecac. Otherwise, if the stomach contents have passed into the intestine, the irritating food should be expelled by a laxative, such as calomel or grey powder. No food should be allowed for some hours, for it will keep up the hyperæmia. Nothing should be swallowed but a few sips of water or a teaspoonful of cool lime water or a little cracked ice. After ten or twelve hours of complete rest the stomach may tolerate one or two teaspoonfuls of pancreatinised milk or milk diluted one half with lime water or Vichy. If this is not retained, it is better to give a little meat juice or beef broth. The next day mild farinaceous food may be allowed, such as arrowroot gruel, cornstarch, or farina. Junket also, or milk toast, may be retained. It is best to return to a solid diet very slowly and carefully, and such articles as rice pudding, scraped beef, the breast of chicken, or the soft part of oysters may be given for a day or two longer before the regular diet is resumed.

For some time after an attack it may be best to reduce the number of meals per diem—a child who has been taking five should take but four, or one who has had four should take but three.

Chronic Gastric Catarrh—Chronic Gastritis

Causation.—Chronic gastric catarrh may be the outcome of such errors in diet as have been described as causative of the acute form. It commonly results, however, from alcoholic excess. It also accompanies diseases in which the hepatic, and consequently the portal circulation is obstructed, producing engorgement of the vessels of the gastric mucous membrane. It may complicate pulmonary and cardiac diseases which cause obstruction to the venous circulation. It is caused by the severer forms of stomach diseases.

Pathological Physiology.—Besides congestion of the blood vessels, which interferes with the maintenance of proper secretion and with absorption, the glands of the stomach furnish a hypersecretion of tenacious, ropy, alkaline mucus, which clings to the mucous coat and prevents the food from exciting the secretion of the gastric juice, and it neutralises and prevents the latter from reaching the food. The food therefore is retained for hours in an alkaline medium, where it undergoes maceration and fermentation, which is particularly liable to develop large volumes of carbonic-acid and marsh gas, which are periodically belched up with such force as to carry out the acrid fluid, and even particles of disintegrated food, producing a bitter and nauseous taste in the mouth. The symptom of heartburn is due to the eructation of organic acids. The appetite is not always lost. It may even be excessive, and it is usually capricious. Thirst is often a prominent symptom. Vomiting occurs at intervals, especially on rising in the morning, after the gastric mucus, mingled with the saliva swallowed, has accumulated during the night.

Dietetic Treatment.—If any improvement is to be hoped for in the condition of a patient with chronic gastritis it is absolutely necessary to secure the intelligent co-operation of the patient himself by strict obedience to rules which must be made very specific and distinct. Many patients will be found to have so little will power that, with the best intentions, when they sit at the table with others whose good health enables them to partake of all the luxuries of the season they are utterly unable to resist temptation.

The patient with gastric catarrh should, as far as possible, be kept from mental strain and worry or business responsibilities, and especially from brooding over his symptoms. A person suffering from chronic gastritis often seems to have but a small amount of nervous energy to expend, and if too much is diverted in other channels, but little is left for the processes of digestion, and gland secretion is altered or withheld. It is a matter of every-day experience with such persons that when free from all concern and anxiety their digestion promptly improves and they can often eat quite indigestible food, whereas much plainer food wholly disagrees with them while under mental strain. It is highly important for them that meals should be taken with regularity and that abundant time should be allowed for mastication. Regular habits, outdoor exercise, and daily sponge bathing in cold water, followed by active friction of the skin, are to be recommended. In forbidding certain classes of food, it is often observed that the patient has discovered that some one apparently indigestible material can be eaten with impunity, and there may be no harm in allowing this to be continued in mild cases. Sometimes merely eliminating from the diet such obviously indigestible foods as pies, griddle cakes, pickles, fried foods, or rich cheese, will produce marked improvement, but it is often necessary to enforce a very strict regimen.

Milk Diet.—Severe cases, especially those complicating Bright's or cardiac disease, demand rigorous restriction of the diet, and it may become necessary to give milk exclusively for two or three weeks. From two to two and a half or three quarts of fresh milk are required for this diet in the twenty-four hours, the amount depending upon the size and weight of the patient and his ability to take exercise. The latter, however, must be reduced to a great extent while the milk diet is in force. The milk may be given either hot or cold, but hot milk is best. It should be diluted with soda water or an alkali, such as sodium bicarbonate or magnesia, and salt should be added. Very bad cases with extensive atrophy and abundant mucous secretion may require pancreatinised milk and beef preparations.

In some cases, especially those due to chronic alcoholism, there is annoying thirst, which is relieved by diluting the milk with equal parts of Vichy or Apollinaris water. The fluid has the additional advantage of increasing the elimination of waste from the system through the kidneys.

To most patients who are ill enough to require a fluid or an exclusive milk diet, it is preferable to give food frequently, at the rate of four ounces of the above mixture once in two hours, until the condition of the stomach improves, when the dilution of the milk is to be reduced, given in larger quantity (six to eight ounces), and the intervals may be prolonged to three hours. When much gastric irritation or nausea exists, the milk, if at all rich in cream, should be skimmed, as fat is not well tolerated. Buttermilk is used quite extensively in Germany and somewhat in this country for the treatment of gastric catarrh. It may be taken undiluted. To some persons the taste is more agreeable than that of ordinary milk. The casein of the buttermilk is already coagulated and exists in a condition of fine subdivision, so that it does not form large clots in the stomach. Patients usually tire sooner of buttermilk than of plain milk. Milk, no matter how given, is apt to produce constipation.

When patients insist that milk always disagrees with them this is often on account of their not having the methods by which it may be prevented from forming tough coagulæ in the stomach, and it is worth while to explain this fact to them, and secure their consent to give a fair trial to some of the numerous means which may be employed for improving the digestibility of this invaluable food (see p. 75). If there is much dilatation of the stomach, milk is usually contraindicated.

Other Diet.—Should it prove impossible for the patient to digest enough milk to support strength, his diet should be supplemented with other articles of food, such as scraped meat or peptonised meat. As a rule, the food should be either fluid or almost entirely solid; drinking considerable fluid with solid food dilutes the feeble gastric juice too much for proper digestion. No broth or soup should be allowed with meals. Alcohol should in general be forbidden, and tea, coffee, or cocoa are to be taken only in moderation, much diluted, and without milk and sugar. Occasionally light wine, such as hock and Moselle, may be given, but effervescing wines are forbidden. Fluids should not be taken too cold.

Oysters may be allowed either raw, broiled, or panned. Butter may be allowed very sparingly, and cream sometimes, but in general fats and oils should be avoided as well as all fat meats, pork, sausages, and solid food cooked in grease. Rich gravies and sauces of every kind must be forbidden, and all solid food must be thoroughly masticated. Many persons, especially those who have an excessive secretion of hydrochloric acid, live best on a diet of lean roast beef, rare steak, or white meat of chicken, eaten with stale white bread or dry toast and very little butter. This diet can be taken for some time before serious objection is made to it.

One occasionally meets with persons in whom the digestion of salt and smoked meats seems to be more easily accomplished than that of fresh meat. The explanation offered by Niemeyer is that these preparations are less likely to decompose and form abnormal fermentation products in the stomach. Dried smoked beef, cut in thin slices and eaten almost or quite raw, is palatable and easily digested. Some dyspeptics can also digest lean boiled ham, lean smoked bacon, and salt fish, such as shredded codfish, thoroughly cooked, better than they can fresh meat. Leube allows caviare, smoked ham, and boiled lean veal. Sweetbreads and calves' brains are digestible. Tough meat and flesh of young animals recently killed, such as "bob" veal, should not be eaten.

Fish and soft-cooked eggs disagree with some persons, but others can digest them without difficulty.

Saccharine and farinaceous foods are to be avoided. Sooner or later they are almost certain to undergo lactic and butyric-acid fermentation in the stomach with the production of much eructated flatus and "sourness." Sugar especially excites the secretion of gastric mucus. When improvement is established, the patient may gradually be allowed a little carefully prepared starchy food, but still no sweets of any kind. A single lump of sugar in a cup of *café au lait* drunk at breakfast can produce an acute dyspepsia, lasting all day. The varieties of starchy foods which may be first eaten are those which have been thoroughly subjected to the heat of baking or long boiling. Such are: Dry bread thoroughly toasted, bread crust, plain crackers, zwieback, gruels or meat soups thickened with arrowroot, thoroughly cooked sago, or ground rice, vermicelli, and macaroni well boiled. The purest carefully baked wheat bread from hard white wheat flour agrees better than the coarser varieties of brown bread, whole-meal breads, etc.

Many persons who take an intelligent but not hypochondriacal interest in their digestion find by repeated trial that the bread of a certain baker agrees with them, while that of another does not, although its nutritive value for normal stomachs may be the same in both cases.

Potatoes are apt to produce flatulency with sour eructations, and when this is the case they must be forbidden. If roasted and very mealy they may be sometimes allowed. Among vegetables those which are especially forbidden are cabbage and cauliflower, the legumes, and corn. A little fruit may be allowed between meals, such as cooked apples, either baked or stewed, or stewed prunes, if not too sweet.

Especially forbidden are pastry, sweets of all sorts, sweet puddings and cakes, griddle cakes, hot breads, pickles, fried foods, and strong condiments.

In all cases of chronic gastric catarrh it is important to reduce the bulk of food taken so as to diminish the liability of its remaining in the stomach undigested. Food which is so selected and prepared as to diminish the work of the stomach should be given only at long intervals in order that the digestion of one meal may be thoroughly accomplished before the next is eaten. It is well to order at least six-hour intervals between the meals, and they should not be eaten too soon after exercise.

Convalescence.—As the patient improves, the dietary may be somewhat enlarged, and thoroughly cooked fresh vegetables, such as spinach, celery, asparagus, onions, and fresh young peas, may be added.

Fresh ripe fruit will be found serviceable in curing constipation, which almost invariably follows as a result of concentrated diet. In many cases this trouble must be counteracted by the daily morning use of some aperient, and a half tumblerful of hot Hunyadi water, or of Friedrichshall bitter water, or a drachm of Carlsbad salts in a tumbler of hot water, should be taken each morning before any food is swallowed. The salts are further serviceable by diminishing hyperæmia of the stomach and hepatic engorgement. Much benefit is derived from drinking a glass of hot water or a glass of hot Vichy from half to three quarters of an hour before each meal, the object being to separate the layer of thick ropy mucus which overlies the orifices of the gastric tubules. Much of the advantage to patients with chronic gastric catarrh received from a course of treatment at Carlsbad and similar spas is due to the action of sulphate of soda and other alkalies in removing mucus from the stomach and cleansing the membrane beneath, rather than to any specific virtue in the salts themselves.

Hydrochloric Acid.—The value of hydrochloric acid given to aid digestion consists quite as much in its power to promote the conversion of pepsinogen into active pepsin as to act directly upon the food. The latter can be accomplished very well by artificial digestion outside of the body. If therefore there is complete atrophy of the gastric tubules in chronic gastric catarrh of long standing, the giving of the acid fails to excite secretion from tubules permanently destroyed, and Boas declares that the acid combines so readily with the salts and albuminoids of the food that it is not practicable to give enough of it to have any free acid remaining, and he only recommends it for those cases where the function of the gastric tubules, as shown by testing the digestive power of a sample of the stomach juice, is not wholly abolished. He admits its usefulness as an antifermentative. This view is not generally held, however, and, as a matter of practical experience, the majority of these cases are improved by taking dilute hydrochloric acid with any solid animal food which is allowed them which is otherwise found to cause discomfort. It is best to give the acid not immediately with the food, but half an hour later, and twenty minims may be prescribed in one dose, or two or three doses of ten or fifteen minims may be given at intervals of half an hour. It may be prescribed alone in half an ounce of water, or mixed with a little glycerin in a claret glassful of water, and it should be swallowed through a glass tube to save the teeth from injury.

Exercise, Massage, Lavage, etc.—Exercise should be recommended, but so regulated as not to interfere with digestion. It should be postponed until digestion has been in progress for at least an hour or two, and, when the patient's strength admits of it, gentle horseback or bicycle riding and moderate rowing is beneficial for the young and middle-aged.

Massage of the stomach, performed two hours after meals, is of service, and lavage is of great value when pyrosis and gastric distress occur so soon after eating as to indicate active malfermentation.

Daily morning douching of the stomach to remove mucus and muco-pus in those in whom a dyspeptic tendency exists will serve to prevent the advent of chronic catarrhal gastritis (D. D. Stewart). This process, which is fully described in connection with the treatment of Dilatation of the Stomach (p. 546), is now much less in vogue than formerly for simple gastric catarrh.

Saline laxatives and appropriate tonics, such as strychnine and arsenic, are indicated in addition to the dietetic measures above described.

Electricity is of service only when one pole of the battery is introduced into the stomach by Einhorn's method (p. 551).

In obstinate cases change of scene and occupation may do much good, and a sea voyage is sometimes to be suggested.

CHRONIC GASTRIC CATARRH IN CHILDREN

Children with chronic gastric catarrh should always eat their principal meal in the middle of the day, and take only a light supper.

When of nervous temperament, they are apt to bolt their food without proper mastication. At the age, too, when their deciduous teeth are being replaced they may from time to time have difficulty in eating solid food. This matter should be inquired into, and if necessary all such food must be minced before it is given to the child. Children accustomed to luxury usually overeat, and suffer in consequence. Their supervision at table is often left to ignorant or careless servants, who should be cautioned, and better heed will be taken if the instruction is given by the physician rather than by an indulgent mother.

In young children gastric lavage is easily performed, and it may be beneficial, but older children are apt to struggle and resist it. The tube may be passed as in gavage (see Gavage), and directions for lavage are also given on p. 547. For this purpose it is well to use only water which has been previously sterilised by boiling.

DILATATION OF THE STOMACH—GASTRECTASIA

Causation.—Dilatation of the stomach may result from stricture of its pyloric end, or from chronic gastric catarrh, in which case it is accompanied by the secretion of much tenacious mucus. The stricture may be due to a carcinomatous growth, to hypertrophied mucous membrane caused by chronic gastritis, or to contracture following gastric ulcer.

Gastric dilatation is also produced by loss of tone or paresis of the muscular coat, by destruction of the muscular coat due to ulceration, and by lack of proper nervous or nutritive supply, such as results from debilitating illness, like typhoid fever, tuberculosis, or general nervous prostration. Less often it is caused by abuses of diet, especially those which give rise to much gas by excessive use of effervescing beverages, etc. The varieties due to gastritis, debility, and dietetic errors are most amenable to treatment.

Pathological Physiology.—The food is improperly digested, owing to want of gastric juice and of peristalsis or to admixture with quantities of mucus. It therefore lingers in the stomach beyond the usual time, ferments, interferes with thorough digestion of the next meal, and renders the chyme unfit for the intestine. Food will often lie undigested in a dilated stomach all night, and be vomited with accumulated mucus in the morning. The undigested food accumulates, and by its weight drags down the stomach and favours further dilatation by stagnation and development of gases. The motor function of the stomach is almost completely suspended, and the organ must therefore be taxed as little as possible.

Dietetic Treatment.—For these reasons it is necessary to limit the quantity of solid, and especially of fluid nourishment. Nothing but the simplest articles of diet should be allowed. All food should be given in a concentrated and readily assimilable form, so that it will either be absorbed directly from the stomach wall or pass promptly into the duodenum.

In bad cases food should be predigested as much as possible, although many of the predigested foods are open to the objection that they are much diluted in the process, and are therefore less serviceable. The more concentrated varieties should be chosen. Ewald recommends the employment of peptonised condensed milk, which is very nutritious and of an agreeable flavour. It should be condensed without addition of the usual excess of cane sugar, which will surely ferment in the stomach.

The patients are often thirsty, and, in fact, the original dilatation may have been caused by excessive imbibition, but the amount of fluid drunk with meals must be restricted to four or six ounces, or in bad cases no fluid at all should be allowed at mealtimes. If the thirst is considerable, a tumblerful of hot water may be taken a half hour before meals, to be absorbed or pass into the intestines before the food enters the stomach. Water is more quickly absorbed hot than cold. In bad cases thirst may be relieved by water enemata, but they are rarely necessary.

The proper diet for gastric dilatation is the same as that recommended for chronic gastritis, except that it is even more concentrated and smaller in bulk, and farinaceous food is almost wholly forbidden.

At first only animal food should be given, such as scraped beef or a piece of broiled chicken, with perhaps a very little dry toast or toasted cracker. If vomiting is a persistent symptom, Pétrequin advises the patient to drink milk very slowly, taking crushed ice with each mouthful. Later, after from two or three to six weeks, if improvement has resulted, more latitude is permissible, and the food advised is lean meat free from coarse fibres; fresh vegetables, young peas, asparagus, tomatoes, tender and well-cooked *purées*, dry bread, haricots, lentils, lettuce or cress with vinegar, simple starches, such as sago, macaroni, rice, tapioca, and vermicelli, boiled or broiled oysters or fish, soft-cooked eggs, orange juice, stewed or baked apples without sugar, stewed pears. Some patients may drink a tumblerful of boiled milk between meals, but, as a rule, it is best to take nothing. Some dietists recommend a perfectly dry diet, omitting all fluids, and order three meals a day at long intervals. In mild cases, coffee and tea without sugar are allowed.

To be avoided are most forms of starchy food, and sugar, potatoes, old peas, beans, corn. Fruit consists largely of water in proportion to its nutritive value, and its vegetable acids are apt to disagree. It must therefore be eaten sparingly. Fats, butter, and oils are not digested in the stomach. Thirst-exciting foods, as salt fish, must not be taken, nor beer, effervescing mineral waters, red wine, thin soups, milk, water, tea, coffee, diluted or light alcoholic beverages.

In all cases too long continuance of a very rigid diet is liable to cause the patient or the stomach itself to rebel. The patient should be weighed once a week. The stools must be examined and the general nutrition carefully considered. If weight is rapidly lost, the food, whatever it may be, is not being assimilated, and it should be changed. It may become necessary to disregard the rules for fluid and put the patient for a time upon a diet of prepared milk.

Aids to Dietetic Treatment.—Other means of treatment which are really adjuncts to dietetic measures should be recommended. Such are lavage, massage, and electricity, which will be considered below. Mucus, especially that which is accumulated overnight, may be washed out of the stomach by sipping a cup of very hot water or taking alkaline mineral water, or a pint of water with ten grains of bicarbonate of soda, on rising.

It is often desirable for the patient to lie down for an hour and a half after eating, and he should especially avoid mental and bodily fatigue, which tend to divert both nerve energy and the blood from the functions of digestion.

Hydrochloric acid and pepsin mixtures with the nitrogenous diet are serviceable.

Lavage.—In cases of either dilatation or catarrh of the stomach which fail to improve on restricted diet and other methods of treatment lavage or stomach washing becomes necessary. This is an entirely safe procedure, and one to which patients become readily accustomed, provided sufficient tact and care is employed when the method is first applied. It was first practised by Kussmaul in 1867. The operation met with so much success that it has since that time been generally adopted, and it is perfectly easy to perform with a little experience and care. It should be attempted in all serious cases in which other methods to relieve the patient have been already tried and have failed. It is almost indispensable in those cases in which the atony of a greatly distended stomach wall prevents the food from being expelled into the intestine, causing constant accumulation and fermentation, or in cases in which decomposing food passes into the duodenum, exciting intestinal dyspepsia, meteorism, and diarrhœa.

As many as sixteen varieties of bacteria have been obtained from the washings of a dilated stomach in which food had been stagnating.

The advantages of lavage are twofold; it not only removes irritating and fermenting material from the stomach, and the ropy, tenacious mucus which it contains, and allays vomiting, but the water itself applied to the mucous membrane cleanses it and stimulates the gastric glands to normal secretion and the stomach wall to contraction. It also promotes more regular action of the bowels.

The relief from the sensations of weight, oppression, discomfort, and nausea which is promptly experienced after lavage is usually immediate and lasts for several hours. It is so great that patients not infrequently learn to pass the œsophageal catheter themselves, and, holding a pitcher of warm water in one hand and a funnel in the other, they wash and siphon out their own stomachs with ease. Usually it is sufficient to wash the stomach once a day. In extreme cases it may be necessary to perform the operation twice a day, but when improvement is once established, washing may be limited to every other day or may be employed occasionally, according to need, but it should be continued for several weeks after the subsidence of all symptoms. As a result of this treatment, the stomach may diminish in size, and the food is always better digested and more completely absorbed, while nutrition and assimilation are correspondingly improved.

The best time for digestion of the principal meal of the day is within an hour after each lavage, when the stomach is empty and thoroughly cleansed, and the meal can often be assimilated completely. If decided repugnance to food exists, the tube may be used for forced feeding, and peptones and predigested milk may be poured in before it is withdrawn from the stomach, although, as a rule, it is best that too much fluid food should not be given.

In performing the operation of lavage a medium-sized œsophageal tube should be selected, about one third of an inch in diameter, having two or three large smooth eyes or "velvet" fenestra and made of good, smooth red rubber which is sufficiently flexible without being so easily bent as to allow the tube to double upon itself in its passage. This tube should be fully eighteen inches long, and it is attached to a length of three feet of common rubber tubing by means of a small glass tube; the other extremity of the rubber tubing is fastened to a funnel through which warm water is poured into the stomach. A glass funnel is preferred, which makes it easier to examine the washings as they return. The patient is cautioned to keep the head straight forward and thrown back and not to bite the operator's finger, and the tube is gently pushed over the dorsum of the tongue down over the posterior pharyngeal wall into the œsophagus. The insertion of the tube will be facilitated by oiling it slightly with a little olive oil, butter, white vaseline, or glycerin, but white of egg or milk are less likely to nauseate.

If there is any difficulty in introducing the tube, its downward passage may be aided by passing the forefinger to the back of the pharynx. If the patient, who either sits or stands, is instructed to make an effort at swallowing while the tube is being inserted it will descend much easier, and pains should be taken to explain the process and reassure him, for nervousness and struggling may excite spasms of the laryngeal muscles and make it difficult or impossible to pass the tube. On reaching the cardiac end of the stomach, the tube is occasionally stopped for a moment, but the patient should be instructed to try and swallow, and with gentle pressure the orifice soon relaxes and the tube enters the stomach. Or a little water poured into the tube may cause the cardia to relax. The funnel is raised above the patient's head, but before pouring in much fluid it should be ascertained that he is able to breathe comfortably and quietly when the tube is momentarily compressed. He should be reassured that he will not choke. Accidents have occasionally happened from passing small tubes down into the larynx, and I have known of one fatal case in which a nasal tube was thus passed and milk was poured into the lungs. A case has been reported in which beef tea was poured into the lungs in this manner, but the patient recovered and the beef tea was coughed up or absorbed. There is very little danger of introducing an œsophageal tube of the ordinary size in the wrong direction, for any attempt to push it into the pharynx will be met by obstruction and spasmodic coughing. If the stomach is full when the tube is first passed, some of the contents may be immediately siphoned out by lowering the funnel below the stomach level and holding it over a foot tub or pail. If necessary, water can be poured in gently to the extent of a quart, or until the patient complains of uncomfortable fulness in the stomach. Care should be exercised not to admit air bubbles. The tube and funnel are then inverted over a foot tub or wash basin and the contents of the stomach are quickly siphoned out. This operation may be repeated a number of times until all the food and mucus have been removed and the washings return quite clear and neutral in reaction.

The quantity of water used in the washing should be measured so that it all may be siphoned out again, as it is undesirable to leave any fluid behind.

When the tube is introduced for the first few times it may excite efforts at vomiting, but it is not necessary to remove it, for the patient can usually regurgitate the long, stringy mucus alongside of it. Salivation is often produced in the first few trials. After one or two attempts patients will learn to swallow the tube themselves with very little assistance and cease to gag upon its introduction.

If there is hyperæsthesia of the pharynx the pharyngeal wall may be touched with a 2- or 4-per-cent cocaine solution just before the introduction of the tube, or several large doses of bromide of potassium may be administered during the previous twenty-four hours. If nausea occurs when the tube first reaches the cardia it is usually overcome by pouring in a little fluid. The success of the operation at the first trial depends largely upon the skill of the physician and the degree to which he has obtained the confidence of his patient, and has been able to overcome any nervous feeling in regard to a process which is at best highly disagreeable. After the sufferer from gastric dilatation has experienced the relief which lavage of the stomach can give, he usually requires no urging to allow the process to be repeated. In withdrawing the tube it should be compressed in order to avoid having any of its contents trickle into the larynx.

The fluid used for washing the stomach may be either cool, warm, or quite hot water. Warm water is best, but it is well to sterilise it by previous boiling. If much mucus is present or much acidity, sodium bicarbonate may be added in the proportion of two or three per cent (15 grains to the pint), or a similar quantity of sodium borate or boric acid, a one-half-per-cent solution of salicylic acid, or a 1-per-cent solution of sodium salicylate. Vichy is occasionally used.

The best time for conducting lavage is shortly before the midday meal, the patient having had a very light breakfast, and it should only be performed when the stomach is believed to be comparatively empty. If the tube is introduced before breakfast, having had nothing to eat for a number of hours, patients are more apt to be disagreeably affected, especially if the washing be long continued, and I have occasionally seen them become faint under these circumstances. It is better, therefore, that a light breakfast of bread and milk, pancreatinised milk, or of a scraped-beef sandwich and a cup of black coffee should be taken; three hours later the stomach is to be washed. There are exceptional cases in which the patient is so distressed by the effort to pass the tube or by the operation of rinsing the stomach itself that it has to be abandoned. Lavage must be avoided in cases complicated by much prostration, feeble heart action, aneurism, hæmatemesis, or hæmoptysis.

Accessory measures which are to be used in connection with lavage and careful regulation of diet are massage and medicinal treatment which consists largely of the administration of tonics, especially strychnine, with the object of increasing the muscular action of the stomach. This remedy may be given hypodermically if necessary.

Massage.—Gastric massage should be performed about two and a half or three hours after each meal for ten minutes. The patient must lie upon his back, with knees drawn up and muscles relaxed. The movements, stroking and kneading, must be always made over the stomach in the direction of the pylorus, the object being to facilitate emptying the stomach through that opening, and to stimulate peristalsis. If not too weak, the patient may be taught to perform these movements himself. This treatment is often of considerable aid in mixing the food and gastric juice and in propelling the food into the intestine. It increases peristalsis.

Electricity.—Faradisation of the stomach is believed by many to increase its muscular tone, and various forms of electrodes have been devised for this purpose. It is probable that very little, if any, electric stimulation reaches the stomach when currents of ordinary strength are applied over the epigastrium, although Ewald and Sievers claim that it does in some cases. This is especially true of faradism. Canstatt first proposed to apply the current directly within the stomach wall, and methods have been devised by Bardet, Einhorn, and others to serve this purpose.

The ingenious electrode invented by Einhorn, of New York, is easily passed into the stomach. It consists of a hard-rubber capsule about the size of a small French olive. The hollow capsule has numerous perforations and within it is a small metallic electrode. The capsule is fastened to a fine flexible conducting wire, which is attached to the battery, and the wire is protected by a minute soft-rubber tube one inch in diameter. This electrode is readily swallowed by placing it upon the dorsum of the tongue and then drinking water. About forty centimetres of the wire should be swallowed. In withdrawing the electrode after use it sometimes catches at the cardiac end of the stomach, but if the patient swallows a little water it slips past. When this electrode is in the stomach, which has been previously partially filled with a pint or more of warm water or saline solution, the second electrode, broad and flat, is placed over the epigastrium or over the back to the left of the seventh dorsal vertebra, and the electric current is carefully turned on.

This treatment is designed especially to increase the muscular tone of the stomach in atonic dilatation and stimulate peristalsis, but it also serves to promote secretion, and hence it doubly aids digestion. The electric current may be applied daily, immediately after lavage, for ten or fifteen minutes, and it should be strong enough to induce good peristalsis. Even patients who are not accustomed to lavage seldom object to swallowing the electrode.

A variety of medicinal remedies are also used with the object of preventing fermentation of food in the stomach and intestine and for artificially aiding digestion by these organs. Among the former are to be mentioned creosote and other substances allied to carbolic acid, naphthaline, salicylic acid, etc. The use of hydrochloric acid and pepsin have been described in connection with chronic gastric catarrh (p. 540).

Vomiting—Seasickness—Vomiting of Pregnancy

Vomiting occurs as a symptom of so many diseases and functional derangements that it will be advantageous to consider collectively the general dietetic means for its relief. The details of treatment will be explained under the headings of the various diseases in which vomiting may become a serious or prominent symptom.

Pathological Physiology.—Vomiting as far as it is related to dietetics may be caused by: 1. Excess of food. 2. Foods and drinks improperly combined (as crabs and milk, beer and champagne, etc.). 3. Fermenting or poisonous food. 4. Irritating and indigestible food, including that which is improperly cooked. 5. Hastily eaten food.

In hysterical patients and in very neurotic conditions of the system, either the sight, taste, smell, or mental suggestion of food may excite nausea and vomiting.

Instances of the influence of the mind over stomach digestion and the mechanism of vomiting are too familiar to need elaboration here. Food which is in itself nourishing may promptly nauseate through disgusting association or environment. For example, a party of early California settlers while crossing the continent were lost during a severe winter in the Sierras. When nearly dead of starvation some friendly Indians took compassion and fed them upon a delicious finely ground meal, which for some days was their staple article of diet, and on which they rapidly gained strength. Being at first unable to understand the Indians, the emigrants could not learn of what the meal was composed. When at length they found out that it was made from pounded dried grasshoppers it produced such nausea that none could touch the food again.

Dietetic Treatment.—The first principle in the dietetic treatment of vomiting from any cause is to give the stomach rest. If it has been overloaded with a large bulk of food, or with indigestible material, it is well to encourage emesis, and distressing retching may be overcome by taking large draughts of lukewarm water. A quart or two will rinse out the stomach and allay irritation to a marked degree.

Well-nourished patients when serious vomiting first occurs should usually refrain from taking food of any kind for from ten or twelve to even twenty-four hours. Exceptions to this rule are sometimes found in that type of seasickness, and sometimes in the vomiting of pregnancy, in which, as soon almost as the stomach is emptied, there is a desire to replenish the loss.

In any case in which the gastric irritation is persistent it is necessary to give fluid food, and only in small oft-repeated doses, preferably in predigested form. The food is best given cold, as a rule, although some persons can relieve nausea by sipping very hot water.

A teaspoonful of prepared milk, or in extreme cases but a few drops, given with a medicine dropper once in ten or fifteen minutes, may be all that the stomach will at first tolerate.

The following is a list of dietetic substances which are commonly prescribed for the relief of nausea and vomiting, or for nourishment while those conditions exist: Cracked ice; pancreatinised milk; milk with sodium bicarbonate (ten grains), and cerium oxalate (five grains); milk and lime water; milk and Vichy, soda, Seltzer, or carbonic-acid water; whey; koumiss and zoolak; beef extracts and peptonoids, such as Johnson's Fluid Beef and Carnrick's Beef Peptonoids, somatose, Valentine's or Liebig's meat juice; raw meat pulp, scraped; strong black coffee; sour lemonade or lemonade and Vichy; clam broth. Dry crackers, dry toast, and ginger-snaps will sometimes be retained in seasickness, or a cracker buttered and sprinkled with a little Cayenne pepper; brandy and soda; iced dry champagne; iced brandy diluted with water, soda water, or Apollinaris.

Very severe and protracted cases may require lavage or nutrient enemata. Vomiting after abdominal surgical operations is often controlled by lavage.

SEASICKNESS

There is no known dietetic treatment of seasickness which is applicable to many cases. There are those who overeat because of the tonic of the bracing sea air. The idleness and lack of accustomed exercise, and perhaps something in the quality of the air itself, all contribute to make them bilious, and unloading stomach and bowels thoroughly once for all suffices to cure them for the rest of the voyage. The habit of indulging in late "farewell suppers" is naturally the worst preparation possible for a sea voyage.

Some persons at sea can leave the table, vomit the first two or three courses of a dinner, return, and finish the meal with astonishing equanimity. With them nausea is not a persistent or annoying symptom, and they need no treatment. Others are always nauseated, but fail to vomit, and consequently grow weak from lack of food. They do well to take a mild emetic at first, and usually a tumblerful of lukewarm water will serve to empty the stomach of food lying there undigested and fermenting. They are then temporarily relieved, and can assimilate some form of predigested food.

Still others, after severe experience with emesis, strongly crave and can actually retain and digest, in defiance of all dietetic laws, substances which they could scarcely eat at home. Old cheese, nuts and raisins, sour pickles, canned lobster, and similar incongruities of diet are indulged in without a qualm.

There is a class of persons of both sexes, though the greater number are women, who become so ill at sea as to reach a serious condition of prostration. These patients are constantly nauseated, not alone by the taste, but by even the sight and odour of food. The mere idea of it, as the suggestion from reading an elaborate *menu*, will nauseate. It is often difficult for such patients on a crowded steamer to obtain the proper food and service, and it is well for them to go provided with certain articles which are most useful. Chief among these is sterilised milk. This is now easily obtainable before sailing, and there is no difficulty in keeping it fresh during the length of an ordinary transatlantic voyage. It may be peptonised at the time it is needed, or diluted with equal parts of Vichy or lime water, or taken with ten grains of bicarbonate of soda and three grains of cerium oxalate to the tumblerful. The Swiss milk, condensed without sugar, may also be used. Fresh lemons and sour oranges are very acceptable to many patients, the former particularly so on account of their greater acidity and special power to quiet the nausea of seasickness. The juice of one or two lemons, squeezed into a tumbler of iced Vichy or Apollinaris, with a little sugar or saccharin, and a pinch of bicarbonate of sodium, makes a most refreshing and soothing beverage.

Prepared clam broth, like milk, can also be taken in bottles, and it often allays nausea. It is mildly stimulating and nourishing.

Other drinks which are recommended besides those above mentioned are weak brandy and soda or Seltzer, cold champagne, or sparkling Moselle. Too much ice water should not be drunk, but cracked ice may be sucked. Strong black coffee is excellent. If there is uncertainty about this being obtained good at sea, the extract of coffee may be carried, which can be drunk diluted in hot water. Coffee distinctly allays nausea, besides being a good cardiac stimulant and diuretic. Some persons can take porter or stout in small doses with benefit.

It is not well to take too much soup or broth at once, for if there is much motion the weight of the fluid, tipping about in the stomach as the vessel rolls and pitches, may easily accentuate the nausea. In some cases patients may retain dry, solid food better than liquids, and they should try soda crackers, zwieback, lemon ginger-snaps, and chipped smoked beef, which can be obtained in boxes at the grocer's before sailing. In extreme cases it may be necessary to use beef peptonoids or other meat preparations, such as beef meal, given either by mouth or in enemata. The white of egg may be given in brandy. Preserved dry ginger helps some persons. Lime-water tablets may be used.

Epigastric applications of hot-water bags or mustard pastes afford relief. It is desirable to lie down at once after taking food, and lie perfectly horizontal, without a pillow. It is very important to keep the bowels freely open with bitter water of some sort. Rubinat is less objectionable in taste than others. Seidlitz powders are usually well retained, and so is citrate of magnesia.

VOMITING OF PREGNANCY

The vomiting of pregnancy usually takes the form of simple "morning sickness." This may not appear until the patient arises in the morning, when she feels faint, dizzy, and nauseated. Such cases are benefited by remaining in bed until a glass of milk, or a cup of warm broth with a biscuit, or a cup of cocoa or coffee and a sandwich has been taken and digested. There may then be no return of nausea during the day, but the diet should at all times be simple, especially the last meal of the day, and all richly cooked food, pastry, sweets, sauces, and elaborate "made dishes" should be avoided. Beyond this such patients may need no further treatment.

In other women the nausea is more persistent, and in the worst instances the symptom is very difficult to control by any therapeutic or dietetic measures.

Such cases are to be treated on the lines suggested above for the cure of vomiting in general and for severe seasickness. Nutrient enemata should be early resorted to if there is any sign of failing strength, and before a patient is allowed to die of inanition artificial delivery may be necessitated. Such extreme cases are fortunately very rare.

The treatment of other forms of vomiting will be considered under the headings of Alcoholism (p. 399), Acute Gastritis (p. 537), Chronic Gastritis (p. 540), and Dilatation of the Stomach (p. 546).

Ulcer of the Stomach

In ulceration of the mucous membrane of the stomach there is danger of irritation of the abraded surface through either the chemical or mechanical action of the food. Excessive secretion of gastric juice itself is believed to be similarly irritating. In serious cases where the ulcer is extensive or where it is deep and the stomach wall is thinned, there is liability of a rupture being caused by overdistention or an undue amount of peristaltic action. In the normal relaxed condition of the stomach wall the mucous membrane is folded into rugæ, but when it is slightly distended the surface is smoothed out, and a greater degree of stretching may rupture an ulcer which is on the point of perforation, but which might still heal over if the tension were not too great. Further danger from the presence of ulcer of the stomach lies in the fact that small blood vessels may be occasionally eroded, giving rise to profuse hæmorrhage, and any food which irritates the surface of the ulcer increases this risk.

Dietetic Treatment.—For these reasons, if the patient is seen soon after the occurrence of gastric hæmorrhage, it is necessary to withhold all alimentation from the mouth and nourish the patient exclusively upon nutrient enemata. This treatment permits the stomach to remain relaxed, and it is not stimulated to peristalsis or secretion of irritating gastric juice.

In addition to the ordinary nutrient enemata it may be advisable twice a day to give rectal injections of a pint of salt water, which by its absorption prevents thirst and relieves the patient of the craving for swallowing liquid, which might result in exciting further vomiting. In severe cases, if the irritability of the stomach continues or the hæmorrhage is repeated, it becomes necessary to continue the rectal alimentation for many days, and patients may live upon it comfortably for a week or, in some cases, much longer.

Lavage has been employed successfully when vomiting and pain in the stomach were uncontrollable. One usually hesitates in adopting this practice on account of a fancied danger of pushing the œsophageal tube through the weakened wall of the stomach, and I have known of one case which resulted fatally from this procedure, where the stomach wall, however, was already eroded through both the mucous and muscular layers, and perforation in any event was imminent. When the stomach wall is weakened the mere act of vomiting itself is a menace of rupture, and the operation of lavage is justifiable if carefully performed. There is no special danger to be apprehended from the use of a very flexible tube which is not pushed too far into the stomach, as the ulcer is usually some distance from the cardiac end, and food can sometimes be poured into the stomach through the tube after lavage with alkaline water, when it may be retained and digested. This treatment should only be resorted to in cases where hæmorrhage has not occurred within a week, and in which other efforts to control pain and irritation of the stomach have been faithfully tried, but have failed.

Debove recommends the use of the œsophageal tube for gavage when vomiting is persistent and nutrient enemata are not satisfactorily retained. The tube should be passed as far as, but not necessarily into, the stomach, and fluid food is poured through it. The act of swallowing is thus avoided, and emesis, as in the case of infantile dyspepsia, is less likely to follow. If the tube proves irritating its use must not be insisted upon.

Generally speaking, however, after a day or two of complete rest the condition of the stomach will admit of the gradual resumption of mouth feeding, but nourishment must be given exclusively in liquid and predigested form. The object is to give only food which will tax the stomach as little as possible, and either be promptly absorbed or pass quickly into the duodenum.

At first but very small quantities, not exceeding one or two teaspoonfuls, should be offered at one time, and the effect in regard to nausea or vomiting must be carefully observed. Later, from four to six ounces should be given every two hours. For those cases of ulcer of the stomach in which patients are allowed to take food per os, a milk diet will usually agree the best, provided precautions are observed against the formation of large curds in the stomach, which are exceedingly irritating. The milk should be given in any form in which it is best borne, and the reader is referred to the article upon the modes of preparing milk and rendering it digestible (p. 76). If it is tolerated, the dosage may be increased to three to four ounces every two hours. Peptonised milk gruel is strongly recommended by Roberts. Da Costa has found that ice cream gave unexpected relief in some cases. Some patients do well upon koumiss, buttermilk, or zoolak. Ewald advocates the use of milk thickened with flour of various kinds to prevent the formation of large coagulæ. The predigested starchy infant foods, such as Nestlé's, Mellin's, Imperial Granum, or malted milk, may be added, but gruels made with coarse cereals are not permissible.

When milk preparations fail, it is unwise to persist in giving them, and teaspoonful doses of beef juice should be substituted, or peptonised solutions or pancreatinised meat juice may be tried. Other patients may be fed upon egg albumin beaten and sweetened or prepared with sherry wine, or the yolk of an egg may be beaten in an ounce of boiling water and added to a tumbler of milk. Less serious cases may be allowed such articles as zwieback or stale bread crumbs or cracker crumbs soaked in milk until quite soft. They will prevent the formation of large coagulæ of milk. One of the various malt preparations may be well tolerated and prove nutritious. Leube's Soluble Meat is a German preparation, which relieves the stomach of all necessary work, and consequently reduces the period of acid secretion in the stomach. It proves very serviceable in the dietetic treatment of gastric ulcer, and may be given alone or combined with milk or salted meat broths and bread crumbs. Leube himself prescribes in this form an equivalent of half a pound of beef in twenty-four hours, and claims good success for it. Mosquera's meat jelly may be employed.

As a rule, if a patient thrives upon a diet of milk and broths, it is best to let well enough alone for three or four weeks, and any increase in either the quantity or variety of the diet should be made with extreme caution. If improvement follows, as indicated by the diminution in pain and the absence of gastric distress after eating, and the patient gains in strength, other articles may be carefully added in moderation to the diet, such as milk toast, sweetbread, eggs (not hard-boiled), scraped meat, custard, a small piece of boiled or broiled white meat of chicken or mutton or fish, chicken broths thickened with arrowroot, rice, vermicelli, clear meat broths or thickened soups to which the yolk of an egg has been added, or crumbled dry toast and a carefully prepared *purée* of potatoes may be prescribed. Stewart recommends the addition of malt to the *purée*.

A few easily digestible solid foods may next be added to the *menu*, such as tender rare roast beef, beefsteak, tender game, like the breast of partridge, quail, or squab in season. The soft part of large oysters (raw or broiled), boiled fresh fish, such as bass, sole, or whiting, rice pudding, bread and milk pudding, tapioca, sago, farina, and cornstarch—are all articles which may be permitted in moderation.

The patient should be informed of the existing condition in the stomach, and of the dangers attending any serious departure from the rules of diet carefully laid down, and it should be explained that for several months after the acute symptoms of gastric ulcer have subsided the greatest care must be observed not to overload or overwork the stomach, and to refrain from eating food such as coarse bread or groats, or vegetables having tough outside covering, like peas, corn, and beans, all of which are liable to produce mechanical irritation. No fruit except orange, lemon, or peach juice should be allowed.

Osler recommends the following *menu* for gastric ulcer:

8 A. M.—Two hundred cubic centimetres of Leube's beef solution.

12 M.—Three hundred cubic centimetres of milk gruel or peptonised milk gruel made with ordinary flour or arrowroot, to which gruel an equal quantity of peptonised milk is added.

4 P. M.—Buttermilk.

8 P. M.—Gruel.

In addition, rectal alimentation is to be given. The whites of eight eggs may be used in alternation with the beef solution.

After a month of this treatment the following articles are cautiously given: Scraped beef, chicken, fresh sweetbread, a farinaceous pudding made with milk and eggs. This treatment should last three months, most of which time is to be spent in bed.

The rules for stimulants are that they should be absolutely forbidden unless they become necessary through exhausting hæmorrhage or great weakness, in which event they had better be supplied through the rectum.

Von Ziemssen prescribes Carlsbad water in order to neutralise the acidity of the stomach and hurry its contents into the duodenum. He recommends drinking half a pint to a pint of this water hot early in the mornings during convalescence.

Aërated waters should not be recommended. The gas is apt to distend the stomach, and the carbonic acid is believed to be irritating to the raw surface of the ulcer.

Cancer of the Stomach

In cancer of the stomach, prolongation of the patient's life and personal comfort depends more upon the dietetic than any other form of treatment. Nourishment should be given in a concentrated and predigested form, and where pyloric obstruction exists, in a condition which admits of direct absorption from the stomach wall. It is necessary to avoid food that is liable to remain long in the stomach and excite nausea and vomiting, which may in turn develop severe pain or fatal hæmorrhage, and to prohibit anything which by undue fermentation might cause distention and stretch an already thinned gastric wall to the point of perforation.

Osler mentions that in organic disease of the stomach pain usually begins soon after eating and continues until its digestion is over or vomiting occurs, but sometimes the pain of carcinoma may be relieved by ingestion of food.

Aside from the local difficulties of digestion in gastric carcinoma in the immediate vicinity of the stomach wall, the gastric juice is either deficient in amount or altered in composition, and the hydrochloric acid may be totally absent. Hence stomach digestion cannot be counted upon at all, and it is important to digest all food by artificial processes.

In nearly all cases nutrient enemata will sooner or later be required either as an adjunct to stomach feeding or to replace it entirely. Owing to the importance of this subject, it will be separately discussed. (See p. 414.)

If much pain follows the ingestion of any food, or if there is a tendency to hæmorrhage, stomach feeding should be entirely replaced in this manner. In no other disease can life be supported for so long a time and so comfortably upon exclusive rectal alimentation. After a few days of rest secured by substitution of enemata the stomach may become less intolerant and food can again be swallowed.

The exact nature and site of a carcinomatous lesion cannot always be determined, especially in its early stages, and each case requires special study. Patients soon find by experience what gives them most distress and learn to avoid it. In general, saccharine and farinaceous foods should be proscribed because they are normally not digested in the stomach, and in carcinoma they linger and, aided by the catarrh which is usually also present, undergo abnormal fermentation with production of gas, nausea, and vomiting. It is usually the case that predigested albuminous food is better assimilated.

Digestion in such cases should be watched from day to day, and when patients can tolerate a little simple farinaceous food without its producing eructations or increasing the gastric pain and discomfort, it may be added.

If the new growth causes stricture of the cardiac end of the stomach, only fluid food can be taken, and the act of swallowing should be studied to make sure that dilatation of the œsophagus is not developing. If, on the other hand, it constricts the pyloric end, food cannot pass on into the intestine and gastric dilatation may result. It then becomes highly important to put into the stomach only that which can be absorbed from its wall. Such substances, besides water, include peptones, albumoses, and alcoholic stimulants (champagne, whisky, and brandy), all which may be taken up by the circulation of the gastric wall in considerable quantity. Albumoses would theoretically constitute a most useful food, being entirely predigested and ready for immediate absorption; but practically patients soon weary of such a diet, and food of that nature will not long support life when given alone. In complete pyloric obstruction albumoses may be prescribed, and in advanced gastric dilatation they are needed. They may be sometimes alternated with other foods with advantage.

If much dilatation exists without nausea or vomiting, fluid foods will sometimes lie unabsorbed in the stomach for one or two days, and then several quarts of fluid will be unexpectedly ejected. It is consequently advisable to examine and percuss the stomach from time to time, to make sure that nourishment swallowed is not accumulating there.

Exceptionally, if the disease has not progressed too far, patients do best on a dry diet, and finally chopped steak, tender rare beef, chicken, scraped beef, soft-cooked or raw eggs may be given, and digestion is facilitated by the use of pepsin and hydrochloric acid or papoid. If there is no pyloric obstruction, and if it does not produce nausea or pain, simple forms of starchy food may be added, such as dry bread, toast, or crackers.

In advanced cases the diet must be fluid and concentrated; food should be given only in very small quantities—not over one or two teaspoonfuls at one time, frequently repeated. Meat extracts, albumoses, buttermilk, pancreatinised milk, koumiss, and prepared egg albumin may be retained. The yolks of eggs are not absorbed from the stomach on account of the fat which they contain. When possible, the diet should consist almost wholly of predigested milk.

Oppolzer advises the use of sour milk in cases of carcinoma of the stomach in which there is more or less constant tendency to vomiting, and in which ordinary milk coagulates in the stomach in large curds. Sour milk is much less apt to form large tough coagulæ. It is usually better, however, in such cases to pancreatinise the milk or give it in the form of koumiss.

For the control of vomiting there may be also tried iced carbonated water, champagne, bismuth, and counter-irritation. For indigestion, eructations, or gaseous distention, antacids and antifermentatives are indicated, or pepsin with dilute hydrochloric acid.

Ewald says: "A diet of starches and vegetables is more easily borne than that of meat, since the diminution in the secretion of hydrochloric acid causes the digestion of albumin and meat to be incomplete. In most cases milk is also poorly borne, on account of the absence of rennet." When milk is tolerated, however, he advises the addition of a few drops of Cognac to each tablespoonful, or the use of kefir or peptonised milk.

Many special systems of diet have been exploited for the treatment of cancer of the stomach, some of which have proved of occasional value, and have at least the merit of being based upon scientific reasoning, whereas others are pure quackery. It is almost needless to say that no such thing as a dietetic "cure" for cancer exists. The most that can be expected of any dietetic system for this fatal disease is that it may make the patient somewhat more comfortable, and prolong his life perhaps for a few weeks or months by maintaining better general nutrition.

Lavage is sometimes employed as an adjunct to dietetic treatment where much catarrh of the stomach or dilatation is present. It may relieve some of the symptoms in the early stages of the disease, but it should be performed with great care, for it is uncertain to what extent the stomach wall may be eroded. I have known of at least one case in which a fatal result followed the false passage of an œsophageal tube.

Diarrhœa

Pathological Physiology.—Diarrhœa is commonly the result of excessive peristalsis. It may also be occasioned by the presence of a large volume of fluid in the intestine, caused either by lack of absorption of an excess of liquid ingested, or oftener by hypersecretion or failure to absorb the fluid of the chyme.

The exaggerated peristalsis is occasioned—

1. By increased irritation of the nerves or muscles of the intestine, due to mechanical stimulation of irritant or undigested particles of food (e. g., the seeds of berries or husk of corn grains).

2. By chemical products which are contained in the food.

3. By abnormal fermentation, the products of which excite muscular contractions. There are many dietetic causes of diarrhœa. It may be produced by fermented or putrefactive food, by improper food mixtures, by food which is too coarse, bulky, and irritating, or by monotony of diet. The excessive use of meat extracts or "pep-

tones" is liable to cause it. In the tropics, as shown among the troops employed in Cuba and Porto Rico in the Spanish-American war, it may originate from a salt-pork ration, the consumption of too much meat, canned dried beans ("baked beans"). In the tropics and in hot weather, generally, catarrhal enteritis is easily excited, and animal food soon spoils if exposed to the heat and air.

Diarrhœa may be (*a*) *acute*, due to temporary errors in diet, "taking cold," causing acute intestinal catarrh, the ingestion of poisons, overdoses of aperients, etc., or (*b*) *chronic*, complicating some intestinal or other malady.

Acute diarrhœa often subsides of itself if food be withheld until the irritant matter has passed off from the intestine.

Chronic diarrhœa of long standing requires great care and patience in treatment.

Abundant greenish fluid stools showing much bile pigment indicate that the stools have been hurried out of the small intestine before digestion was complete.

Of the many forms of diarrhœal diseases, the treatment of those only which are most influenced by diet will be discussed in the succeeding pages. There are a few propositions which have general application to the different varieties, which will be mentioned here.

Dietetic Treatment.—It is a general rule to moderate the quantity of food and avoid all food likely to undergo abnormal fermentation (such as sugars), or having a considerable residue. Unirritating or bland substances only should be taken. Fruits and vegetables must be wholly interdicted.

At the commencement of an acute attack food may be withheld for ten or twelve hours, and a little barley water or arrowroot gruel flavoured with a mere taste of lemon or spice should then be ordered with one or two tablespoonfuls of brandy in soda water. Mutton or chicken broth may next be given, and, if desirable, it may be thickened with boiled rice, tapioca, sago, or cracker crumbs. Patients who are not at the same time "bilious" or vomiting may take milk diluted with one third lime water.

The return to ordinary diet should be in all cases gradual, and such articles as milk toast, oysters, well-cooked macaroni, boiled rice with beefsteak gravy, the breast of boiled chicken, or a little partridge in season, with baked and mashed potatoes, may be first allowed.

Loose stools sometimes occur immediately after meals, the impulse for the bowels to move coming so suddenly that the patient scarcely has time to leave the table for the closet. In such cases "some one article of diet is at fault" (Osler). The patient should be put upon a diet restricted mainly to meat and stale bread or toast for a few days, and made to lie down and rest immediately after meals. Taking food into the stomach excites a reflex intestinal peristalsis, and the intestinal contents are hurried onward before they can be digested.

For the form of diarrhœa which occurs in hysterical women, if a milk diet is not well borne, Osler recommends feeding the patient upon egg albumin exclusively while medicinal antispasmodics are given to diminish peristalsis.

In diarrhœas demulcent and mucilaginous drinks are useful, and they are believed to coat the alimentary canal and protect it from local irritation. It is doubtful, however, whether any such action occurs beyond the stomach.

Diarrhœa in Infants and Young Children

Dietetic Causes.—The dietetic causes of diarrhœa in infants and young children may be classed as due to—

1. Too frequent or irregular feeding.
2. Overfeeding.
3. Feeding with improper or "spoiled" food.

The first and second causes are commonest in early infancy, and the third is commonest in childhood, although any or all of them may operate at any age.

Children brought up in the country are much less subject to diarrhœal disorders than those raised in cities, owing to the relative purity of their milk and other foods, and the greater resisting power with which their better general health and vigour supplies them.

In a series of nearly two thousand cases among infants of fatal diarrhœa, collected by various observers (Hope, Meinert, Ballard), only 3 per cent received the breast exclusively. These are very significant data, and point to the conclusion that the vast majority of cases are due solely to the use of improper or contaminated food.

Differences in the mere chemical composition of the cow's milk used for feeding are not sufficient to account for the frequency of diarrhœal diseases, and the further conclusion is reached, and has been sustained by bacteriological research, that the harm is caused by noxious germs.

Diarrhœa occurring in nursing infants must be accounted for in other ways, although germs may readily have access to the child's mouth from an unclean nipple or from sucking its own soiled fingers.

Aside from this, anything which disturbs the mother's digestion may excite diarrhœa in her baby, as, for example, improper food, menstruation or pregnancy (rarely), strong nervous influences, such as grief or worry, great exhaustion, extreme anæmia, the use of certain powerful drugs.

Evidently the intestine becomes stronger or less susceptible to bacterial poisons after the first two years or thirty months of life, for the frequency of serious diarrhœa lessens, although the child often gets worse milk to drink than it had when fed upon the bottle.

It has been suggested that water may excite diarrhœa by hurriedly washing germs into the intestine which are ordinarily killed in transit by the acid of the stomach. The bile is reputed to be antiseptic, but Booker has found that all bacteria will grow in a 10-per-cent solution of it, and it easily undergoes fermentation from decomposition of its mucus. Its antiseptic reputation rests upon the fact that it stimulates peristalsis, keeps the bowels moving, and thereby prevents food from accumulating and fermenting abnormally.

In large cities, where women among the poor are obliged to go out to work by the day, they, as a rule, suckle their infants for only the first six months, or if for a longer period, they add other food or have their babies bottle-fed by a neighbour or in a "day nursery" during the hours in which they themselves are away from home. Such hand-fed children are often given more than they can assimilate.

As the infant grows older it is brought to the family table, and when a year and a half old it is not seldom stuffed with any articles from it. Beer, sausages, bananas, potatoes, tea, and coffee—all are given.

Overfeeding and the use of such harmful food maintains almost constant dyspepsia, and if it does not itself cause diarrhœa it predisposes to it by keeping the alimentary canal in a constant state of irritation or hyperæmia, so that slight additional factors excite the condition, and bacteria find a fertile soil in which to develop.

In older children foods which are among the commoner causes of diarrhœa are unripe or overripe fruits of all kinds, berries with seeds, vegetables having a tough outer envelope, such as old peas, beans, and green corn, imperfectly cooked cereals, like coarse hominy, rice, or oatmeal, nuts, raisins, and dried currants. Generally speaking, diarrhœa is more apt to be caused by fruits and tough meats imperfectly masticated than by vegetables.

Examination of the Stools.—In all serious cases the stools should be examined, if possible, microscopically, to determine the degree of digestion and absorption of the food. The chief abnormal ingredients are fat, bacteria, mucus, casein, starch, and, if meat has been eaten, muscle fibres. The green diarrhœa of infancy is usually of microbic origin. Diarrhœa of putrid character is due to albuminous fermentation, and produces more severe symptoms (see ptomaine poisoning) than those produced by the simple fetid stools of starch fermentation.

Fat.—The normal percentage of fat which the stools contain is, according to Uffelmann's analysis, fourteen on the average, but in diarrhœa with intestinal dyspepsia it rises often to forty or fifty, and it has reached sixty-four. The fat appears in minute white flocculi, varying in size from that of a pin's head to a split pea. These small masses are often mistaken for casein, but the careful researches of Wegscheider, Baginsky, and others have demonstrated them to be composed of inspissated fat and colonies of bacteria. It is an easy matter to distinguish them from casein, as they alone are dissolved by the addition of a few drops of alcohol and ether.

Bacteria.—The commonest bacteria of infant stools are the *Bacterium lactis aerogenes* and the *Bacterium coli commune*. In fact, these two normal varieties are the only constant kinds in milk-fed babies (Escherich), although Booker has found in different cases of infantile diarrhœa, and especially cholera infantum, forty varieties in all which bear no special relation to particular foods. The first-named germ occurs only when milk has been ingested, for it thrives, as its name indicates, upon lactose. Its chief site is the small intestine, where it causes milk to ferment. The *Bacterium coli commune*, on the contrary, elects the large intestine and thrives upon the residue of digested food. Booker is of the opinion that the influence of the various pathogenic germs in the production of diarrhœa is attributable more to alteration of the food and intestinal contents than to direct irritation of the intestinal wall.

Casein.—Undigested casein is a less common ingredient of the stools than was supposed before the above-described observations were made. When present it is in the form of smooth, somewhat hard masses, often of a yellow or yellowish-white colour without, but white when broken open. They are usually friable, and have a cheesy odour. They may present a semi-transparent or horny appearance.

Starch.—Starch granules appear in the stools very often when imperfectly cooked amylaceous food has been eaten, such as oatmeal, barley, potatoes, bread, etc.

They are recognised by the microscope, and by the addition of a solution of iodine, which colours the stools dark blue.

Meat Fibre.—Muscle fibres are easily recognisable by microscopic examination, but not otherwise.

Dietetic Treatment.—The principles of dietetic treatment of simple bacterial or mycotic diarrhœa occurring in infants under two years of age are, first, to give the alimentary canal rest, and, secondly, to give food which is very thoroughly absorbed, leaving the least possible residue of waste. All food is to be withheld for a few hours, and cool sterilised water or barley water, and cracked ice (if pure) is given to allay thirst. The child will not suffer from lack of food. It will suffer much more with it. If stimulants are needed, ten to thirty drops of brandy, well diluted, may be prescribed.

After the interval of rest food is to be cautiously administered, but in less than the usual quantity. Unless the infant can have breast milk, which is usually most desirable for it, it is best to give no milk at all, but instead such articles as whey, thin mutton or chicken broth, barley gruel, or egg albumen beaten in half a pint of cold water to which a teaspoonful of brandy and a pinch of salt are added. After two or three days of this diet, if the child continues to improve, the milk diet given before the illness is to be gradually resumed, but the feeding should be watched for at least a week.

To older children, when diarrhœa has been excited by eating improper food, unless the bowels have been already very thoroughly evacuated, or if signs of intestinal irritation continue, it is best, as with adults, to give castor oil and opium in the form of paregoric or Dover's powder, and then to feed the child upon the principles laid down above for infants. As a rule, it is best to avoid "prepared foods" or patented infant foods, and good nutritious home-made fresh broth from lean mutton, or chicken, or beef, is to be preferred.

Entero-colitis in Infants and Children—Summer Diarrhœa

Summer diarrhœa is exceedingly fatal among infants in hot weather in densely populated localities, and they require very careful feeding for this disease. Intractable cases are prolonged for several weeks, with more or less vomiting, diarrhœal mucous stools, fever, and meteorism, and a variety of complications supervene.

Prevention.—Entero-colitis is a subacute milk infection, resembling the acute form, cholera infantum, but it is less violent, although much more prevalent. It is produced by toxins developed by the activity of bacteria in the food, and it is therefore to a large extent preventable, and most easily so by exclusive breast nursing.

The preventive treatment for weanlings in nurseries where there are several children consists in absolute cleanliness and antisepsis, and the nurse must be made to realise the necessity of disinfecting diapers and her own hands *at once*, and she must never handle either food or food utensils with soiled hands, for by neglect of these simple precautions the germs are passed on from one child to another. When cow's milk is used in hot weather it should be Pasteurised unless absolutely fresh and clean.

Dietetic Treatment.—As a preliminary to dietetic treatment the alimentary canal should be evacuated of all irritant material. The stomach should be washed out through a funnel, a (No. 10) soft rubber catheter, hot water (102° F.) being used, to which salt is added (a teaspoonful to the quart). The colon should be similarly irrigated with hot salt solution. If the child is still nursing, and the mother's milk is found to disagree, a wet nurse should be secured whenever possible. If the child is fairly strong and well nourished at the commencement, it is best to withhold all food for several hours, and merely give a little barley water or some equally bland beverage. In any event it is best to abandon milk and its preparations entirely for two or three days. In this manner the intestinal germs which are causing the mischief are starved out or replaced by others which are comparatively innocuous.

There are many cases of enteritis in children in which milk wholly disagrees, even when Pasteurised or pancreatinised, apparently because the casein is not properly digested in the stomach, and in such cases the casein should be prevented from passing through the alimentary canal in tough and irritating coagulæ.

Fresh meat broths (beef, mutton, or veal), pressed-meat juice, and egg-albumen solution with ten to thirty drops of diluted whisky or good brandy, are to be given in lieu of all milk. Children a year or more old may have gruels of arrowroot, barley, or rice, but commercial baby foods and patented meat extracts should be omitted. A mixture of cream and water is sometimes well borne.

It is important to give nourishment in very moderate quantity, one or two teaspoonfuls at a time, to prevent overfilling of the stomach. For older children a little scraped beef may be prescribed three times a day; and they may be allowed to drink whey.

After several days, but not until the symptoms have well-nigh disappeared, a very gradual return to milk is permissible.

In those cases in which children lose all appetite or infants persistently refuse to take the bottle, the prognosis is extremely unfavourable, and recourse must be had to rectal feeding and stimulation.

In every protracted case an exact record should be kept of the quantity of food taken, and no general report should be accepted from the nurse that the child is simply " feeding well." Frequent weighing and comparison with the amount of food ingested, combined with personal observation of the stools, are the best guides for the physician to follow in regulating the diet, and they should never be neglected.

During convalescence older children should be carefully watched to see that they do not surreptitiously, or through ignorance of their nurses, obtain unwholesome food. Such articles as potatoes, tomatoes, and other fresh vegetables, coarse cereals, like oatmeal, wheaten grits, and corn-meal, must be forbidden, as well as fruits. Holt has seen a fatal issue from eating a few raisins.

Cholera Infantum, or Acute Milk Infection

Cholera infantum is a gastro-intestinal disease of violent acuteness, characterised by severe vomiting, purging by serous stools, collapse, very rapid emaciation, thirst, fever, and other symptoms.

According to Holt, between 2 and 3 per cent of the cases of diarrhœal disease in infants are cholera infantum.

It does not occur in nursing infants, but only in those fed by artificial means. No specific micro-organism has been detected, although various germs abound in the watery evacuations. Vaughan believes it to be due to tyrotoxicon, which he has demonstrated in cow's milk, and which exists only in milk or some modified form of it, such as condensed milk, or baby food made in part of milk.

The disease prevails especially in hot weather, and is so rapidly fatal, usually within one or two days, that very prompt and vigorous treatment is imperative.

Dietetic Treatment.—The giving of milk in any form must be immediately and peremptorily stopped, and, as Vaughan says: "Prepared baby foods should be thrown out of the window. Acute milk infection is a form of poisoning by a substance more powerful and deadly than white arsenic." The poison must therefore be washed out; and no matter how much vomiting and diarrhœa have already occurred, the stomach must be cleansed by lavage, and the colon must be irrigated by at least a gallon of warm Castile soapsuds and water, after which cool water with fifteen to thirty grains of tannic acid to the pint should be injected (Vaughan), with the object of precipitating poisonous proteids. The irrigation has a further advantage in that it replenishes by absorption a portion of the water which has been rapidly drained from the system by the violent purging, as in the case of Asiatic cholera, and the loss of which causes insatiable thirst. The lavage allays gastric irritability, and alcoholic stimulation must then be ordered in the form either of half a teaspoonful of iced champagne or from ten to fifteen drops to a teaspoonful or more of whisky or good brandy, diluted in water or Vichy.

From four to six or eight ounces may be given in twenty-four hours to avert collapse. If necessary, the brandy is to be given by rectum, or the whisky, in extreme cases, by hypodermic injection.

Accessory means are bathing in warm mustard water and friction. No nourishment except the alcohol is allowable for at least twenty-four hours, when warm meat juice, koumiss, zoolak, pancreatinised meat broths, or egg albumin with whisky is to be prescribed in teaspoonful doses every half hour or hour. For a day or two this diet will suffice, and milk should not be again given until the expiration of that time, when the ordinary previous diet may be cautiously resumed.

Older children may be allowed to have junket and scraped beef which has been squeezed through a sieve.

Cholera Morbus—Acute Catarrhal Enteritis in Adults

Cholera morbus may be caused by the ingestion of indigestible foods or improper drink, such as polluted water, or water or beer drunk in large quantity after long-continued thirst, or chilling after excessive exercise and perspiration. An attack may be excited by unripe fruit and vegetables, such as green apples, watermelons, cucumbers, or nuts.

Dietetic Treatment.—The patient should be kept quiet in bed, well covered, and in severe cases it may be advisable to give no food for the first twenty-four hours, after which the diet should be very light, consisting of meat broth or of pancreatinised milk with lime water in the proportion of one third of the latter, given alone or with a little boiled rice or milk toast. Brandy and soda or champagne may be prescribed. The desire to drink water constantly should be restrained, as it tends to keep the contents of the intestine too fluid and increases the diarrhœa. Thirst may be relieved by cracked ice, very weak cold tea without sugar, or oatmeal water. When the patient is first seen, if there is evidence of accumulation of irritating food in the intestine which has not been wholly eliminated by the diarrhœa, it is advisable to evacuate the bowel with a dose of castor oil or salts.

The following day, if diarrhœa and vomiting have ceased, the diet may be increased slowly; otherwise it should be still restricted to broths and milk. Among the foods which may be first allowed are a soft-cooked egg, raw oysters, scraped beef with soda crackers or toast, and well-boiled rice. If the attack has lasted but a day or two, the patient may soon return to his normal diet; but if it has been protracted, or if he has been much weakened by it, he must observe caution in eating for several days. The diet for convalescence given on p. 441 may then be followed.

Intestinal Fermentation and Putrefaction, Autointoxication

Intestinal autointoxication is a toxæmia resulting from absorption of abnormal food products formed within the alimentary canal by bacterial action. This definition excludes ptomaine poisoning, milk, fish, and meat poisoning, etc.—conditions due to ingestion of already poisoned substances. Autotoxæmia disturbs the vascular, nervous, digestive, and eliminative functions, and the toxins may be demonstrated in the stomach contents, fæces, and urine. The symptoms are due to: 1, fermentation; 2, putrefaction.

1. Fermentation symptoms are caused by the fermentation products of carbohydrate food, principally CO_2 and organic acids, such as lactic, acetic, and butyric chiefly, and to some extent formic, succinic, valerianic, propionic acids, and acetone. Alcoholic fermentation is also present. These symptoms are in part mechanical, due to pressure from gas; such are: eructations, stomach and intestinal tympanites, palpitation, flatus, abdominal tenderness, and irregular stools. In addition there may be nausea, vomiting, a foul odour in the breath and fæces. With the exception of oxalic acid in oxaluria, fermentation products are not recovered from the urine to any extent, as the ultimate products of carbohydrate food are CO_2 and water. Slight fever may be present.

The severity of fermentation autointoxication symptoms depends upon: (1) the composition of foods, (2) the variety of foods, (3) the number and kind of bacilli introduced with the food, (4) the reaction and quantity of the gastric juice, (5) the motility of the stomach, and (6) the rate of absorption of fermentation products.

2. Putrefaction symptoms are caused by intestinal putrefactive processes involving the proteid foods, and resulting in the formation of nitrogen and sulphur compounds, chiefly of the aromatic series; such are: indol, cresol, phenol, skatol, with hydrogen sulphide gas as a by-product, free nitrogen and hydrogen. Other less important products are: putrescin, cadaverin, neurin, leucin, cystin, methyl, mercaptan, and carburetted hydrogen. Excess of H_2S produces hydrothionanæmia. The putrefactive bacillary processes take place mainly in the colon, but may extend to the small intestine and stomach. In general the symptoms of putrefaction are more distinctly toxic and less mechanical (less gas is formed) than those of fermentation. The effects of putrefaction are especially manifest upon the blood and nervous system. C. H. Herter gave indol experimentally to several persons, with the effect of producing such symptoms as frontal headache, vertigo, restlessness, insomnia, frequent micturition, diarrhœa, and finally a condition of neurasthenia. *Indol* is derived from the tyrosin of proteid food, through action of the colon bacillus, but it is not derived in any quantity from milk. It is closely related to indican formation.

Neurin is another highly toxic intestinal product formed sometimes in cases of intestinal obstruction, and derived from lecithin in egg yolk and from other sources. According to Herter, in man it causes increased peristalsis, diarrhœa, abdominal cramps, and lessened heart force and pulse tension.

As the nitrogen and sulphur of putrefactive products are eliminated through the kidneys as ethereal sulphates, etc., unlike the carbohydrate final products, it becomes comparatively easy to detect them and trace their relationship to special articles of diet.

The clinical results of autointoxication may be immediate or acute and violent, with much gastrointestinal disturbance, or they may be remote, i. e., chronic. In the latter instance such conditions are associated as neuritis, neuralgias, tetany, epilepsy, anæmia, arterio-sclerosis, skin eruptions like eczema, acne, pruritus, and exfoliative dermatitis, tetany, poliomyositis, psychoses, melancholia and neurasthenia, and miscellaneous toxæmias like goutiness and lithæmia. It is not claimed, of course, that intestinal autointoxication is the *sole* cause of all these conditions, but it is usually associated with them, often both antedates them and makes them worse, and they are capable of improvement under dietetic regulation.

It should be observed that in many cases of intestinal autointoxication the primary digestive disorder may be in the stomach. Hastily eaten food, coarse or indigestible food which is imperfectly digested in the stomach, passes into the intestine in a condition which may give rise to much irritation, and if many bacteria are present, to the development of a variety of more or less toxic products. Similarly, hyperacidity, and especially hypermotility of the stomach, which causes the food to pass too quickly into the intestine, may result in intestinal autointoxication.

The foul breath which often characterises this condition is in part due to the elimination through the lungs of hydrogen sulphide gas, which, after absorption by the intestinal vessels, is conveyed to the pulmonary circulation and liberated with the exhaled air.

Many cases are rebellious to treatment, and naturally it is more difficult to control intestinal than gastric digestion, not only because the intestine is relatively inaccessible, but because of the highly complex digestive processes in which the bile, pancreatic and intestinal juices are concerned.

The **dietetic treatment** of autointoxication is suggested by a knowledge of its ætiology. The fermentation cases do best upon a diet of simple proteid foods, broths, fish, chicken, eggs, scraped beef, etc., with dry toast, stale bread or crackers. The putrefactive cases, if severe, may be best treated with a diet of bread and milk, later with fruits, cereals, and the fresh green vegetables. In both classes of cases elimination should first be promoted by laxatives, such as calomel or castor oil, and the drinking of water in large quantity; in both, intestinal antifermentative remedies are useful, such as creosote, β-naphthol, salol, ichthyol, or bismuth subgallate.

Those mixed cases in which the symptoms of fermentation and putrefaction are combined, are best treated with a temporary diet of milk and bread or crackers, together with eliminatives and antifermentatives, as above described.

Chronic Enteritis in Adults—Chronic Intestinal Catarrh—Chronic Colitis

In severe cases it is often advisable to put the patient upon a milk diet for several weeks. Except in tuberculous subjects this is often successful in effecting a cure. The milk may be skimmed or boiled and diluted with lime water. As a rule, fatty and saccharine food is forbidden, and farinaceous food should be restricted in quantity. At first fats fail of digestion in the intestine, and later other foods. Patients must be especially instructed to take their meals very slowly and masticate sufficiently. The diet should consist chiefly of bread and lean meats—foods which leave the least residue. Scraped beef, beef meal, and beef peptonoids are useful. The intestinal indigestion may be improved by the use of pancreatic extracts with bicarbonate of sodium. The food may be pancreatinised before it is eaten, or pancreatin may be given in keratin-coated pills designed to remain undissolved until they have reached the small intestine. The stools should be watched for undigested particles of food, muscle fibres, etc.

If emaciation continues with an exclusive diet of animal food, it may be best to give oatmeal porridge or mush which is predigested with diastase or malt extract. Baked potatoes may be similarly treated.

Foods to be avoided are very rich milk, green vegetables, raw acid fruits, dried fruits and nuts, richly cooked acid or fat dishes, crustaceans, pork, veal, coarse bread, pastry, sweets, and desserts of all kinds.

In milder cases in which there is more or less constipation with intestinal catarrh, it is important to regulate the bowels, and this may be done in part by the character of the food, also by systematic exercise, both active and passive. Mild calisthenics, massage of the limbs and the abdominal wall, combined with abundant fresh air, daily bathing in cold water, and friction of the skin, are all useful aids to treatment.

There are cases of chronic colitis in adults which do not improve upon any diet, and after trying a great variety of foods the patients seem to get on even better for a time on a mixed diet of considerable diversity.

Alcoholic stimulants should be given, and the best forms are claret, sherry, or brandy, all diluted to two or three times their bulk with Apollinaris or plain water. Sée recommends the Tannin Wine of St. Raphael.

Some patients are considerably benefited by residence for a few weeks at one of the alkaline mineral springs.

An intestinal test diet has been devised by Schmidt and Strassburger to aid in determining the degree of peristalsis and other intestinal conditions which are determined through examination of the stools. The diet comprises, milk, eggs, mashed potato, scraped meat, butter, oatmeal, bouillon, and zwieback. If charcoal or carmin be added, these substances, being indissoluble, reappear in the stools, thus marking off the beginning and ending of those stools which contain the waste of the test meals. Thus from the time the carmin meal is eaten until the first carmin stool is usually fifteen to twenty-five hours, but with colitis, especially in the lower colon, the time may be shortened to ten hours or less. By varying the ingredients of the test meals, one ingredient at a time, the toleration for different types of food, fats (butter), carbohydrates, meat, etc., is ascertained.

Chronic Intestinal Indigestion in Children

Chronic intestinal indigestion in children should be treated by dieting rather than by medicines. Diligent inquiry must be made into the cause of the trouble, and the diet must be regulated accordingly. The stools and the urine must always be carefully examined. If the former are hard, white, and lumpy, if they are too loose and contain undigested coagulæ of casein and drops of fat, or if they are sour from lactic-acid fermentation, the milk is certainly disagreeing. If the child is nursing, the mother's milk may be at fault. If the woman is worried, exhausted, or possibly pregnant, or suffering from insomnia, menstrual disorder, phthisis, or other chronic ailment, or if lactation is too long continued, her milk must be replaced by that of a good wet nurse, or, failing this, by the bottle. This change will often cure the indigestion at once. It may be that the infant is simply overfed, or fed too often. The excess of milk fails to be absorbed, undergoes lactic-acid fermentation, produces gas with abdominal distention and diarrhœa or irregular passages, together with loss of weight, fretfulness, and other symptoms. If the child is being fed upon a mixed diet with milk and one of the prepared infant foods, such as Mellin's, Ridge's, Horlick's, etc., the difficulty may be with either the proteid or the carbohydrate elements, but the prepared foods had better be abandoned. It is easy to ascertain which is at fault by confining the diet exclusively for a few days to one or the other of these classes of foods, and noting the effect on the bowels. Moreover, proteid intestinal indigestion usually produces offensive alkaline feculent stools, while carbohydrate indigestion causes acid stools with more flatus. Of course both classes of indigestion may coexist in the intestine, but the difficulty is primarily with one sort or the other, and hence the advantage of substituting for the mixed diet a more elementary one. In place of milk, egg albumin, pressed-beef juice, or meat broths are to be given. Or if these proteids are not digested, the diet should consist for a few days of barley or rice gruel, or gruels of " torrefied starch "—i. e., wheat flour which has been boiled or roasted in order to burst the starch granules and partially convert the granulose into dextrin. The digestion is carried still further by the use of diastase or malt extract, or malted milk may be given.

A mixture of cream and water (p. 494) is well tolerated in some cases, or peptonised milk and various other preparations of milk may be given; but at present peptonised milk is less in vogue than formerly, as its power of restoring emaciated tissues has been seriously called in question. "Modified" or "humanised" milk is to be preferred (p. 90).

Older children may have beef or chicken jelly, scraped beef, etc. It is well to avoid monotony of diet, lest the appetite fail entirely.

Chronic Gastro-intestinal Catarrh—Chronic Entero-colitis—Chronic Diarrhœa in Children

These conditions in children should be treated by very careful regulation of the diet. Parents are apt to be ignorant in regard to this matter, and strict written rules should be furnished to them. Children should be fed at regular intervals at least four times a day, in order that the quantity of food given each time may not be too much. They must not be given acid food, such as pickles, or indigestible substances of any kind, or fruit. Many cases do best when put upon a plain milk diet for several weeks, or, if this is not expedient, peptonised solutions or pancreatinised food may be substituted in part. Other good temporary substitutes for plain milk are buttermilk, whey, and koumiss. Beef broth should not be given exclusively, on account of its occasional tendency to increase diarrhœa. If the stools contain much fat it is an indication that the pancreatic and biliary secretions are deficient, and the use of pancreatin is then of special service.

These children cannot digest sugars, starches, or fats very thoroughly, although cod-liver oil may be assimilated, and when it is it constitutes a valuable food. It does not necessarily increase diarrhœa, and it may even check it indirectly by improving nutrition.

Among foods which may be allowed to older children as improvement begins are raw oysters, boiled or broiled fresh fish, minced beef and chicken, soft-cooked eggs, soda crackers, bread and milk, toast, thin bread and butter, blancmange, custard, junket, and wine jelly. Sometimes the child continues to emaciate upon a diet of animal broths and meats, and fails to digest either eggs or milk. In such cases pancreatinised mush or some simple cereal, such as barley or rice, may be given with malt extract, and among vegetables which may sometimes be allowed, if diarrhœa has ceased, are asparagus, spinach, stewed celery, cauliflower, and thoroughly baked potatoes with a little salt and butter well mixed.

Hot water should be recommended before meals if the child will take it. It may be given a faint flavour of some spice, such as cinnamon or clove, and whey is an excellent beverage. Some children become very fond of koumiss, but it is expensive unless home-made (p. 82).

Many of these children become strikingly emaciated, and, in spite of all dietetic regimen, the skin is dry and wrinkled, and care should be taken to improve its nutrition. This may be done by tepid baths before bedtime and gentle friction, and by inunctions of three or four drachms of warm melted cacao butter or warm olive oil or cod-liver oil, to be rubbed in over the extremities and parts of the trunk other than the abdomen. In this way little if any nourishment can be rubbed into the circulation, and the main benefit of the inunction consists in improving the condition of the skin by local action, and in preventing excessive heat loss, to which poorly nourished children are prone.

Massage should be given for a quarter of an hour every morning. It may be applied over the entire body, unless there is much diarrhœa, when the abdominal wall should be omitted.

Simple Atrophy—Marasmus

Marasmus is a form of starvation occurring chiefly in artificially fed infants, but also in those at the breast, in whom there is great wasting of the muscular and other soft tissues, and sometimes catarrh of the alimentary canal. The food is either too limited in quantity, is indigestible, or else is supplied in a form in which the ingredients are not properly balanced. Breast-fed children are more apt to suffer from insufficient quantity, and hand-fed infants from improper quality of food and overfeeding. "Food upon which a child has thrived for three or four months, perhaps, can become unsuitable, and consequently lead to wasting if the digestive powers be suddenly reduced by an intercurrent disease" (Louis Starr). The treatment of marasmus is therefore essentially dietetic, and the reader is referred to the general directions for infant feeding. No detail should be considered too trivial for the physician's personal attention. If nursed, the mother or wet nurse's milk should be examined for richness in cream and curd. If hand-fed, the most scrupulous care must be taken to secure antiseptic cleanliness, and milk or milk and meat juice should be the staple foods, to the exclusion of all farinaceous articles and patent "baby foods." The disease is commonest in the first year of life, but may occur in the second, and its effects in enfeebling the constitution may last much longer. It is just at this period that mothers—for reasons of supposed economy or expediency—are tempted to supplant the only natural infant food (milk) with all sorts of prepared foods. It is because they do not know how to prepare cow's milk properly and adapt it to the baby's needs that they substitute or add artificial foods.

All milk should be peptonised or Pasteurised (p. 79), and lime water or barley water are the best diluents, the former being preferred if there is vomiting or acid eructation. (For the correct degree of dilution according to age, see Infant Feeding.) If good top milk cannot be obtained, one or two tablespoonfuls of cream with a teaspoonful of milk sugar is to be added to each bottle. Some infants do better for a short time upon a cream-and-water mixture.

In other cases all milk should be withheld, and expressed-beef juice, diluted meat broths, and egg-albumin solution must be used. Louis Starr says: "At eight or ten months from two to four fluid ounces of thin mutton or chicken broth free from grease may be allowed each day in addition to the milk; at twelve months the yolk of a soft-boiled egg, rice and milk, and carefully mashed potatoes with gravy; and at the end of the second year a small quantity of finely minced meat."

Cod-liver oil should be given, but never until the digestive functions are well restored, as shown by the character of the stools, the absence of eructation and flatulence, and a clean tongue. It is to be prescribed pure, or in one of the emulsions with calcium lacto-phosphate.

Daily warm baths and inunctions of two or three drachms of cod-liver oil, or, better, olive oil, are to be ordered, with fresh air in abundance.

Mucous Disease—Chronic Pseudo-membranous Gastro-enteritis—Membranous Enteritis

Pathological Physiology.—Mucous disease is an obstinate chronic affection in which large quantities of thick, ropy mucus are formed in the alimentary canal, but chiefly in the large intestine. The disease is accompanied usually by neurasthenia and disorders of gastric and intestinal digestion and absorption, of greater or less severity.

In the disease called membranous enteritis a similar condition is present, and the hypersecretion results in the formation of long tube casts of fibrinous mucus. The passage of the casts is sometimes accompanied by severe paroxysmal pains, and blood may appear in the stools. Although they may be separated clinically, the dietetic treatment of these two affections is the same. Young children normally secrete more mucus from the intestines than do adults, and the long continuance of an irritating diet of improper food may give rise to hypersecretion. Chronic mucous disease is sometimes a sequel of the infectious diseases which particularly affect children, notably whooping cough. There are a larger number and variety of bacteria found in the stools than are usually present, but this disease is not definitely attributable to the action of any one species. The disease is also sometimes associated with intestinal worms.

Symptoms.—The appetite is very irregular. It may be exaggerated early in the disease, and fail completely later on. The food does not nourish the child, absorption being prevented by the mucus, and it causes flatulency and discomfort. Emaciation is progressive and extreme. Some of the stools consist wholly of mucus, fatty epithelial cells, and granular detritus, while others contain particles of undigested food, milk curds, meat fibre, etc., mixed with mucus.

Dietetic Treatment.—The only hope of cure of this condition lies in the most rigid dietetic treatment, combined with regular habits, bathing, etc. In the worst cases only predigested fluid food should be given, such as pancreatinised milk, meat juice, and egg albumin. Beef tea, light broths of veal, mutton, or chicken, *consommé*, or milk punch may be allowed.

Sometimes it is necessary to give no food by the stomach for six or eight hours, and then commence to feed very slowly, giving teaspoonful doses at fifteen-minute intervals. If the child has been living for long upon milk alone, and the stools show fat and undigested curds, it is best to make a radical change and proscribe it entirely. Jacobi gives instead a mixture containing five ounces of barley water, one to two drachms of brandy or whisky, the white of an egg, and a little salt and cane sugar. Dose, a teaspoonful every five or fifteen minutes. This is a fairly palatable mixture. It is considered best to withhold all farinaceous and saccharine articles until some sign of improvement appears.

Edwards prescribes the dietary of the London Northeastern Hospital for Children. (See Hospital Dietaries.)

Dysentery

During an attack of acute dysentery the patient should be kept absolutely quiet in bed, and should not be allowed to rise for the movement of the bowels, making use of a bedpan instead. Throughout the active stage the diet must be strictly confined to easily digestible food, and in most cases it is wisest to give only predigested fluid articles. Peptonised or pancreatinised milk, or boiled milk, pressed-meat juice, whey, or raw egg albumin beaten with sherry and flavoured with nutmeg are recommended. Many patients do best upon a diet of raw scraped beef or meat balls (p. 113).

In cases of acute dysentery, and especially in the amœbic form, the loss of strength, anæmia, and emaciation progress very rapidly, and the strength must be supported by stimulation, for which brandy is preferable to whisky.

During convalescence the diet must be very cautiously increased, and confined to food which is promptly and completely digested, leaving but little residue. For this purpose animal food should be chiefly eaten, while fish, tender beefsteak, roast beef, boiled or broiled chicken, eggs, custard, blancmange, dry toast, junket, well-boiled rice, or wine jelly, may be given. All fruits and vegetables must be forbidden, and butter and cream should be taken sparingly.

If the disease occurs in infancy, the child, if possible, should be fed at the breast. Otherwise all milk given should be Pasteurised. Beef tea and mutton broth may be allowed in moderation, and special care should be observed not to overfeed.

CHRONIC DYSENTERY

Chronic dysentery is often best treated by an exclusive milk diet of from two and a half to three quarts a day, with rest in bed or on the lounge. In other cases rare steak or roast beef or chicken and egg albumen may be allowed, with dry toast, zwieback, or crackers. The milk and meat diet may be advantageously combined.

In Osler's opinion, if there is much ulceration of the colon meat is not well borne, and it is better to keep the patient upon a diet which will give but little residue, such as boiled or peptonised milk.

The stools must be examined every day or two to ascertain the presence of undigested fragments of milk curds or meat, oil globules, mucus, blood, etc. If improvement does not occur, the patient may be put upon a diet of egg albumen with beef juice, or some of the preparations of beef meal (p. 113) or peptonoids, with pancreatinised milk. Return to solid diet must be very gradual, and may be conducted on the lines directed for convalescence from typhoid fever (p. 441).

Acute Intestinal Obstruction

Many of these cases demand immediate operation, but if for any reason this is not performed nothing should be given by the mouth. If any food be taken it decomposes, and even drink may excite severe vomiting. The patient may be nourished by the rectum, and thirst can be relieved by injection of a pint of lukewarm water with a teaspoonful of salt into the rectum. If the latter is irritable a smaller quantity should be employed, and more frequently given. Another method of relieving thirst is to inject a pint or two of warm, sterilised salt solution of the above strength into the cellular tissue beneath the skin, after the manner of the hypodermoclysis recommended in cholera (p. 455). If necessary half an ounce or more of whisky is to be given from time to time hypodermically, weakened by two or three times the quantity of salt solution. If all these injections are sterilised and inserted deeply they are much less painful than if inserted immediately beneath the skin.

If the obstruction is overcome without operation, the diet should be very slowly increased, giving only fluid nourishment by the mouth for two or three days, or until all symptoms have subsided.

The fluid food should consist of beef juice, broths, egg albumin, and simple farinaceous gruels. Milk, if not wholly absorbed, forms too bulky feces.

The symptoms of profound collapse, thready pulse, etc., depend not upon the local condition of obstruction, but upon sapræmic intoxication from toxins produced by decomposition of retained food. This statement is corroborated by the prompt relief which sometimes succeeds emptying the bowel after removal of the obstruction and the use of lavage and irrigation with warm water (106° F.).

Chronic Constipation

Physiology.—The periodic daily evacuations of the bowels are determined by peristaltic contractions of the muscular wall of the intestines excited by their contents. The thick fluid condition of the food (chyme) which enters the small intestine from the stomach is gradually altered by absorption of water and soluble ingredients in the small intestine. This process is accomplished by rhythmical vermicular contractions of the intestinal wall which are reflex in character and stimulated in different degrees by the bulk and chemical combination of the food and by the various digestive secretions, namely, the intestinal and pancreatic juices and, especially, the bile. The peristalsis is more active in the small than in the large intestine, for it has the triple function of (1) mixing the food and digestive fluids; (2) bringing the whole mass into contact with a large surface for absorption; and (3) propelling the residue towards the large intestine.

Simultaneously the local blood current is increased. The vessels and lymphatics in the intestinal wall and mesentery become greatly distended by absorption of food products. The increase in volume and flow of the blood also stimulates peristaltic contractions.

Towards the lower end of the small intestine the food is found diminished in volume by absorption, and the mass is consequently somewhat drier. The ileo-cæcal valve is periodically relaxed by reflex mechanism, and the peristalsis of the small intestine propels the food onward into the large intestine, where further absorption takes place, and the residue is more slowly moved towards the sigmoid flexure. Here it remains and accumulates until a certain bulk is gathered, which by pressure or distention excites the reflex mechanism of defecation. This mechanism employs a large number of muscles, and hence the need of a controlling nerve centre, which is found in the lumbar region of the spinal cord.

Constipation, when not due to intestinal obstruction, is dependent upon lack of peristalsis, as diarrhœa is due to excessive peristalsis.

Many persons are wholly ignorant of what constitutes a normal stool. The custom of using patent water closets often prevents them from seeing the stool, and they are unable to correctly estimate its amount or character. A little accumulation of residue left over each day will presently cause very uncomfortable constipation. The normal stool should weigh about five or five and a half ounces, of which only one and a half ounce is solid matter. It should constitute a sausage-shaped mass, in all about six inches in length.

Pathological Physiology.—Constipation may result from one or more of the following causes, which are related to diet: 1. Insufficient quantity of solid food. 2. Too highly nutritious or concentrated food. 3. Insufficient fluid. 4. Astringent food and drinks. 5. Indigestible food. 6. Lack of digestive fluids. 7. Irregularity in diet. 8. Obstruction from overeating. 9. Lack of peristalsis. 10. Lack of exercise.

1. Insufficient food is one of the most common causes of constipation. In prolonged starvation the bowels cease to move entirely. Persons who eat but sparingly have too little bulk of food to excite the normal peristaltic motion of the intestines, and the waste products accumulate in consequence.

2. Too highly nutritious or concentrated food, such as richly seasoned meats, milk, meat extracts, peptonised fluids, etc., when almost completely absorbed, leave insufficient residue of waste matter. Peristalsis is therefore either not excited or the contracting intestinal wall has insufficient bulk of material to seize upon and propel.

3. Insufficient fluid often causes constipation, and for three reasons: (1) The chyme is not kept liquid enough to be thoroughly mingled with the digestive juices. (2) The intestinal walls become too dry and friction over the hardened fecal masses is increased, making it difficult to propel them. (3) There is less fluid absorbed by the blood, and consequently the digestive juices and intestinal mucus are reduced in amount and altered in quality.

4. Astringent food or drinks, such as tea, brandy, or claret, constipate by checking the mucous and other secretions, thereby increasing friction within the intestinal wall.

5. Indigestible food may be so hard and bulky as to be imperfectly acted upon by peristalsis and incompletely mingled with the digestive juices, or it may give rise to abnormal fermentation and production of substances which inhibit absorption and peristalsis.

6. Lack of digestive fluids in normal proportion or serious alterations in their composition retard digestion and lessen peristalsis.

7. Irregularity in diet or in the intervals of taking food, eating too hastily, imperfect mastication, and great variations in the quantity of food eaten, all tend to disorder digestion by disturbing the

natural rhythm of its various stages, and especially the periodicity of defecation.

8. Obstruction from overeating, particularly in children, may cause constipation from the accumulation of larger quantities of waste matter than the intestinal muscles have power to propel.

9. Lack of peristalsis occurs through enfeebled intestinal muscles or imperfect nerve stimulation.

10. Lack of exercise fails to stimulate the circulation, both general and local, and to secure the abundant oxygen supply needed for complete oxidation of the food. It also fails to stimulate peristalsis by the natural movements of the body, especially of the abdominal muscles, and by increasing the flow of bile.

Constipation is not infrequently a constitutional habit or family peculiarity, running through several generations. It is provoked by sedentary habits and neglect of the calls of Nature, and it is the usual accompaniment of impoverished conditions of the blood and malnutrition, and especially anæmia, neurasthenia, hysteria, and chronic diseases of the liver and stomach. It is also frequently present in connection with acute fevers, and the habit of the perpetual consumption of drugs of many varieties may occasion it.

Weakness of the muscles of the intestinal and abdominal wall are common factors in the production of constipation. This symptom is therefore present in obesity, overdistention of the abdominal wall during pregnancy, and in atony of the large intestine and chronic diseases of its mucous membrane. It is also produced by obstruction from the pressure of tumours, accumulation of scybalæ from impaction of foreign bodies in the bowel, stricture, and localised atony of the sigmoid flexure.

Symptoms.—In all common cases the symptoms accompanying constipation are debility and lassitude, while more or less mental depression is present in persons of nervous or hypochondriacal temperament. When it occurs in the course of chronic insanity it increases languor, moroseness, and irritability of temper, and not seldom excites acute and violent symptoms. As a result of the accumulation of waste matter in the lower bowel, internal misplacements may occasionally result, or, if they already exist, they may be increased. Sacral neuralgia is sometimes produced, and hemorrhoids from congestion of the rectal veins may occur. Occasionally constipation may result from malformations of the intestine—adhesions which bind loops and coils of the intestine in abnormal positions and interfere with peristaltic movement. The impacted feces accumulate in the colon and are found chiefly in the sigmoid flexure, but they may also form large tumours in the hepatic or splenic flexure, or even in the right inguinal region. In aged persons sacculi of the colon may become permanently distended, and scybalæ become calcified as enteroliths. A channel is sometimes bored through the impacted masses of fecal material, and the long-continued constipation will give rise to diarrhœa. The fecal mass acts as a local irritant, and diarrhœal stools pass through the channel.

Chronic constipation may sometimes give rise to acute attacks of localised pain and considerable fever (104° F.). These attacks may simulate appendicitis, localised peritonitis, or other acute abdominal diseases.

Dietetic Treatment.—Before ordering the diet for chronic constipation, the patient must be minutely interrogated as to his daily habits of life, such as occupation, hours for meals and for exercise, recreation, and sleep, the kinds of foods and quantity usually eaten, the amount and kinds of fluids drunk, hour for going to stool, the use of stimulants and tobacco, and presence of mental worry or anxiety.

The principles of dietetic treatment of chronic constipation are based upon supplying digestible food, which will excite peristalsis either by its bulk or its physical and chemical properties. Vegetable food in general, as distinguished from nitrogenous diet, furnishes a much larger proportion of waste matter. Herbivorous animals have more abundant evacuations than do carnivores.

Following is a list of common foods discussed in their relation to constipation:

Vegetables.—The cellulose of starchy foods is difficult of digestion and of comparatively little nutrient value for man; hence it yields a considerable quantity of waste material. This is true of the starch granules of potatoes, corn, peas, beans, etc.

Other vegetables which leave a large residue after digestion are tomatoes, spinach, lettuce, asparagus, salsify, cabbage, and celery. Tomatoes and spinach seem to possess slight special laxative properties. Spanish onions, boiled, are laxative.

Cereals.—The various cereals used for bread when coarsely ground contain a large proportion of the external envelope of the grains, which is more or less hard and rough, and by its presence in the intestine it stimulates peristalsis through mechanical irritation.

For the above reasons the following articles of diet tend to overcome constipation: Coarse Graham bread, rye bread, wheatena, wheaten grits, cornmeal, Indian meal, oatmeal, brown or "wholemeal" bread, Boston brown bread, shredded wheat.

Molasses and honey added to bread are laxative. Gingerbread, especially for children, is sometimes efficacious. With some persons the substitution of milk sugar (lactose) for cane sugar proves laxative.

Beverages.—Coffee, beer, cider, and unfermented grape juice are somewhat laxative.

Oils.—Olive oil and cod-liver oil, if taken at bedtime into an empty stomach, are laxatives for some persons, particularly children.

Adults may take a dessertspoonful of best Lucca oil with each meal, eating it with fresh vegetables, such as beets or lettuce, or mixing it with potatoes.

Fruit.—Fruits are laxative, either because they contain indigestible seeds, which act mechanically in the intestine (e. g., figs, berries), or because the vegetable acids and salts which they furnish upon being absorbed stimulate the digestive secretions and peristalsis.

Fruits with seeds are laxative, such as figs, blackberries, strawberries, huckleberries, blueberries, and also grapes in large amount without the seeds.

Fruits having special laxative properties through chemical action are apples, pears, peaches, oranges, shaddock, cherries, prunes, plums. Many fruits act in both the above ways, and raisins, figs, prunes, and apples leave considerable bulk of waste matter after digestion.

Fruit is always more laxative when eaten between meals or some time—say, half an hour—before breakfast. It then enters the intestine more promptly, and it is not retarded in its effect by the presence of other articles of diet. Its action is furthered by drinking a tumblerful or two of water.

With many persons constipation may be prevented by eating one or two oranges or the juice of half a grape-fruit before breakfast. The latter is very sour, and considerable sugar is required to make it palatable. This is a decided disadvantage for those who have flatulent dyspepsia or gout. Instead of sugar, the bitterness may be disguised by a little sherry or rum poured upon the cut fruit. A half dozen dried figs or a dozen or so of French prunes eaten at intervals during the day, when the stomach is empty, produce a laxative effect. These fruits in smaller quantities are very good for children. In some cases the breakfast may be confined exclusively to fruits for two or three months.

Cooked Fruits.—With many persons having imperfect digestion raw fruits disagree, and since their laxative properties are not much weakened by being cooked, it is better to eat them in that form. Stewed prunes, or apples either stewed or baked, are very easy of digestion, and the latter may often be eaten by invalids in whom the digestive organs are very weak. Cooking berries or other suitable fruits by stewing renders them much more digestible, and does not impair their nutritive qualities. The principal objection to cooked fruits is that they usually require so much sugar to make them palatable that they may cause flatulency. A little bicarbonate of sodium will neutralise the acidity, and saccharin may be added instead of sugar.

Canned or dried fruits and fruits preserved in sirups are of little value for constipation.

A few fruits, like the banana, are apt to cause constipation.

Owing to the prevalent idea that fresh fruit relieves constipation, patients occasionally eat too much of it, with the result of producing dyspepsia and increasing their original trouble.

Nuts.—Nuts, especially English walnuts and almonds, are excellent laxatives, partly from their bulky residue and in part from the oils which they contain.

Water.—Copious draughts of either very hot or cold water, two or three tumblerfuls, should be taken before retiring and on rising. Many persons, from a belief that water drunk with meals is injurious, abstain from it and forget to take fluid between meals, and become constipated in consequence. If they happen to lose water by free perspiration also, the difficulty is enhanced. Such patients should be advised to drink water freely, as above indicated. It also aids digestion to take a tumblerful of hot water about an hour after a meal unless the gastric juice is feeble in strength of acidity. The stomach contents becoming somewhat thickened by loss of fluid through the pyloric orifice or by direct absorption through its own wall, are better digested by being diluted again. The temperature of the water drunk makes but little difference as far as constipation is concerned. Cold water is warmed and hot water is cooled by the œsophagus, so that upon reaching the stomach it is nearly of the normal body temperature, no matter how much it differed from this when swallowed, provided it has been taken slowly. If swallowed in large draughts it does affect the stomach temperature for a few moments, but it is soon brought to the normal body temperature again (p. 339).

When patients will not drink enough plain water, they can be induced to take lemonade or water flavoured with some aromatic. A few cloves put in a tumbler of boiling water and allowed to steep overnight impart their flavour to the fluid, which may be drunk on rising in the morning.

Summary of the most Useful Articles for Chronic Constipation.—Abundant water, coarse brown or bran bread, oatmeal, butter, fresh green vegetables (lettuce, spinach, sprouts, rhubarb, etc.), prunes, figs, apples (cooked or raw), peaches, berries, buttermilk, apple cider, koumiss, honey, English walnuts.

Foods to be Avoided.—Persons suffering from habitual constipation do well to give up the following articles: Eggs, milk, sweets, pastry, puddings made of simple amylaceous substances—such as rice, sago, etc.—fried foods, rich gravies, sauces, curry, strong condiments, pickles, cheese, tea, sour or red wines.

AIDS TO DIETETIC TREATMENT

It is an important and infallible rule in cases of chronic constipation that hygienic as well as dietetic treatment should supersede the use of medicine. It is very necessary to establish a uniform hour for going to stool each day, and all efforts at straining should be avoided. Exercise in moderation should be insisted upon, such as walking at least an hour or two twice a day, but of exercise in the open air, horseback riding is by far the most beneficial. One or two rides a week are much better than none. Many persons find improvement from bicycling. Tight lacing and constriction of the abdomen by tight belts should be avoided, and also sitting long in positions compressing the abdomen. Much good may be accomplished by elementary instruction in calisthenics, in which special attention is paid to deep respiratory movements of the diaphragm and abdominal muscles.

Regularity should be observed in habits of life, in hours of sleep, and of meals. Many business men whose daily routine of early rising, exact hours, and evening dinners is disturbed on Sundays by late breakfast and a noon dinner, find that the regular habit of the bowels is interrupted at the first of the week, and in consequence may suffer for a day or two from headache and "biliousness."

Massage.—Massage is the process of manipulating the muscles and subcutaneous cellular tissue. The aim of the treatment is to mechanically compress and stimulate the structures beneath the skin, and it is to be distinguished from the effects of merely rubbing the surface of the body, which acts through excitation of the cutaneous nerves and circulation.

Massage promotes the movement of the blood through the veins and of the lymph in the lymph spaces and capillaries, and favours the removal of waste products from the tissues compressed, and the increase of healthy metabolism in the muscles. It also stimulates the latter in a slight degree to contraction. It aids the functional activity of the liver, stomach, and bowels. The various manipulations are complex, and when rightly performed require the skill and experience of thoroughly trained operators. The chief manipulations are classed as—

1. Percussion by short quick blows of the fingers or small rubber hammers.

2. Rolling the muscles and subcutaneous tissues beneath the extremities of the fingers.

3. Kneading with the fingers and palms of both hands, placed one above the other, on the patient's arm or leg.

Massage of the abdominal muscles is most useful for constipation, and both percussion or mechanical vibration and kneading are to be used. It should be performed in the direction of the colon, commencing low down on the right side of the abdomen, ascending to the ribs, crossing to the left, and descending upon the left side to the sigmoid flexure. This mechanical movement not only pushes along the intestinal contents, if the abdominal wall be not too fat or rigid, but it stimulates peristalsis by reflex action. If possible, it should be given in the morning before rising, and at first daily, for fifteen or twenty minutes, but later every other day. The treatment should be continued for a month or more. Obstinate cases have been cured in this manner, and the method is especially serviceable for very obese patients.

Some persons derive aid from manipulating the abdominal wall for themselves while lying in bed in the morning. A large wooden ball like a croquet ball or a heavy metal ball weighing four to six pounds may be rolled over the abdomen for five or ten minutes every morning, pressing it in deeply in the direction of the colon. This sometimes, in thin subjects, promotes the movement of the intestinal contents.

Medicines.—Discussion of the medicinal treatment of constipation is not within the scope of this work, but the practice of continually taking laxatives and strong cathartics cannot be too strongly condemned. The constant daily overexcitation of the bowels by such remedies as aloes produces a deplorable condition in which the bowels refuse to act at all without constantly increasing dosage.

The majority of such cases can be cured by diet, but the rules must be very distinctly laid down, and the patient must exercise patience and care in adhering to them. I have sometimes been able to relieve patients who for several years had depended wholly upon strong cathartic pills or enemata, by stopping all medicine, and enforcing simple dietetic rules, especially in regard to drinking abundant fluid and eating laxative and bulky food. They often think that a daily movement is absolutely necessary, and the worry and nervousness which its absence occasions increases the difficulty. They should be reassured, and told not to be concerned if the bowels do not move at first for two or three or even four days, and that if they do not have an unaided passage in that interval they can certainly be relieved, and diet and regimen will succeed in time if persistently followed.

In very obstinate cases when diet does not succeed alone, attention to its regulation will enable the patient to obtain the desired result with mild and decreasing doses of simple saline laxatives such as Congress, Crab Orchard, Mt. Clemens, Apenta, or Rubinat water, in lieu of strong cathartic pills, or patent medicines.

Tobacco.—Tobacco smoking increases peristalsis. Some men become constipated when deprived of their after-breakfast cigar. The effect of tobacco is not constant, however, and by disordering digestion too much smoking may be an indirect cause of constipation. In those in whom it acts favourably upon the bowels, a good cigar is usually more active than any other form of the weed.

Bathing.—A daily morning cold bath followed by vigorous friction of the skin is of great service.

Electricity.—Faradisation of the abdominal walls is frequently useful, but, owing to the fact that the electric current when applied superficially radiates over the skin without penetrating to any extent beneath the surface, it cannot be expected to reach the intestinal wall. Any benefit derived from such application must be purely of a reflex character from excitation of the cutaneous nerves transmitted through the cord to the sympathetic nerves. A much better method of applying a faradic current consists of introducing one electrode for several inches into the rectum, while the other is moved about over the surface of the abdominal muscles. In this manner these muscles may be made to contract and move the intestines to some extent, and it is possible for a portion of the current to pass through the sigmoid flexure. If carefully adjusted, the application of the current gives rise to no pain or discomfort.

Bandaging.—In very obese persons, who are liable to suffer from constipation, the pendulous and relaxed abdominal wall should be supported with an abdominal bandage. The same treatment may give comfort when the wall is much distended in childbearing or by the presence of large abdominal tumours or accumulations of ascitic or ovarian fluid.

Constipation in Infants and Children

In earliest infancy from two to three daily evacuations from the bowels are considered a normal number, but in childhood, as in adults, one passage is normal. In later infancy constipation is exceedingly common on account of the milk diet, and bottle-fed babies are more subject to it than sucklings. The small intestine is relatively longer than in the adult, the large intestine easily becomes distended, the pelvis is more contracted, and peristalsis is usually less vigorous, owing to a less powerful musculature than obtains in adults.

When constipation is present in an infant at the breast the milk may be too rich in casein and deficient in fat, salts, and sugar. This may be due to a constipated habit of the mother, and laxative foods should be given to her rather than medicines to the child. If the child is nursing a wet nurse, it may be best to change to another in perhaps an earlier stage of lactation, or one whose milk is less rich in proteids.

If the infant's stools consist of dry and brittle scybalæ it should be given more water to drink, or a little oatmeal water, which is laxative. Other simple and oftentimes effectual remedies are from half to a teaspoonful of olive oil, molasses, melted sugar, or butter.

In the case of hand-fed babies when the milk forms large and hard curds, and when the proportion of cream is too small, the addition of water and cream will often remedy the evil.

As an occasional, but not habitual, simple remedy for constipation in such cases relief may be obtained by making a mixture of a tablespoonful of whole-meal gluten flour in a pint of water, boiling for three hours to a thick mass, and adding a teaspoonful of the mixture, unstrained, to each feeding bottle.

Artificial foods, " prepared " foods, and condensed milk are more apt to excite diarrhœa than constipation, but it should be remembered that they may cause the latter, and the continued use of coarse food or cathartics, or of large enemata, overstimulates the bowel and results in constipation.

When it is necessary to use enemata they should be small, and not too frequently given. From ten to thirty drops of glycerin in two teaspoonfuls of water is quite sufficient for a young nursing infant. The glycerin, by virtue of its hygroscopic power, abstracts water from the rectal mucous membrane, causing hyperæmia, which in time excites peristalsis. A simple injection of two teaspoonfuls of cold water containing a pinch of salt is often successful.

Suppositories may also be used. They should be small, conical in shape, and well oiled before being inserted. They may be made of glycerin, soap, molasses candy (Fruitnight), or gluten.

For older children, from three years up, some one or more of the following articles should be included in the *menus*. By this means it will be possible to do without castor oil, senna, rhubarb, strong enemata, and other remedies which are constantly abused.

Foods Recommended.—Oatmeal, corn bread, cracked wheat, porridge, wheaten bread made of unbolted flour, bran bread soaked in warm milk, gingerbread, bread and molasses (not sirup), brown bread and honey, stewed prunes, baked apples, figs, olive oil and olives, cod-liver oil, fresh green vegetables, orange juice, peaches, and whey.

Foods Forbidden.—Certain foods should be absolutely forbidden to older children, such are cheese, dry fruits (except figs and prunes), fruits having small seeds, spices, pickles, nuts, raisins, dried, salted, or preserved foods of all kinds, canned corn, sweets, candies, cakes, and excess of farinaceous foods. All articles likely to produce flatulent dyspepsia must be avoided. Children on a mixed diet do well to avoid starchy foods and take more broths and soups. Variety in the diet is desirable.

Children should be trained to go to stool at regular hours, and should be early taught the evil consequences of neglect to respond to the calls of Nature. School-teachers should not detain them at their lessons when they are inclined to seek the closet. Water-closets or privies are often dark, cold, and otherwise disagreeable, so that children dread going to them.

Abdominal massage is very helpful in overcoming chronic constipation in young children. It may be performed two or three times a day for five minutes. The movements should be made with the fingers of a warm, dry hand, which move the integument and abdominal wall over the intestine. The treatment must be very gentle, and if the muscular wall is tense, it may be conducted while the infant is nursing or feeding, as suggested by Fruitnight.

Hemorrhoids

Hemorrhoids usually complicate cirrhosis of the liver sooner or later, but they also result from chronic constipation and other causes. The dietetic treatment is substantially that of chronic constipation (p. 582). Much depends upon preventing the stools from becoming hard or bulky. Large quantities of coarse vegetables and cereals should therefore be avoided as well as milk. Alcohol is injurious, especially in the cirrhotic cases. Fresh fruits and abundant fluids are serviceable in uncomplicated cases. Regularity in meals and in time of going to stool should be enjoined, with abundant outdoor exercise. Straining at stool must be avoided.

Appendicitis

Causation.—Appendicitis is mainly interesting from the dietetic standpoint on account of the possible causative relation of certain food residues. In about one third of the cases fecal concretions are found in the appendix, and in one thirteenth foreign bodies have been discovered. It is a popular belief that the disease is often established by the presence in the intestine of grape seeds or skins, lemon, orange, or mustard seeds, cherry pits, bits of chicken bone or clam shell, etc., but such is not the case. Substances of this nature are no doubt often swallowed, but they seldom make their way to the appendix or do any harm; and it is now known that the disease, while it may exceptionally be produced by such irritants, is commonly caused in other ways, and is often of bacterial origin. I have known of one fatal case resulting from eating a large number of soft-shell crabs, but such accidents are very rare. On the other hand, both overeating and overdrinking may indirectly cause appendicitis as well as the consumption of too highly seasoned foods, for these factors provoke catarrh of the intestine, distending the bowel with feces and gas, and making it easy for the catarrhal process or for bacteria of various sorts to enter the appendix and set up local inflammation there. The recurrent cases are more apt to be excited directly by overeating and improper food.

Dietetic Treatment.—The dietetic treatment of appendicitis which has not yet passed into the surgeon's hands should consist in giving only such food as will be thoroughly absorbed, leaving as little residue as possible to irritate the lower bowel and excite peristalsis. Until the outcome of the attack is decided it is best to put the patient upon a fluid diet, consisting chiefly of nutritive broths. Beaten eggs may be allowed, and a moderate quantity of pancreatinised milk, whey, or buttermilk. Cocoa may be given, and strained gruels of rice or barley.

In recurrent cases the patient should be cautioned to eat moderately and avoid all coarse or hard food, such as grits, coarse oatmeal, tough meats, fibrous vegetables, the skin of fruits or potatoes—in short, everything likely to overload the intestine with accumulated waste.

The operative cases should have the diet recommended after laparotomy. Usually the digestive organs require almost absolute rest for twenty-four hours after the operation, and hot water may be sipped. No food at all should be given for fully six hours before operation.

Acute Peritonitis

Acute peritonitis, if due to causes within the alimentary canal, demands absolute rest of the stomach and intestines, and this is secured by giving all nourishment, stimulants, and medicines in the form of nutrient enemata (p. 414). Any food in the stomach is likely to excite vomiting and aggravate the pain and other symptoms.

Most cases of acute peritonitis demand laparotomy, and the dietetic treatment is given under that heading.

In other cases a very little fluid nourishment may be cautiously administered per os, such as peptonised milk, light gruels of pearl barley or arrowroot, plain meat juice squeezed from a fresh steak, or one of the forms of peptonised meat or egg albumin in sherry should be tried. Only one or two teaspoonfuls should be given once in fifteen minutes or half an hour, and every effort must be made to prevent the occurrence of vomiting or meteorism. Twelve or fifteen ounces per diem of predigested food given by the mouth is all that should be prescribed in such cases. The resumption of a full diet should be extremely gradual, occupying several weeks.

It is well to avoid the use of aërated waters of all kinds on account of their tendency to increase meteorism and render the patient still more uncomfortable. Alcoholic stimulation is usually required in severe cases, and if the stomach is intolerant it should be given in the form of dry champagne or dilute whisky or brandy. The latter may be added to rectal enemata.

The reader is referred to the section upon the diet for convalescent typhoid-fever patients (p. 441) for hints as to selection of a *menu* for convalescents from peritonitis.

Chronic Peritonitis

In chronic peritonitis the outcome of chronic tuberculosis, or other disease, plainly cooked animal food agrees best. Starches and sugars, from their tendency to ferment and dilate the bowels with gas, should be avoided. Broiled tender chop, steak, chicken, or white meat of fish may be given. Eggs, milk, and cream are permitted when they do not cause dyspepsia. Bread should be eaten sparingly, and must always be stale or toasted. Zwieback and crackers are given for variety. All food should be eaten very slowly and in very moderate quantities at a time.

DIET IN LIVER DISEASES IN GENERAL

Biliousness

Symptoms.—" Biliousness " is an unscientific but very convenient term employed to express functional disorder of the liver, usually accompanied by an oversecretion of bile, which is often vomited. The condition is characterised by headache, nausea, vomiting, constipation, a furred tongue, anorexia, offensive breath, malaise, and, if it continues, by a sallow, yellowish, or pasty complexion.

Causation.—The most common cause of biliousness is eating too much food or too rich or badly cooked food combined with sedentary habits.

Sir Henry Thompson, speaking of the habit of overeating, says: " The surplus fund of nutrient material unused is stored up in some form. When a certain amount has been thus disposed of—the capacity for storage varying greatly in different persons—an undesirable balance remains against the feeder, and in young people is mostly rectified by a ' bilious attack.' This relieves the system for a month or six weeks, when the process may be repeated."

" In functional derangements of the liver much more permanent benefit is to be expected from careful regulation of the ingesta than from physic " (Murchison).

Continued disregard of the warnings of bilious attacks is liable to lead in time to more serious trouble, such as habitual lithæmia or oxaluria, and in some cases gout. It is possible, although it is not absolutely proved, that diabetes may be placed in the same category.

Persons spending a holiday at the seaside, who breathe more invigorating air than that to which they are accustomed in inland cities, often are tempted to eat too much and exercise but little, with the prompt result of overloading the liver and inducing a bilious attack, for, as Harley says, the liver "acts like a wise horse when overloaded—simply stands still until part of its burden is removed."

Those who have a tendency—often hereditary—to biliousness frequently exhibit idiosyncrasies in regard to special articles of diet, the eating of which, even in moderation, may quickly precipitate an attack.

A bilious condition is sometimes induced by absorption of ptomaines from food in the alimentary canal, which are taken up in such quantity that the liver fails to destroy them.

Bouchard has attempted to show that the ptomaine-destroying function of the liver is aided by glycogen, and is consequently favoured by ingestion of starches.

Dietetic Treatment.—The digestive functions of the liver are so varied that it is difficult to arrange any diet for either functional or organic diseases of that organ which meets all the requirements of theory, but clinical experience has abundantly proved the value of certain general principles, the most essential of which is that the liver should be taxed as little as possible, and a non-stimulating diet is required.

Food in general after it has reached the duodenum acts as a stimulant to the liver, and two or three hours after a full meal the bile secretion is increased; but there are a few foods to which a special stimulating effect has been attributed, although their influence, if any, is slight. These are chiefly the succulent vegetables, like tomatoes, and also spinach and cresses. Strong alcohol, condiments, such as pepper, mustard, spices, and especially curry, have the same effect, and should be avoided. Fats and sugars eaten too freely are very apt to disturb the action of the healthy liver, especially during hot weather.

Coffee and tea may be allowed only in such moderation as one cup a day. Alcohol had better be prohibited entirely. Beer, ale, porter, strong liquors, liqueurs, and all sweet wines, such as champagne, sherry, Madeira, port, and Tokay, must be absolutely forbidden. If necessary as a tonic, a little Rhine wine, hock, or Moselle may be used (not over a couple of glasses daily), or much-diluted whisky. Of all the organs of the body, none is more often poisoned and made cirrhotic by alcohol than the liver, and the moral needs no further emphasis. Many other chemical stimuli, such as opium, derange the liver functions and interfere with the elaboration of food.

More or less intestinal dyspepsia always results from alterations in the quantity or composition of the bile, and on this account as well the food must be carefully selected, and all sugars and most starchy aliments must be forbidden as well as fats.

Among the articles especially prohibited in all cases of liver disease are condiments, spices, curries, pickles, sauces, rich soups, fried food of every kind, veal, pork, sausages; salt foods, such as corned beef and salt fish; crustaceans, new bread, preserves, and sweets of all sorts; pastry, puddings, cakes; all the heavier starchy vegetables, such as potatoes, corn, peas, beans; salad oil; oily fish, like salmon and sardines. Only fresh food should be given.

In acute functional derangement of the liver, whether there is imperfect or diminished secretion of bile or hypersecretion, it is best to considerably reduce all food in quantity. At first, if there are vomiting and headache, only light broths, beef tea, and perhaps dry toast or a cracker should be given.

In acute hepatic disease the tongue becomes furred and the appetite is apt to fail. The latter, in a manner, keeps guard over the liver, for when that organ is overloaded or incapacitated to work a failing appetite leads to taking in less food until proper functional activity is restored. But there are many chronic cases in which continued absence of appetite leads the patient to take less nourishment than is really needed, and in such cases it is not a reliable guide. It is not desirable to restrict the diet too closely or allow it to become monotonous. The palate should rather be tempted by reasonable variety.

In regard to the suggestions given below, it must be remembered that they are very general, and are applicable rather to the chronic types of hepatic disease, although they will serve also for those afflicted with recurrent or intermittent attacks of biliousness, and should be followed between the attacks. In very active disease, such as acute congestion, acute yellow atrophy, abscess of the liver, etc., obviously the diet must be much more limited. In ordinary uncomplicated bilious attacks induced by high living, a day or two of practical starvation with the use of a mercurial cathartic is wholly curative.

The following articles can usually be allowed in moderation excepting in very severe cases:

Animal Food.—Fish, such as sole, flounder, halibut, smelt, whitefish; the soft part of oysters, liver, sweetbread; lean meat, such as roast beef, broiled beefsteak, mutton chops, or chicken (lean beef is better than poultry or game); eggs, milk and its preparations, such as koumiss, whey, buttermilk, junket, malted milk. Many persons with hepatic disorder insist that milk always makes them bilious. If this proves to be true of natural milk, it should be predigested or given with sodium bicarbonate or Vichy, or in one of the numerous ways described on p. 79.

In advanced cases of hepatic disease milk constitutes an excellent food, and may be used abundantly, provided the proper form for its administration in a given case is determined. Baked custard and blancmange or other forms of gelatin may be eaten.

Vegetable Food.—Of fresh green vegetables the following may be eaten: Spinach, asparagus, tomato, squash, pumpkin, celery, oyster plant, beet tops, cresses, lettuce (without oil).

Cereal Foods.—Bread should be eaten in small amount. It must be stale or toasted. Zwieback is good, and dry rusk, not too sweet. Graham, gluten, or wheaten crackers may be permitted. Other starchy foods should be eaten sparingly; but boiled rice, rice pudding, sago, and tapioca are admissible.

Fruits.—Fresh fruit in season is wholesome, and useful to overcome the tendency to constipation. Grapes, oranges, strawberries, peaches, and roast apples may be eaten.

Water should be drunk freely, except when ascites is present; and light beverages, such as lime juice in aërated water, lemonade, or dilute raspberry vinegar, may be serviceable.

Directions for Eating.—The manner of taking food is very important. There is apt to be hyperæmia of the stomach and intestines from time to time, as a result of engorgement of the portal system, and catarrhal conditions are easily excited in these organs by food which is hastily bolted without thorough mastication or which is not well cooked or not perfectly fresh. The teeth should always be examined to ascertain if the patient can masticate properly. Fluids should not be drunk with meals. The patient should not eat directly after violent exercise or fatigue, but should first lie down and rest for three quarters of an hour. If he suffers from dyspepsia, he should rest after meals as well. In many cases three meals a day suffice, but they should be given at intervals of about six hours, to insure complete digestion between. In others, when considerably enfeebled, or in cases of hepatic congestion and advanced cirrhosis, it is better to feed the patient four or five times a day, or once in three hours, giving a smaller quantity of food which is easily digested. It is advisable to take the principal meal at noon.

From the fact that the bile is diminished in amount or altered in composition, constipation is the rule, and proper laxatives should be frequently given if the bowels cannot be kept in order by fresh fruit.

Hot water in an empty stomach is quickly absorbed, and passes directly to the liver through the portal vessels. If salts, such as Carlsbad salt, are given, they are absorbed with the water, and stimulate the liver cells. The water increases the portal blood pressure, and thus indirectly the pressure of the gall ducts, and favours the elimination of bile.

Moderate systematic exercise should be prescribed whenever possible, and the best forms are horseback and bicycle riding. The "jouncing" movements of the former shake and compress the liver, and stimulate its circulation and the outflow of bile.

Acute Catarrhal Inflammation of the Gall Ducts—Angiocholitis—Catarrhal Jaundice

A bland or non-stimulating diet must be given in the acute stage of angiocholitis. Vomiting is sometimes present, or it may be artificially induced as part of the treatment, so that the stomach is not in a condition to bear solid food. Moreover, much food on entering the duodenum will increase the local inflammation of the common bile duct. Diluted or peptonised milk is to be given, or buttermilk, whey, light meat broths, clam broth, pressed-beef juice, egg albumin.

In a few days, if pain, tenderness, vomiting, and fever subside, the diet is to be slowly increased, and such articles may be added as milk toast, bread and milk, broths and light soups without vegetables, the breast of chicken, oysters, sweetbread, meat jellies. Later, eggs, and boiled or broiled fresh steak may be eaten. Fat and butter should be avoided, and pains should be taken to prevent constipation and putrescence of the intestinal contents.

Fatty, amylaceous, and saccharine food is to be avoided, and for some time after the acute symptoms have subsided the basis of diet should be whitefish, lean meats, and fresh green vegetables.

Cooked fruits, not too sweet, and to which sugar has not been added, such as sour apples, prunes, etc., can be eaten. Considerable fluid should be taken both as a diluent and to promote the action of the kidneys and lessen the tendency to constipation. Water acidulated with lemon juice or effervescent waters (soda water, Seltzer, and Apollinaris) may be drunk three or four times a day between meals. Coffee and tea are allowed only during convalescence.

Cirrhosis—Ascites

Causation.—Cirrhosis is a disease of the liver occasioned by irritation of that organ by substances in the blood derived more particularly from the portal system after direct absorption from the intestine. Among those irritants may be mentioned as the foremost excitant alcohol, which produces fully 60 per cent of all cases. Strong alcoholic stimulants often contain fusel oil or other especially noxious impurities. The prolonged use of strong condiments, or spices, such as curry and peppers, may occasion cirrhosis, as also may chronic metallic poisoning by arsenic, antimony, lead, or phosphorus. Experimentally, ptomaines have been made to excite the disease in the lower animals, and continued poisoning by such agents may possibly produce it in man. Cirrhosis may be caused in other ways, but the facts above mentioned show its frequent relation to dietetic errors. As a result of fibrous hepatitis, the terminals of the portal vein are obstructed and the portal venous system is congested, the blood being dammed back in the vessels of the stomach, spleen, intestines, and pancreas. Owing to the congestion there is frequent vomiting, sometimes of blood, and there is marked interference with the character of the digestive secretions as well as the process of intestinal absorption.

Dietetic Treatment of Cirrhosis without Ascites.—Cirrhosis without accompanying ascites is often best treated by a milk diet for two or three weeks. Bread and crackers may be allowed with the milk, but nothing else. Hot water and aërated waters should be drunk in large quantities, fasting, to " flush " the liver. Subsequently a light diet is to be prescribed in accordance with the suggestions given for the treatment of liver diseases in general (p. 592). All condiments, relishes, sauces, fats, fried food, pastry, and sweets must be withheld, as well as alcohol in every form. The skin and bowels must be kept active.

ASCITES

Pathological Physiology.—A further important symptom which is seldom absent towards the close of a protracted cirrhosis, if the patient lives long enough, is ascites. This is an accumulation of serum in the peritoneal cavity, which has been produced by the altered blood pressure of the portal system and the altered composition of the blood itself. The fluid accumulates with considerable rapidity, and may reach an enormous quantity—sometimes as much as twenty-four quarts—greatly distending the abdominal walls, floating the viscera out of position, and by pressure interfering with digestion and absorption. In addition the loss of so large a quantity of fluid from the blood is a serious detriment to nutrition, inasmuch as the ascitic fluid not only contains water in large amount, but serum albumin, which may be present in the proportion of from 1 to 2 per cent to over 6 per cent. In the ascites accompanying cirrhosis the loss of albumin in this manner may be somewhat less than when the serous accumulation is due to other causes.

These facts should be borne in mind in relation to the dietetic treatment of the disease. Repeated aspiration of the abdominal cavity not only abstracts large quantities of water from the system, but also abstracts considerable albuminous material. In those cases in which fluid refills the peritoneal cavity promptly after aspiration, it is a question whether the nutrition of the body may not suffer by drawing off so much serum albumin. On the other hand, when once transuded, it is of no further service to the organism unless it can be reabsorbed. The point for consideration is whether too frequent removal of the ascitic fluid will cause greater drain on the blood than would be consequent upon letting it accumulate in the abdominal cavity. Much will depend upon the relative pressure within the peritoneal sac and the blood vessels, which will affect the rate of osmosis of albumin. This discussion leads to the query, whether it is not necessary to supply the constant loss of albumin by an increased allowance of animal food, and, secondly, to what extent water should be withheld from the dietary.

Dietetic Treatment of Cirrhosis with Ascites.—When uncomplicated ascites is present it is generally best to restrict the quantity of fluid ingested and put the patient upon a " dry diet," consisting of bread and meat chiefly. By simply withholding fluid and stimulating the force of the heart and the action of the kidneys I have sometimes seen large quantities of fluids disappear from the abdominal cavity; but this treatment is not always successful. There is more hope of success when the disease occurs in young persons, or, as it sometimes does, in children. Cirrhosis and ascites are very apt to be associated with renal and cardiac lesions and gastric catarrh, which make it much easier to say what food the patient must not eat than what he can have. If the urine is very scanty it may not be wise to withhold fluids, and some clinicians of wide experience believe in giving fluids in unrestricted amount, holding the view that this will increase diuresis to such an extent that not only will all the fluid drunk be promptly eliminated, but that the active kidneys will drain more from the blood, which will in time be replaced by reabsorption of the ascitic fluid. The same reasoning is often applied to cases of pleurisy, general anasarca, etc. It seems much more rational to endeavour to promote diuresis when possible by medicinal measures than to add a large bulk of fluid to an already overbalanced circulation.

It is of importance in every case to measure and estimate carefully the total amount of fluid ingested both in beverages and as food and make a comparison with the quantity of urine voided, and if possible with the weight of the patient and girth of the abdomen at different levels.

If the fluid diet is followed by rapid reaccumulation of ascitic fluid after aspiration, for example, within a fortnight, it is desirable to replace it by as much simple solid nutriment as the patient can digest, or by predigested and concentrated foods. An outline of the appropriate diet for such cases will be found upon p. 441.

The " grape cure " and " milk cure " have been strongly recommended in Europe for the treatment of cirrhosis and ascites. They are said to ameliorate the symptoms and promote reparative processes, both acting largely through diuretic influence.

Fatty Liver

Pathological Physiology.—The liver is the great storehouse of latent energy in the body, which is accumulated in glycogen and fat. A certain proportion of fat is to be regarded as a normal constituent of the parenchyma of the liver. This varies considerably within normal limits, depending upon the character of the food ingested and the degree of its oxidation in the liver and other tissues. After a diet consisting largely of fats and oils or of carbohydrates the accumulation of fat in the liver is considerable. Lack of exercise and unfavourable hygienic conditions, by retarding oxidation processes, also promote its accumulation. Persons addicted to constant overeating of carbohydrates are therefore liable to this affection. They become stout, take less and less exercise, and the second condition favouring fatty infiltration of the liver—namely, lack of oxidation—is added. Fatty liver is also caused by various diseases in which the composition of the blood is altered and the metabolism of oxidation is interfered with. Such are advanced anæmia, chronic alcoholism, and tuberculosis. It is suggested by Fitz that the fatty diet often recommended for the latter disease—consisting of cod-liver oil, rich milk, butter, cream, etc.—is productive of fatty disease of the liver.

Dietetic Treatment.—The dietetic treatment is indicated by the previous considerations, but since the local condition is commonly merely an accompaniment of more serious general disease, it may be unwise to advise too sudden or extreme alterations in the accustomed diet of the patient. In general, all forms of sugar, starch, and fat should be reduced gradually to a minimum, and, if possible, finally omitted entirely, excepting in tuberculous patients whose general bodily nutrition is of more importance than the danger of local fatty infiltration. In these cases the object desired is better promoted by increasing oxidation processes by climatic and hygienic treatment rather than by withholding the carbohydrates. Malt liquors and alcoholic drinks in general must be forbidden. In other cases, especially in the alcoholic form, the diet should consist of nitrogenous food, fresh green vegetables, and fresh succulent fruits. The following articles may be taken: Lean meat, boiled or broiled fresh fish, lettuce, spinach, celery, tomatoes, gluten bread, and toast.

Amyloid Liver

The condition of amyloid liver after it has become sufficiently pronounced for diagnosis is usually fatal within a short period, and consequently but little aid can be derived from dietetic treatment. The diet should be so regulated as to burden the digestive organs as little as possible, and in advanced cases such predigested foods as peptonised meat or milk ought to be given. If the stomach digestion is fairly active, nitrogenous food will agree better than the carbohydrates.

Syphilis of the Liver

In advanced syphilitic hepatic disease non-stimulating food only is permissible, such, for example, as milk and eggs, chicken, beef or mutton broths, fresh fish, oatmeal, boiled rice, semolina, revalenta, bread, and light farinaceous puddings—such as tapioca, sago, blancmange, and custards. Alcohol in all forms is prohibited.

Abscess of the Liver

In hepatic abscess the same general dietetic treatment is to be followed as that indicated for syphilitic disease of the liver. The aim should be to carefully avoid overloading the digestive organs at any time, and to give assimilable and predigested food in small quantities at frequent intervals, at least once in three hours. Animal broths and light vegetable *purées*, with various combinations of milk and eggs, should form the staple articles. No solid foods should be given, excepting such as a little fish, such as sole or haddock, a few oysters, sweetbread, and milk toast.

Fats in all forms are forbidden. Malt liquors, port, sherry, and all forms of strong alcohol must be prohibited. If any stimulant is required, a little hock, Moselle, or champagne may be taken, or very weak brandy, diluted with Apollinaris or Vichy.

Gallstones

Pathological Physiology.—Gallstones are formed in the gall bladder or larger bile ducts by precipitation from the bile of cholesterin, mixed with more or less mucus. Occasionally they contain the bile pigment (bilirubin) or calcium carbonate. Cholesterin is an alcoholic substance which may be extracted in varying amount from the blood or nervous tissues, especially the brain, and from the bile. It may be obtained in flat, rhombic, colourless crystals. Somewhat rarely it is excreted in the urine. It also exists in the waste matter contained in the lower bowel. Cholesterin is maintained in solution in the bile by alkaline salts, the sodium and potassium taurocholate and glycocholate. Calcium unites with the latter substances, forming new compounds with the biliary acids which are insoluble salts that no longer keep cholesterin in solution. When organic acids exist in excess in the tissues calcium is liberated, and on reaching the liver produces the above reaction.

An excessive accumulation of cholesterin in the system will result in its precipitation from the bile, and this occurs when for any reason the bile has long been retained in the gall bladder, where it has been concentrated by reabsorption of some of its fluid ingredients. Bacteria are undoubted agents in the formation of many stones. The precipitation of cholesterin is favoured by the presence of a pre-existing hepatic stone or any foreign body in the gall bladder, such as an intestinal parasite, or its ovum, or thickened mucus.

Gallstones are oftenest present in advanced life and among those who adopt sedentary habits which lead to accumulation of bile in the bladder. On the latter account they are more common among females, and their occurrence is often related to excesses of the table, in regard to both food and drink.

All diseases of nutrition, such as long-continued dyspepsia, chronic rheumatism and gout, diabetes, and obesity, may be accompanied by the formation of biliary calculi.

Among other explanations given for the formation of gallstones is an excessive proportion of fat in the diet, although cholesterin is not true fat, but is really an alcohol allied to fats in some of its properties. Lack of exercise is a contributing factor.

Harley, who has given more careful attention than any other writer to the prevention of a return of gallstones by dietetic treatment, called attention to their greater prevalence in cold latitudes than elsewhere, and attributed this fact to the influence of certain foods, especially meat fat and suet. He wrote: "Starchy puddings and fat bacon cause more gallstones in this country [England], I believe, than all the other kinds of food put together."

The hydrocarbons are more completely consumed in early years than after middle life, and hence the greater prevalence of gallstones in the latter period, as above mentioned.

Bauer believes that "the formation of gallstones may often be referred to a faulty diet, for an excessive consumption of meat or free indulgence in fat and in spirits would probably favour their formation."

Less often gallstones are composed of pigment or of calcium carbonate, or of various mixtures of these substances with one another or with mucus. Individual stones sometimes attain the size of a small egg, and they may cause suppuration and the formation of a fistula from the gall bladder which opens into some other abdominal organ, or externally.

In many cases the stones exist in considerable number and size without giving rise to any symptoms or discomfort, but the smaller-sized stones occasionally find their way into the common bile duct, and their passage provokes intense agonising local pain, known as biliary colic.

Dietetic Treatment.—From the above account of the manner of formation of bile stones it is evident that patients who have once suffered from biliary colic or other symptoms of the presence of concretions should exercise care in their diet and habits of life, in order to prevent the further formation of stones, and, if possible, to aid in dissolving those already present. The diet must be regulated with the object of lessening the production of cholesterin and of diluting the bile. Animal food may in itself contain cholesterin, and should therefore be taken very sparingly. A diet of concentrated animal food, by diminishing the alkalinity of the fluids of the body, favours the deposition of cholesterin from the bile, although this ingredient may not be present in abnormal amount in such food. Patients should be cautioned against excessive indulgence in any particular article of food, all richly cooked food must be given up, and if they are in the habit of eating nitrogenous food in excess, a larger proportion of fresh vegetables or farinaceous food should be substituted.

Calves' brains and the viscera of animals used as food in general, and particularly the liver, should be wholly interdicted. Sugars and fats must be forbidden in every variety.

Some vegetables, such as peas and carrots, are believed to contain material which closely resembles cholesterin. Carrots, moreover, are sweet, and sweet vegetables and fruits should be avoided, and also egg yolks, on account of the fat they contain.

Fresh green vegetables and acid fruits which, by virtue of their alkaline salts and organic acids, easily combine in the blood with alkaline bases should make the basis of the diet. The potassium salts which are contained in potatoes and other vegetables in abundant quantity are believed to be serviceable, because they retard the liberation of calcium, which, it has been shown, precipitates cholesterin. Bread and well-cooked cereals and fresh fish, except salmon and mackerel, may be eaten. Chicken or lean beef may be allowed, but all meat should be taken sparingly and not oftener than once a day.

For the purpose of diluting the blood and, through it, the bile, large quantities of fluid should be ingested, but it is best to avoid aërated waters and mineral waters which contain salts of lime. A tumblerful of hot water should be drunk at night, and another on rising in the morning. Champagne and other beverages which hold much carbonic-acid gas in solution must be avoided, as must malt liquors. Coffee, tea, and claret may be drunk in moderation. If the case is one in which considerable gastric catarrh or dilatation of the stomach is present, it is inadvisable to give much fluid by the mouth, and sometimes the desired result may be obtained by injecting salt water through a long flexible rubber tube into the colon. Intestinal irrigation as well as active purgation favours removal of the bile and prevents its accumulation in the gall bladder. Prout gives one or two drachms of sodium phosphate or sulphate daily to prevent concentration of the bile. For purgation the Carlsbad Sprudel salts and Saratoga salts are valuable. In women tight lacing should be prevented, and the habit of sitting long in cramped positions which interfere with free hepatic circulation.

Large doses of olive oil, several ounces at a time, have been recommended for use during the passage of a gallstone, with the idea apparently of in some mysterious way lubricating the channels through which the stone is carried. But the oil, if absorbed, is taken up by the lacteals and emptied into the thoracic duct without going anywhere near the liver or bile passages, so that such an explanation of its use is absurd. The foreign bodies which it is claimed appear in the stools after giving oil in this manner have proved to be not stones, but inspissated masses of oil.

PANCREATIC DISEASES

Disease of the pancreas is usually impossible to diagnosticate with accuracy until it is far advanced, and but little can be expected from dietetic treatment. Since the pancreatic juice is on every account the most important of all the digestive fluids, being a universal digestive agent for all foods, and the most vigorous one, its absence or deterioration results promptly in emaciation, which becomes extreme. When the presence of disease of this gland, such as a cyst, is established, it is best to withhold all fats and carbohydrates from the diet. They are not digested in the stomach, and when the pancreatic juice fails, they merely ferment in the small intestine and do positive harm. Milk, pancreatinised meat preparations, beef peptonoids, and egg albumin, with alcoholic stimulants, must constitute the chief reliance for nourishment.

It is of interest to note that the continued presence of fat or oil in the stools is regarded as a strong diagnostic point in favour of the absence of pancreatic fluid. As a positive test this may have some value, but not as a negative one, for if bile is present in normal quantity the fat of food may still be emulsified and, to some extent, absorbed. In a half dozen cases of undoubted pancreatic cyst in which the diagnosis was established by aspiration or autopsy, I have known doses of several ounces of olive oil administered for diagnostic purpose to give no residue in the stools. The absence of fat in the feces does not therefore necessarily exclude pancreatic disease.

DIET IN DISEASES OF THE NERVOUS SYSTEM

Neuralgia—Gastralgia—Enteralgia

Causation.—Neuralgia is a term applied to a variety of nerve pains which may be associated with organic lesions of various structures which irritate the peripheral nerves, or which may be purely functional and temporary excitations of the nerve trunks or their end organs. Lesions involving the nerves themselves are not described as neuralgias. The irritability and conductivity of nerve fibres is so dependent upon nutrition that debility resulting from imprudent living and improper or insufficient food would naturally be expected to rank among the chief predisposing causes of this affection.

Persons undergoing severe mental worry or strain, physical fatigue, prolonged exposure to cold, prolonged lactation, etc., are apt to suffer from indigestion or malassimilation of their food, and the one condition reacts upon the other in altering the tone of the nervous system.

Moreover, many diseases which may be called dietetic in that they are so closely associated with or influenced by dietetic errors (acting eventually through the composition of the blood) are very commonly accompanied by neuralgic pains. Such are gout, rheumatism, lithæmia, arthritis deformans, diabetes, and chronic alcoholism. To benefit the diseased condition by appropriate diet, among other means, is to cure the neuralgia.

Neuralgic pains are often connected immediately with the digestive tract, especially in cases of neurasthenia and hysteria among women, and are excited by irritating foods or by fermentative processes.

Dietetic Treatment.—The dietetic treatment of neuralgia is based upon certain general principles which may be observed whereever they do not conflict with the special disease of which the pain may be merely an incidental symptom. This treatment is liable to be overlooked while attention is wholly given to devising new remedies for the immediate, though often merely temporary, relief of the pain.

It is of the utmost importance to early ascertain the cause of the pain and learn whether it be not due to one of the conditions above mentioned, which may be found to exist in a latent form. Careful examination of the urine should in all cases be made to ascertain the possible presence of the uric-acid diathesis, of sugar, of phosphaturia, etc.

Since a majority of cases are accompanied by general debility and occur in anæmic, constipated women who take little outdoor exercise, the blood also should be examined for anæmia. A nutritious and ample diet should then be prescribed, accompanied by moderate exercise and abundant fresh air, to insure more perfect oxidation. Anstie says correctly that "neuralgic patients require, and greatly benefit by, a nutrition considerably richer than that which is needed by healthy persons." This is particularly true of the extremes of age.

Fats and oils are most serviceable, and under this heading cream, Devonshire cream, butter, bacon, fat meat, salad oil, olives, and cod-liver oil may be used.

Neuralgic patients usually dislike fats, perhaps on the general principle that people are likely to prefer different food from that which they most need for disordered conditions of the system. Some are even made bilious by fat, but with a little tact and perseverance in selecting the proper kind of fatty food and directing the mode of taking it these objections may be overcome. Patients may take more butter than usual, though they refuse cream, or they will take cream though they refuse cod-liver oil. Salad oil and fat bacon are not apt to provoke objection.

In neuralgia due to general debility or anæmia without lithiasis, nitrogenous foods are indicated in addition to the fats above mentioned, and good roast beef, beefsteak or chops, eggs, milk with bread and butter, light starchy foods, and fresh vegetables should be ordered. Meat should be eaten two or even three times a day, and additional lunches may be given between meals, consisting of milk, a glass of claret and a sandwich, a cup of cocoa and a biscuit, or broth thickened with beef meal or an egg.

Gowers says that he has sometimes known " severe neuralgia to occur first on the patient commencing a purely vegetable diet, to disappear when meat was taken, and recur with severity on each of four successive attempts to return to vegetarianism."

If the nervous system has been greatly overtaxed or the digestive organs are exceptionally feeble, it may be advisable to put the patient for a few days on a diet consisting largely of milk, eggnog, beef broth, and *purées*, accompanied by rest and passive exercise (massage). After a few days the more substantial nitrogenous foods may be added. In cases associated with lithæmia or rheumatic diathesis, however, the quantity of such foods should be reduced, and the special regulations described under the heading of rheumatism and lithæmia must be followed.

Coffee and tea should be used only in moderation, and in bad cases had better be prohibited altogether.

Alcohol in restricted dosage benefits many anæmic cases. Claret or Burgundy may be drunk with meals, but alcohol should never be taken merely to relieve pain or otherwise than a food, for there is danger of becoming too much addicted to its use.

Substances to be especially forbidden are pastry, sweets, and confectionery of all kinds, griddle cakes, condiments, fried food, and rich, highly seasoned sauces and foods.

All meats should be eaten at regular intervals, and, except as directed above, eating between meals must be prohibited.

VISCERAL NEURALGIAS

The visceral neuralgias are produced in the sympathetic nerves chiefly. The digestive viscera—stomach, intestines, liver, etc.—in a normal state are free from sensory impressions, but their nerves are constantly conveying reflex impressions, which, however, are to be distinguished from ordinary tactile sensibility. Hypochondriasis, by concentrating mental attention upon the various abdominal viscera, undoubtedly develops hypersensitiveness to such nerve currents.

The condition described as ptomaine poisoning and various forms of auto-intoxication may excite a severe neuralgia as a symptom.

Dietetic Treatment of Visceral Neuralgias.—Neuralgias of any of the abdominal viscera are apt to be excited by functional activity (although they also may occur independently of it), and hence the diet should be made as simple and nutritious as possible, in order that digestion shall not be unduly prolonged. If any one article of food is found to excite the paroxysms it should be abandoned. It is often advisable in severe cases to limit the diet for a few weeks to two or three simple articles of food, such as beef, bread, milk, and rice.

GASTRALGIA

Causation.—In neuralgia of the stomach, called gastralgia, or gastrodynia, the pain is situated in the epigastrium, penetrating to the back. It is distinctly localised and intense. It may be paroxysmal, or there may be dull constant aching with exacerbations of a moderate lancinating character. It is usually relieved somewhat by moderate gentle pressure, but intensified by deep pressure. Such pain is not infrequently associated with anæmia, chronic constipation and hysteria, and in a severe form, accompanied by violent vomiting, it constitutes the "gastric crisis" of locomotor ataxia. Gastralgia may also be occasioned by the continued excessive use of stimulants, such as alcohol, strong tea and coffee, and chewing tobacco, and by the inordinate use of sweets. An excessive formation of hydrochloric acid in the gastric juice may occasion a very painful variety of gastralgia.

Dietetic Treatment.—In all cases of gastralgia careful inquiry must be made in regard to irregularities of diet, and the relation between eating and the occurrence of the pain. If the pain is worse while the stomach is empty and is mitigated by taking food, it is suggested by Gowers that it is due to morbid action of those nerves which normally excite hunger. Such cases should be treated by giving nourishment in frequent small quantities. In addition to the three regular meals of the day, which should be light, a glass of wine or a cup of hot bouillon and a biscuit or two, or a glass of milk punch or eggnog, may be taken at 11 A. M., 4 P. M., and again before retiring. A tumbler of milk or a few crackers may be kept by the bedside and taken in the middle of the night should the patient be awakened by the pain. The pain itself is an indication of impoverished nutrition, and the nervous system requires rest while the tissues need food. In still other cases food intensifies the pain and excites immediate emesis. This is especially true of the gastric crises of locomotor ataxia. Here sedatives, such as bismuth, cocaine, or anodynes must be given to relieve the irritation of the gastric mucous membrane while food is temporarily withheld until the pain has subsided. The diet subsequently should be gradually increased, commencing with small quantities of peptonised albuminous food. In gastralgia the appetite is very capricious, and there may be excessive craving for certain articles of diet, such as pickles, condiments, etc.

In all forms of gastralgia the pain is aggravated by distention of the stomach. If starchy food tends to produce flatulency it should be avoided, together with sugars and fats. Tea and coffee and tobacco must be given up. The bowels should be kept freely open.

Enteralgia—i. e., a true neuralgic pain in the intestines—is not common if " peristaltic unrest " be excluded. It does occur, however, and most frequently in the lower rectum, in which case it is to be relieved by local treatment rather than dieting.

Hepatalgia, or neuralgia of the liver, is an indication of functional overwork of that organ, which may be relieved by a careful inquiry into the dietetic habits of the individual and correction of errors in addition to purgation.

In severe forms of neuralgia which do not yield to dietetic and medicinal control prompt relief is often secured by change of scene and sea bathing, or a course of mineral baths. Hygienic measures improve functional activity and promote oxidation and assimilation by the tissues of the products of digestion, as well as the elimination of waste.

Migraine

Migraine, or " sick headache," is a neurosis characterised by pain in the course of the fifth nerve, often accompanied by nausea, vomiting, mental depression, and local vasomotor disorders.

There are many causes assigned to this affection, among them heredity, the gouty diathesis, improper food, etc. Some obstinate cases are unaffected by diet, but others are much benefited by attention to it, and it is always worth while to attempt a cure by it. The patient should be very closely interrogated in regard to all the habits of diet and hygiene, such as the hours for eating, the kind of food eaten, its method of cooking, bathing, exercise, mental work, hours and frequency of the stools, etc. In this way only can possible faults be detected and corrected. The gouty should be forbidden the use of wines, malt liquors, sugars, and starches. The anæmic should be ordered more animal food and fats and cod-liver oil. The dyspeptic should abstain from carbohydrates. The neurotic should give up tea, coffee, and tobacco. It has been shown by Roberts that both tea and, to a lesser extent, coffee may materially retard starch digestion, even when drunk in very small quantities. Yet there are some patients who can ward off an impending attack of migraine by taking two or three cups of strong tea or black coffee.

Plain cereal foods may be allowed, such as wheaten grits, "germea," hominy, and oatmeal, but the addition of milk and sugar to them may cause fermentation and make them undesirable. In this case saccharin may be substituted, or an extract of malt.

Fresh green vegetables, such as asparagus, young peas, French beans, string beans, sea-kale, and stewed celery may be eaten, but potatoes, corn, cabbage, tomatoes and rhubarb should be avoided.

Excepting anæmic patients, those suffering from migraine should not eat much meat. It is best to take it not oftener than once a day, and the white meat of poultry and broiled fresh fish are better than much red meat.

Milk may disagree and cause headache through lactic-acid fermentation, interfering with digestion.

New bread, pastry, richly cooked food, condiments in excess, shellfish, crustaceans, cheese, sauces, and desserts in general are forbidden. Many of these foods may produce ptomaines by putrefactive fermentation, which act as poisons to the blood and nerves. Vinegar and acid fruits should not be eaten, especially in connection with amylaceous foods (Roberts).

Obviously no rules of diet apply to all cases of a disease which may originate from so many different causes, and in chronic cases careful observation and experimentation will be necessary to establish the best course.

Overeating, irregular eating, and late suppers should be forbidden. Outdoor exercise, bicycling, or horseback riding should be prescribed to aid digestion, and the bowels should be kept active by eating fruits.

Patients are often found who, as a result of following every one's advice, have gradually cut down their diet, one article at a time, until they are actually suffering from inanition, and it requires no little tact and firmness to convince them that they can eat anything at all. They will live on nuts and fruit alone, or on hot water and raw beef, or follow the latest dietetic "fad," whereas they really need a common-sense diet of plain, nutritious food, such as that prescribed above for neuralgia or anæmia.

Decayed teeth are a frequent cause of facial or other neuralgias, and the pain is often directly excited through the food or liquid taken being too hot or too cold, or strongly sweet or sour. Many persons experience temporary but severe frontal pain after swallowing iced beverages or ice cream too rapidly. In some persons the site of the pain is in the vault of the pharynx or in the throat itself. It is often relieved by momentarily compressing both carotid arteries. Brunton suggests that cold excites the sympathetic plexuses about the carotids and alters their calibre, putting them into a state of spasm. These forms of neuralgic pain are, however, usually trivial, and are to be avoided by proper care of the teeth and regulating the temperature of the food.

Neurasthenia

Causation.—Neurasthenia is a condition of loss of tone of the nervous system which is of a functional rather than an organic character. It is also called nervous exhaustion or nervous prostration. Strictly speaking, it is not a disease, but rather a functional derangement of considerable duration, which, however, with proper care and dietetic treatment results usually in complete recovery. The most apparent cause of neurasthenia is overwork of the nervous system due to continued excitement or strain or prolonged emotional depression and anxiety. It is far more apt to be produced by overwork of the nervous system than of the muscular system, although it may be occasioned by the latter. Different individuals are endowed with varying degrees of nerve force, and the complex demands and great activity of highly developed civilisation tempt or compel many people to draw upon their physiological capital of energy at the expense of its income, with the result of exciting the entire central nervous system, including both brain and spinal cord, to an unwonted and sometimes dangerous degree. For this reason neurasthenia is essentially an affection incident to the occupations and customs of city life, rare or comparatively unknown in the repose of the country. It is a curious but undeniable fact that there appears to be more or less fashion in regard to some diagnoses, in nomenclature at least, if not in the diseases themselves, and of late years " nervous prostration " has taken rank among ordinary functional disorders.

The general name neurasthenia includes a large variety of nervous symptoms, and while all of the physiological processes of the body are more or less impaired, the symptoms may predominate in one or more mechanisms, as, for instance, that of the circulation, gland secretion, or absorption.

Men who find themselves in business straits or in circumstances of prolonged anxiety feel that they are straining their vital powers, and resort to an increased or excessive use of stimulants, such as alcohol, tobacco, coffee, and various drugs, to excite their overtaxed mental and physical powers into greater activity. By means of this substitution of force, especially with the use of alcohol, they are enabled to work on, and still further excite a debilitated nervous system until finally the limit of endurance is reached, and some slight additional strain reduces them to utter prostration. Not infrequently local functional disorders, such as writer's cramp, neuralgia, etc., give warning that a general neurasthenic condition is imminent, and if this warning be not heeded in time, more serious symptoms inevitably follow.

Neurasthenia reacts on the digestive system, producing malnutrition and a variety of functional disorders, for so dependent is the whole alimentary canal upon a normal vigorous blood supply and nerve regulation that it necessarily suffers profoundly.

General Treatment.—The treatment of neurasthenia is fundamentally based upon two absolutely essential conditions: First, complete body rest, with the necessary absence of the original exciting cause of the difficulty, which will enable the impoverished tissues to become regenerated and have the balance of their energy properly retarded; secondly, a nourishing diet, which will supply the material for this energy and tissue metamorphosis. Various tonics, such as strychnine, iron, and arsenic, are of recognised benefit to the nervous system, but the main reliance in all treatment must be placed upon rest and food. The milder cases may be relieved by a change of occupation and the enforcing of strict rules in regard to the hours of sleep, the methods and time of eating and taking exercise, bathing, etc. Many persons with functional nervous disorder have no appetite early in the day, but towards evening can eat a substantial meal, and they should dine late.

Patients who for years have been accustomed to exceedingly active mental work find it almost impossible to endure confinement, absence from social intercourse, and lack of occupation, and in such cases the advantages of dietetic treatment may be enhanced by cheerful surroundings and diversion. As a rule, it is far easier for the fatigued or worried business man or "brain worker" to break off completely his accustomed occupation for a period of several weeks or months, to be spent in travel or at some foreign spa, than it is for him to continue his ordinary occupations in moderation, and take exercise and proper food and sleep in accordance with the rules laid down by the physician.

In many cases of this nature travel affords a certain and fairly prompt relief, but it has the disadvantage that it involves considerable irregularity in the hours of rest, character of diet, etc., as well as the fact that many are deterred from this means of cure by the expense involved. In another class of cases too active travelling is stimulating and fatiguing, and if such people are not made ill at sea nothing gives more benefit than the isolation, invigorating air, and enforced idleness of a sea voyage. For others, in whom the digestive system is comparatively little impaired, camping or living an outdoor life in the woods affords the same advantage. Whatever journey is undertaken, therefore, should be in the direction of rest and moderate diversion without the sight-seeing which is involved in visiting new cities. The physician should not only study carefully the previous habits of the patient, but should consult his tastes in regard to occupations and amusements. When this is done and his confidence has been thoroughly gained, it is far easier to have the rules for diet which are prescribed carefully adhered to. In still another class of cases of neurasthenia the general nerve breakdown is so sudden and the exhaustion so extreme that absolute rest at home and in bed is imperative. To this class of cases belong a large number of overworked society women whose lives of constant excitement and mental activity or stimulation, combined with the number of charitable interests or other occupations to which they give much energy, wear them out in time.

The most severe cases of neurasthenia require special treatment, the principles of which are, first, complete rest for body and mind; secondly, systematic feeding; and thirdly, massage. This treatment is applicable to those cases in which the nervous system is so greatly exhausted that the patient suffers continual depression from the least exercise, exertion, or emotional excitement. In some instances insomnia is a predominant and serious symptom; in others the patient is drowsy in the daytime and unable to perform any concentrated mental labour; in others again inanition is the most pronounced feature, and the rapid loss of weight and failure of strength alarms the patient, or the body may even increase in weight, while the muscles become soft and so feeble as scarcely to support the frame. Many cases are complicated with pronounced hysteria, hypochondriasis, or unnatural irritability.

One of the first requisites in treatment is to secure a faithful and intelligent nurse and to isolate the patient from well-meaning but oversympathetic friends whose constant inquiries and suggestions are apt to aggravate existing conditions by focusing the attention of the patient upon them. In general, it is best to allow no one to see the patient excepting the trained nurse, the physician, and perhaps some one trusted member of the family. All business matters and domestic news of an exciting or depressing character should be carefully kept from the patient, and such connection as may be allowed with the outside world should be only of a cheering and encouraging nature.

It is very important that the nurse, who is so constantly with the patient, should be congenial and possessed of the requisite tact and cheerfulness of disposition. Many of these details may seem trivial, but their importance is appreciated after experience, which shows how easily infringement of the rules, such as the untimely reception of exciting news or the visit of an untactful friend, may react upon the digestive system and interrupt the favourable progress of the case for several days. This is particularly true of all hysterical cases. On the other hand, there are some instances in which patients with active minds do decidedly better if mild, pleasurable occupation or entertainment, such as reading aloud, is provided for them, which is carefully limited to prevent fatigue.

It is necessary to explain the general plan of cure and its object to both patient and family in order to secure their cooperation, and this having been done, the treatment which has received the name of "rest cure" should be outlined by definite rules in a most careful and systematic manner. To be of any service, the rest cure should last six weeks or more, and in severe cases it should be explained that this treatment by no means completes the restoration of the normal nerve functions, but is to be regarded as a basis for a further regimen of exercise and outdoor life. While the rules for diet for individual cases must be distinctly laid down, and conscientiously adhered to, there is scarcely any other variety of disease in which the physician is called upon to exercise more tact and discretion, and the success of the treatment will depend very largely upon the extent to which he adapts its provisions to the needs of individual cases. It is comparatively easy to prescribe definite regulations for the treatment of neurasthenia, but practically there is no case which does not present individual peculiarities which require special consideration.

THE "REST CURE"

At the commencement of treatment in severe cases the patient must lie absolutely quiet in bed and not be even allowed to raise the arms or head to take food. After a week or ten days of such enforced and absolute rest, the patient may gradually be allowed to sit up and feed herself, but usually a full month or six weeks should be spent in bed with no further exertion. The lack of voluntary exercise must be supplied by the tonic effect of bathing and massage. The patient should receive a sponge bath every morning soon after breakfast, which is to be given with hot water, or hot sea water if it can be obtained. A portion of the body only is to be sponged at a time, and friction with a coarse towel should immediately follow. In some cases benefit results from rubbing a piece of ice or a cloth dipped in ice water over the skin for a moment after the hot-water sponging. The alternate stimulation of the cutaneous nerves by strong degrees of heat and cold always produces a tonic effect, and the influence of the ice water and friction is analogous to that produced by the Brand system of cold bathing.

After the bath, which, if properly given, may consume a half or three quarters of an hour, the patient must be allowed to rest, and at noon or in the early afternoon massage is to be given, at first every day, and later on alternate days. At the commencement of the case the massage should be exceedingly mild, and caution is required in this respect, for neurasthenic patients are often injured by the too vigorous or prolonged efforts of the massage operators. For the first day ten or fifteen minutes will suffice, and if the effect is favourable, the time may be gradually extended to an hour. Owing to the nature of the diet, which at first is of milk, and from the lack of exercise and loss of tone of the intestinal walls, neurasthenic subjects are uniformly constipated, and the massage should be particularly adapted to remedy this difficulty.

Massage of the abdominal muscles should be performed by gently rubbing and kneading the abdomen, commencing in the right iliac fossa and following the direction of the colon upward to the free border of the ribs across to the opposite side and downward to the sigmoid flexure. By this means peristaltic action is undoubtedly stimulated, and the contents of the large intestine are mechanically propelled in the proper direction.

Dietetic Treatment.—The feeding of the patient must be based upon the principle of giving all the nourishment which can be assimilated. The stools should be carefully watched from day to day to make sure that the milk or other articles of food are thoroughly digested. Nourishment should be given at brief intervals, which must depend somewhat upon the amount of time allotted to sleep, but in cases of great exhaustion patients should not be permitted to go more than four hours at any time without food, and sleep must be interrupted for feeding, if necessary. In other cases when sleep so interrupted is readily resumed, food may be given with regularity once in two hours throughout the day and night, as in typhoid fever. When improvement is attained, the intervals of sleep will naturally be longer, and it will be both unnecessary and unwise to awaken the patient for feeding. The basis of the diet in most cases should be milk, and by studying the taste and digestion of the patient it is usually possible to prepare it in such a manner that it is well borne. (See Adaptation of Milk for the Sick, p. 74.)

In commencing the milk diet the objection of the patient often has to be overcome, and it is advisable to begin slowly, giving skimmed milk in tablespoonful doses four or five times a day for two or three days until the patient is accustomed to it. Other food is of course allowed at first, but this is to be gradually reduced and the milk substituted for it in increasing quantity until four ounces of skimmed milk are taken every two hours. It is finally given up to eight or ten ounces at the same intervals. The taste, if disagreeable, may be overcome by the addition of a little black coffee or caramel. If it produces weight and epigastric oppression or causes flatulence and eructations it is to be diluted by one half or one third with lime, barley, or rice water or Vichy. One of the "prepared foods," such as Nestlé's or Mellin's, may be added, or the milk may be pancreatinised or temporarily replaced by koumiss or zoolak. The exclusive milk diet tends to make the patient drowsy and to allay irritability in all the organs of the body, and it is actively diuretic.

The constipation which the milk occasions may be overcome by a pill of ox gall or a dose of bitter water in the morning, or by enemata of warm soapsuds, when the latter do not produce the exhaustion which occasionally follows their use.

Many patients do very well on the exclusive milk diet for a week or two, and they may be fed very much as typhoid-fever patients are, excepting that they may take more milk. If they can digest it, two and a half or three quarts a day should be given as recommended by Weir Mitchell, who was the pioneer of this method of treatment in this country. After five or six days of such treatment a chop or a poached egg may be added at noon. The next day bread and butter or bread and milk is given, besides, for supper, and then an egg or a little meat at breakfast, until the patient is taking three good meals of plain food daily, but in addition at least two quarts of milk. The exclusive milk diet is believed to prepare the digestive system for the assimilation of other foods.

Playfair's Diet

Playfair's diet for neurasthenia is a good example of a milk diet, soon combined with other foods, as follows:

First Day.—Twenty-two ounces of milk in divided doses.

Second Day.—Fifty ounces of milk in divided doses.

Third Day.—Fifty ounces of milk in divided doses. Massage, half an hour.

Fourth Day.—Fifty ounces of milk in divided doses; egg, bread and butter; dialysed iron, forty minims in two doses. Massage, one hour and a half.

Sixth Day.—Fifty ounces of milk in divided doses; mutton chop. Massage, one hour and fifty minutes.

Eighth Day.—Fifty ounces of milk in divided doses; mutton chop; porridge and a gill of cream; maltine, twice daily. Massage, three hours; electricity, half an hour; continued to end of treatment. The solid food is now gradually increased until such a diet is reached as the following for the

Tenth Day.—6 A. M., raw meat soup, ten ounces; 7 A. M., a cup of black coffee; 8 A. M., a plate of oatmeal porridge, a gill of cream, a boiled egg, three slices of bread and butter, and cocoa; 11 A. M., milk, ten ounces; 2 P. M., rump steak, one half pound of potatoes, cauliflower, a savoury omelet, milk, ten ounces; 4 P. M., milk, ten ounces; three slices of bread and butter; 6 P. M., a cup of gravy soup; 8 P. M., a fried sole, roast mutton (three large slices), French beans, potatoes, stewed fruit, and cream; milk, ten ounces; 11 P. M., raw meat soup, ten ounces.

Fifteenth Day.—Three full meals daily of fish, meat, vegetables, cream, and fruit; two quarts of milk and two glasses of Burgundy.

Twenty-second Day.—Amount of food lessened.

Leyden's Diet

Leyden's diet for neurasthenia is a modified form of milk treatment which gives excellent results in some cases:

At 7 A. M., half a litre of milk, slowly sipped in half an hour, a small cup of coffee with cream, eighty grammes (nearly three ounces) of cold meat, a mealy baked potato; 10 A. M., a litre of milk with three biscuits; 12 A. M., the same; 1 P. M., broth, two hundred grammes (about seven ounces) of fowl, *purée* of potatoes, green vegetables, one hundred and twenty grammes (nearly four ounces) of *compote*, and pastry; 3.30, 5.30, 8, and 9.30 P. M., half a litre of milk, making a daily consumption of three litres and a half of milk. In the after part of the day, two meals each of eighty grammes (three ounces) of roast meat with bread and three biscuits.

Keating's Diet

Keating's diet for neurasthenia is adapted to patients who need not be kept constantly in bed. It is as follows:

At 6 A. M., a tumblerful of strong hot beef tea; 8 A. M., a half tumblerful of iron water, and breakfast of fruit, steak, coffee, and a goblet of milk; 8.30 A. M., a goblet of milk with a dessertspoonful of malt extract, six grains of citrate of iron and quinine; 10 A. M., electricity; 12 A. M., a goblet of milk and malt; 2 P. M., dinner, preceded by a half tumblerful of iron water and a third goblet of milk and malt; 6 P. M., third dose of iron water. Light supper of fruits, bread and butter, and cream; a fourth goblet of milk and malt; 10 P. M., beef soup, four ounces, preceded by massage with cocoa oil for an hour.

Two quarts of milk are taken daily, in addition to all other food. The patient on this diet is allowed to be out of bed for four hours every day, one of which may be spent in business.

If milk can not be made to agree with the patient in any form, meat broths and *purées* and light farinaceous food may be prescribed. Eggs may be given dropped into bouillon or any of the preparations of egg albumin. Meat essences and extracts, such as Liebig's or Valentine's, are serviceable, but the latter are so merely for their stimulating effect upon digestion. If the condition of the stomach is good, the constipation resulting from so concentrated a diet may be overcome by the use of oatmeal porridge for breakfast, whole-meal bread, and fresh fruits, such as the juice of the shaddock or dried or stewed prunes. A reference to the receipts given at the end of this book for the several kinds of fluid food will enable the physician to prescribe sufficient variety to stimulate the appetite of the patient, and in many cases a slightly different *menu* can be ordered for each day in the week. Most patients after a fortnight to three weeks of semisolid diet are able to digest meat and other solid foods. As an example of an excellent typical dietary for this stage of the treatment, the following is given by H. C. Wood:

At 8 A. M., rolls or toast, cocoa, weak coffee or roasted wheat coffee, beefsteak, tenderloin, or mutton chop; 9 A. M., bathing; 11 A. M., oatmeal porridge with milk or else a half pint of molasses; 12 noon, massage; 2 P. M., dinner, bouillon with or without egg, beefsteak, rice, white potatoes roasted; dessert of bread pudding, blancmange, or similar farinaceous articles; 4 P. M., electricity; 5 P. M., milk toast; 9 P. M., a half pint of skimmed milk or koumiss.

Bilfinger believes that a modified vegetable diet is most useful in the treatment of neurasthenia, being less irritant to the nervous system than a preponderance of animal food, and for anæmic subjects who require proteids he prescribes milk and oatmeal porridge and preparations of ground meal of legumes. He allows chocolate and cocoa for beverages. A vegetable diet is useful in certain chronic cases in which the patient is much worried over the smallness and infrequency of the stools. Accompanied by large draughts of water such diet gives copious and ready evacuations. For this purpose such vegetables should be prescribed as celery, string beans, spinach, peas, and potatoes and beans in *purées*. Sago, rice, and cracked or shredded wheat may be also eaten. Meat should not be allowed more than once a day. Milk, butter, and cream toast are excellent foods for these patients.

Electricity.—The use of the electric current is of service in promoting the nutrition of the body during the period of absolute rest from voluntary movement. It should be distinctly remembered that the electric current itself possesses no special nutritive value or "vitalising" influence, such as is often claimed for it, but that it acts favourably upon the muscular system by causing the muscles to contract, and in that way also quickens the circulation. The contraction of muscles compresses the contents of their lymphatic vessels and venous radicles, thereby aiding circulation, while the phenomena are accompanied by metabolism which involves the appropriation of the ingredients of the food which have been absorbed. The faradic current is used for this purpose. It may be applied to special groups of muscles at first, and subsequently to the entire body. Care should be taken not to fatigue individual muscles, and the current should be carefully regulated and applied in accordance with the condition of the patient. The use of electricity in relation to the treatment of constipation has been referred to under that heading. It is doubtful whether the local application of electricity over the abdominal wall exercises any definite influence upon the digestive processes which may be going on in the viscera beneath the electrodes.

Insomnia and Disordered Sleep

Insomnia is due to many causes, but those which concern dietetics are the opposite extremes of overfeeding and starvation or inanition. Overfeeding or eating improper food may cause disordered sleep, nightmares, or temporary insomnia from attacks of acute indigestion, dyspepsia, or biliousness, but inanition or malnutrition is more apt to cause true insomnia from exhaustion. Neurasthenic subjects whose nerve energy is insufficient to conduct their digestive and absorptive functions completely are very liable to suffer from insomnia. They unfortunately resort to hypnotic drugs instead of first trying the efficacy of dietetics.

It is a good rule in such cases to improve the nutrition by carefully regulated feeding at frequent intervals. In addition to three good meals a day, the patient should be made to take one or two quarts of milk, with beef tea and one or two ounces of malt extract. By gradually increasing the diet according to such rules as those given for the treatment of neurasthenia, in a week or ten days the patient can often be made to reach the maximum above given, and improvement is almost certain to follow. It is best to take the heaviest meal of the day in the early afternoon not as late as six o'clock, for an overloaded stomach with indigestion is itself a cause of insomnia, but, on the other hand, going to bed with a perfectly empty stomach is usually undesirable. In mild cases a glass of hot milk, a couple of teaspoonfuls of meat extract in hot water, or a cup of good beef tea and a biscuit, or a cup of cocoa, or chicken broth, or a light sandwich and a glass or two of beer or ale, taken just before retiring, will serve to divert the blood current from the brain to the stomach and induce cerebral anæmia and sleep without the use of medicines, stimulants, or "nightcaps," and if anodynes have to be given, a little food taken in this manner increases their efficacy and makes a smaller dose possible.

Vertigo

Vertigo, although it arises from many causes, may be occasioned by digestive disorders, such as the production of flatulency and palpitation, or by the absorption of products of indigestion which act as irritants of the vascular system. Such products, for example, are developed in some persons by eating shellfish, strawberries, etc. (p. 383). Lack of sufficient food may cause it.

The dietetic treatment is that of dyspepsia (p. 530). Fats, sugars, and starches are forbidden, and alkaline and laxative waters, such as

Vichy, Congress, or Hathorn water, are of service to open the bowels and increase the activity of the kidneys. Lithæmic cases should be kept for a week or two upon a vegetable diet (p. 512).

Chorea

Mild cases of chorea require no special regulation of diet beyond that which is directed towards the prevention of flatulent dyspepsia (p. 534) and constipation (p. 582). In more pronounced cases it is sometimes advisable to put the patient for a time upon a milk diet. Sweets and farinaceous foods should, as a rule, be forbidden for fear of increasing palpitation through exciting flatulence. Other patients do better with a diet of animal food, consisting of meat, fish, eggs, and oysters with bread and milk, koumiss, or matzoon. They are apt to be anæmic, and they should be encouraged to take as much food as the digestive organs will tolerate. Cod-liver oil is very useful in these cases.

Epilepsy

Epilepsy is a functional nervous disorder, which may often be considerably improved by careful attention to diet. A very large proportion of cases occur in childhood at a period when existing functional derangements of the nervous system are readily aggravated by improper food. Many rhachitic children with imperfect development of the teeth, feeble digestive organs, and consequent malnutrition develop epilepsy while teething. Of twenty-seven cases occurring among children recently analysed by Osler, more than one half developed before the fifth year and more than three fourths before the tenth year. Very many cases are closely associated with errors in diet or affections of the alimentary canal, and while such conditions may not cause the disease, they readily precipitate epileptic seizures. This statement applies to grand mal and petit mal rather than to the localised or partial convulsions known as Jacksonian epilepsy, which are due to local and definite cortical motor irritation. Of the varieties of epilepsy, petit mal is more favourably influenced by diet than are the other forms.

Patients should have their eating supervised with care. They should be well fed, but must eat only easily digestible food and have their meals at regular intervals, and the principal one must be in the middle of the day in order that digestion at night may be completed before going to sleep. All food should be eaten slowly, and meat, if given, must be very thoroughly masticated, and the stomach should never be overloaded.

As a rule, meat should be allowed but once a day. Some children with petit mal, or even grand mal, improve rapidly on a strictly vegetarian diet or on a bland diet of which milk, bread and butter, and simple starchy foods, such as rice pudding, cornstarch, Indian-meal pudding, etc., form the basis. I have seen cases of epilepsy among young children in which, while the medicinal treatment remained constant, a return to meat diet was invariably followed by convulsions, which were absent on a vegetable or exclusive milk regimen.

As a rule, adults do not seem to be aided by dieting to such a degree as children; nevertheless, they do well to take but little meat and to be abstemious and regular in their habits of eating. Dr. Mersan, of the West Riding Asylum, in England, tried the experiment of putting a number of chronic epileptics for some weeks first upon a diet of flesh and then upon a vegetable diet, and *vice versa*. The results showed that their convulsions were not materially lessened in number or severity, but it was noticed that while their food consisted largely of meat their mental condition was more stupid. At the epileptic colony of Chalfont St. Peter, the patients are allowed meat once a day, but all the inmates are men, leading an active outdoor life, and hence better able to digest stimulating proteid food. Gowers allows his patients meat twice a day, and asserts that he has seen cases in which fewer epileptic seizures occurred while eating flesh than when abstaining from it. One patient had paroxysms only after eating beef, but not in connection with other varieties of meat. It is evident that no definite rule should govern all cases. It is worth while to reduce the nitrogenous food for a month or two, and if improvement does not follow, or nutrition becomes less active, it may again be added to the dietary.

Dr. Whitmore Steele, formerly of the Utica State Asylum, in speaking of the treatment of chronic epilepsy at that institution, informs me: "We endeavour to reduce the amount of albuminous foods, giving a more liberal and easily assimilated diet also. Invariably overalimentation in our epileptics produces attacks." Epileptics will often gorge themselves with food and drink if allowed to do so.

Some of the carnivores, as well as animals accustomed to a mixed diet, develop convulsions from a too liberal allowance of meat, if at the same time they are kept in confinement. In these cases, however, the convulsions may be due to reflex irritation from the stomach or bowels, produced by large masses of slowly digested food, rather than to the chemical nature of the food. The same thing may occur in young children who are allowed to gorge themselves with any hastily eaten bulky diet, and the resulting convulsions should not be confounded with genuine epileptic seizures accompanied by loss of consciousness, and recurring periodically. Some patients have a distinct epigastric aura preceding the convulsions.

It is extremely desirable to prevent intestinal putrefaction.

Should the stools become offensive, or much flatulence or indicanuria appear, the patient should be given a milk diet for a week or two, and cathartics and intestinal antifermentatives should be employed, such as salol, creosote, or guaiacol carbonate.

Many are obliged to take large doses of the bromides and other medicines. It will be found that the disagreeable symptoms of bromism are much less apt to occur if the diet be so regulated as to carefully avoid constipation and to insure the consumption of abundant fluid diluents. Vichy or carbonic-acid water and water should be drunk freely between meals, and especially after taking medicine, and daily thorough evacuations of the bowels should be secured by the use of fresh vegetables and fruits, prunes, figs, apples, oranges, etc. Adults should abstain from agents which are likely to overstimulate the nervous system, such as alcohol and strong tea and coffee. The use of tobacco should also be interdicted.

Beri-beri

Beri-beri is a form of multiple neuritis very rarely imported into this country by Chinese, Ceylonese, Japanese, or Philippine Islanders, who have acquired it in their native countries or on the voyage. It is characterised by anæmia, general œdema, and more or less stiffness and paralysis of the extremities, with dyspnœa and serous effusions. Sometimes there are muscular spasms.

Beri-beri has been attributed to the absence of fresh animal food from the diet, a sort of antithesis to the cause often assigned to scurvy. It has more specifically been attributed to the excessive consumption of rice and adzuki beans to the exclusion of other food; but these views are incorrect, for upon the authority of Baelz it is stated that the best fed and best nourished are frequently subject to the disease. In the Japanese navy, where the disease was formerly not seldom encountered, it has been practically exterminated by increasing the nitrogenous-food ration and lessening the carbohydrates.

The latest view of the disease is that it is not caused by bad food, but by a micro-organism, and that bad food and bad hygiene are merely predisposing factors.

Locomotor Ataxia

Locomotor ataxia is a disease which cannot be said to be particularly influenced by any system of dietetic treatment, although it is believed by some writers that the quantity of meat ordinarily eaten should be reduced. As in many other forms of very chronic nervous disease, a generous diet is desirable, with an abundance of fat, butter, cream, cod-liver oil, etc., when the stomach will tolerate it. Strong liquors should be forbidden, but light wines, malt liquors, tea, and coffee may be allowed in moderation. A reasonable use of tobacco need not be proscribed.

In those cases in which the "gastric crises" predominate the diet must be restricted for a few days when the crises occur, upon the principles established for the treatment of gastralgia. (See Gastralgia.) It may be necessary at such times to put the patient upon a simple milk diet.

Other diseases of the spinal cord do not usually demand particular dietetic treatment, but Bauer says that "some diseases of the spinal cord lead to an extraordinary falling off of the demand for nutriment." This is due to alterations in general metabolism, which is further evidenced by a marked reduction in temperature.

Apoplexy

The several forms of cerebral hæmorrhage may interfere with nutrition in a variety of ways. If coma is present, voluntary deglutition being suspended, great care must be exercised in feeding the patient. Liquid food is best given in teaspoonful doses, and the effect of each spoonful must be carefully watched to see that it is successfully swallowed before another is given, otherwise fatal choking may result from food passing over an insensitive epiglottis and larynx, when particles of food may be drawn into the lungs and excite local disease. Concentrated meat extracts, beef peptonoids, and peptonised milk may be given in this manner.

In extreme cases, when rigidity of the jaw interferes with feeding, or when paralysis involves the mechanism of deglutition, a long, slender catheter may be introduced through the nose and passed into the stomach, through which fluid nourishment is poured, after the manner of feeding patients suffering from melancholia. (See Melancholia, p. 621.)

The rectum may also be utilized for nutrient enemata (p. 414). In unilateral facial paralysis without unconsciousness patients may be willing and able to swallow, but mastication is difficult or impossible. The food constantly gets into the buccal cavity behind the teeth of the paralysed side, and the tongue, perhaps also partially paralysed, dislodges it with great difficulty. The retention of food is accompanied by a copious secretion of saliva, which, dribbling from the depressed angle of the mouth, adds greatly to the discomfiture of the patient. All nourishment should therefore be given in fluid form, or in such finely divided state that it does not require mastication, and can be readily washed down with water. Milk, thick broths, *purées* thickened with macerated vegetables, long-boiled rice, sago, or barley with cream, custards, soft-cooked eggs, etc., may be given. The patient should be fed very slowly to prevent the food from running out of the mouth. The mouth should be frequently cleansed with listerine or a saturated aqueous solution of boric acid. In cases of hemiplegia without facial paralysis the patient can masticate and swallow, but the mental condition or loss of appetite makes the use of food which can be swallowed with the least possible effort desirable. Convalescent hemiplegic cases which run a very protracted course naturally suffer from lack of exercise, and almost invariably become constipated. It is well in such instances to recommend simple and non-nitrogenous diet, containing laxative food, cooked fruit, and coarse cereals, to regulate the bowels. It is important to reduce arterial tension, to prevent, if possible, a repetition of the intracranial hæmorrhage. Large draughts of fluid rapidly absorbed tend by adding to the volume of the blood, to temporarily increase the intravascular pressure. The blood vessels, however, show a very remarkable ability to maintain an average pressure of the fluid within them, and the possible danger from this source of an exclusive fluid diet may be averted by increasing the functional activity of the kidneys by diuretics and reducing the arterial tension by the remedies in common use, such as chloral, nitroglycerin, and the nitrites. When the tension is very high, it is well to give a non-stimulating diet without much meat, and milk should form the basis of it. Alcoholic stimulants should be forbidden.

Acute Insanity—Melancholia—Primary Dementia—Mania

Acute insanity may result from overwork or severe mental strain, or from numerous diseases. It overtaxes the vital powers and causes wasting, inanition, and exhaustion. As the symptoms may result quite suddenly, often within a few hours after intense emotional strain or excitement, the digestive system is at first not necessarily disturbed to any considerable extent, although the appetite may be entirely absent. Subsequently various digestive disorders and malnutrition may supervene.

The insane, especially the melancholic, often refuse food absolutely, or can be induced to take it only very sparingly.

Forced Feeding.—When food is absolutely refused by the patient, the question of forced feeding must be considered in order to tide him over the emergency and support life until confusional insanity or delirium subsides.

Concerning this problem opposite views are held. Some alienists regard the operation of compulsory feeding as good mental discipline, others decry it, and defer it as long as possible. It must be understood that the refusal of food may be either a complication or a symptom of the special form of insanity in which it occurs, and the patient should be carefully studied to determine which condition is present. As a complication, it may be caused by central nerve lesions that hinder deglutition, such, for example, as those found in either acute or chronic paralytic dementia. Or digestive disturbances, dyspepsia, or gastric catarrh may cause a loss of appetite which in the patient's disturbed mental state is exaggerated into a refusal of all food. Such local disorders may themselves cause hallucinations or delusions, giving rise to "sitophobia," or horror of taking food. Obviously in such cases cure of the complication may be sometimes effected by treating the local condition. Lavage will sometimes relieve it entirely.

When the refusal of food is purely a symptom of the disease, as it occurs in melancholia or delusional insanity, an attempt should always be made to learn the exact nature of the delusion, and to try if it cannot be dispelled or offset, as in the case of some paranoiacs. For example, the delusion may apply merely to food cooked in particular ways, or served in a certain manner or by certain persons, and the patient may have no real loss of appetite, but may even try to obtain food by stealth and be pleased at his success in that direction, and his food should be placed where he can find it unobserved.

Some patients will refuse all fluid foods who are willing to take solids, or *vice versa*, or they may refuse food offered by an attendant and yet accept it from a fellow-patient.

If their delusions take the form of suspicion of poisoning, they may sometimes be overcome by showing them eggs in the shell, unpeeled potatoes and fruits, which obviously can not have been poisoned beforehand, and which are then cooked in their presence. Some patients will only eat if left alone or after others have finished, because they feel unworthy to eat with them. Others who persistently refuse food will take it greedily if an apparent show of force is made in placing it within their mouths.

Patients with chronic or asthenic mania may refuse food from inattention, although able to eat if their surroundings are quiet and their attention can be momentarily obtained. If they can be induced to take but a few mouthfuls at a time they should be fed repeatedly at short intervals.

Food should be cooked and served as temptingly as possible, and the patient, if unable to keep himself in order, should have his mouth cleansed and clothing protected from soiling.

The appetite is seldom a safe guide in insanity, and when it fails completely forced feeding should not be postponed until the patient has become too exhausted to rally. Cases of depressive insanity are very apt to require it sooner or later, and sometimes it is practised continuously for a year or more. In acute mania, however, it may be only necessary to employ the method for a few days, after which the patient will eat of his own accord if given the opportunity.

In cases of melancholia, after one or two feedings with the stomach tube, I have often, by a little firmness and patience, satisfied the patient that swallowing a glass of milk for himself was more agreeable than having it poured in through a tube. When voluntary starvation is the fixed intent, if the patient can be convinced that he has got to take food in some manner, he may yield to the inevitable and choose the lesser of what he regards as two evils. With a stomach tube in one hand and a glass of milk in the other the argument can be made very forcible.

The physician himself should always direct the passage of the tube for the first few times. Afterwards, if the patient is not refractory, an attendant may do it. Occasionally the aid of two or three assistants is necessary to overcome resistance. The patient should be made to sit down or lie upon his back, and either an œsophageal or nasal tube may be used, according to the directions given on p. 547. There are certain advantages in the use of each tube. The œsophageal tube does not so readily admit of regurgitation alongside of it as the nasal tube does (although occasionally patients can regurgitate through the tube itself). If it be filled before it is inserted, and if a little fluid be squeezed out of it when part way down the œsophagus, reflex swallowing occurs, which may be taken advantage of to further propel the tube. The disadvantage of this method of feeding is that the patient often struggles and must be gagged. A wooden gag shaped like a bit, with a central perforation through which the tube is passed, prevents it from being compressed by biting. But the gag is disagreeable, it may slip and break a tooth, and the head and arms must be rigidly held by two assistants. I have known a refractory patient with melancholia to bite off and swallow eleven inches of stiff œsophageal tube, which remained in the stomach for eleven days before it was ejected by vomiting!

The nasal tube possesses the advantage that it can be more easily introduced with much less struggling, but it has the disadvantage that greater care is required to prevent passing it into the larynx, for the insane are sometimes strangely insensitive. The former difficulty can be obviated by getting the patient to speak, or by closing the tube after it has been inserted and before fluid is introduced, in order to make sure that breathing is not obstructed. This form of tube should be of as large a size as can be conveniently passed. A No. 8 catheter will serve.

For forced alimentation it is necessary to give food in fluid form, and a quart of milk, with one or two beaten eggs, either raw or slightly cooked or made into eggnog, may be prescribed two or three times a day. Nutritious meat broths, thickened with barley, rice, or vermicelli and strained, or potato *purée*, may also be given through a large tube. Cream and cod-liver oil should be added to the diet. In a case reported by H. C. Wood, for six weeks the patient lived with the greatest benefit on six pints of milk and sixteen raw eggs taken daily. If an ounce of malt extract be added to oatmeal or potato gruel in milk, it soon makes the mass sufficiently fluid to pass through the tube. As this method of feeding prevents the saliva from commingling with the food, there is additional advantage in giving malt or diastase to replace it.

For obstinate patients, feeding with the tube twice a day—at say 8 A. M. and 5 or 6 P. M.—is sufficient, and a quart of food can be introduced at once, but more feeble patients may require feeding three or four times a day. If gastric catarrh or dyspepsia is present, preliminary lavage may be employed, and then food and medicines may be poured through the tube.

Both hypnotism and primary anæsthesia under chloroform have been utilised in extreme cases to enable food to be given to the insane, but the latter method is only necessary or justifiable in very exceptional cases.

Nutrient enemata are of little value in the feeding of the insane who resist feeding, for if the patient realises their use he can make it more difficult to be nourished in this way than by the stomach or nasal tube.

Suralimentation.—Suralimentation is to be recommended when feasible. (See p. 471.)

Brush says: "In acute delirious mania, in melancholia with frenzy, and in some of the maniacal seizures incident to the aged, the great importance of a liberal persistent use of milk, eggs, and animal broths cannot be overestimated."

If patients will eat they should be given abundant nutritious food, such as tender meats, custards, cereals with butter, sirup, or cream, eggnog, thickened broths, *purées*, beef jelly, gruels, etc., which are made palatable to tempt the appetite, and the number of daily meals may be increased or nourishment may be given once in three hours. By diverting the blood current and nervous energy for digestive processes, the general nervous system and mental condition become soothed and quieted. Fresh fruit and fruit juices should be offered occasionally.

Special Precautions.—In acute insanity there is a tendency for the body temperature to fall two or three or more degrees below the normal. This is especially true of those cases of primary dementia which are due to exposure and privation accompanied by severe mental strain, such, for example, as occur from shipwreck or from any form of severe sudden shock. While regulating the diet, therefore, attention must be given to the preservation of the body heat, and the patient should be surrounded by uniform temperature, to be maintained in an overheated room or by hot-water bottles and warm clothing. Sustaining the normal temperature will facilitate the digestive functions.

The insane must be closely supervised while eating. They often bolt their food, when given too much at a time, in a manner that soon destroys digestion. In such cases all food should be given in a state of fine subdivision or fluid or semifluid form. Patients with advanced general paresis or different paralytic diseases may easily suffocate by getting a piece of meat in the larynx. Patients with mania gravis, or suicidal melancholia, etc., should of course never be intrusted with knives or with plates or dishes which can be easily broken into sharp fragments with which to cut themselves.

DIET IN SKIN DISEASES

It has long been known that a relation exists between various errors in diet and certain skin diseases, but it is only within the past ten or fifteen years that attention has been directed to the importance of systematic dietetic treatment to aid the cure of such ailments, and a more thorough investigation of this subject is much to be desired.

Skin Diseases which are caused by Improper Diet.—The skin diseases commonly referable among other influences to dietetic causes are erythema, urticaria, acne, eczema, and scorbutic eruptions.

Many chronic skin diseases, if not originally caused by dietetic errors, are undoubtedly much protracted and made worse by them. This is particularly true of eczema, impetiginous and seborrhœic ecthyma, strophulus, and the cutaneous lesions of the tuberculous diathesis, and sometimes of psoriasis.

The very important alimentary substance alcohol, when taken in excess, greatly aggravates many forms of chronic cutaneous lesions, notably those of syphilis and rosacea, and the capillary congestion and muddy complexion of chronic alcoholism is well known.

The modes of production of cutaneous eruptions by dietetic errors are various. Probably in the majority of instances such eruptions are due to malfermentation products, ptomaines, etc., which are absorbed through the digestive tract. In other cases they may be due to an effort to eliminate incompletely oxidised food products or poisons from the cutaneous glands (as in the case of drug rashes), and it has been suggested that they may be sometimes caused by reflex nerve irritation from the alimentary canal, although the latter theory is less tenable. It is, however, interesting to observe the fact that an intimate relation often exists between irritation and inflammation of the skin and of mucous membranes. Overeating, and especially the overfeeding of infants, is a common cause of skin eruptions, and the attempted elimination by the sweat glands of fatty acids is irritant.

General Principles of Dietetic Treatment.—There are certain general principles of dietetic treatment which are applicable to a majority of all severe cases. The food should be of simple kind, restricted in variety, and plainly cooked. Milk, meat, and stale bread are more desirable than amylaceous or saccharine food. If fever is present at the outset, a milk diet must be ordered. The tuberculous and gouty require fats in some form. Chronic cases with malnutrition and anæmia must have abundant nourishing animal food. In the case of scorbutic eruptions the trouble arises sometimes (but not always) from malnutrition from withholding certain articles, such as fresh fruit and vegetables, from the diet.

Substances to be particularly avoided in skin diseases are raw and unripe fruits and vegetables, sweets and pastry of all kinds, condiments and highly seasoned dishes, veal, pork, and alcoholic beverages. Other injurious foods will be mentioned under the treatment of the several varieties of skin diseases described below.

Erythema—Urticaria

Either acute erythema or urticaria may be caused in some persons by eating fish, and particularly shellfish and crustaceans, as oysters, clams, lobsters, shrimps, and crabs. It is also produced by strawberries, bananas, and other forms of fruit. Crustaceans and strawberries are perhaps the most common excitants.

The action of the food poison is wholly different from that of ptomaines (p. 379), for it originates from fresh as well as stale food, and may be derived, as in the case of strawberries, from vegetable food. Some persons have an attack regularly every spring when strawberries first appear on the table. Others show occasional immunity, depending upon their condition at the time. Those persons who are hurt by one kind of poisonous food are not necessarily affected by the others. The whole matter seems to be influenced solely by idiosyncrasy.

Other alimentary substances which have been observed to sometimes poison are pork in various forms, sausages, mushrooms, cheese, and even mutton (Jackson).

Symptoms.—The eruption develops suddenly and within from two to six hours after ingestion of the food. It is commonly a typical urticaria with large pink wheals, which quickly come and go over all parts of the body. They are accompanied by intense itching and burning. This affection usually lasts but a few hours, or possibly for two or three days, though sometimes it may continue for several weeks.

Treatment.—The eruption usually disappears upon withdrawing the offending article from the diet, and giving a saline cathartic and some simple remedy to regulate digestion and prevent fermentation, such as salol, salicin, or rhubarb and soda. Large quantities of water should be drunk.

The troublesome itching is best relieved by sponging with common baking soda, a teaspoonful to a quart of water, or a solution may be applied to the wheals of menthol and chloral, each a drachm, in a couple of ounces of a mixture of equal parts of alcohol and camphor water. A 1–40 carbolic-acid solution may be similarly applied.

Acne

Causation.—The larger number of cases of acne are produced by improper food. The papules and pustules which constitute acne are caused by inspissation of the oil of the sebaceous glands, which plugs their orifices and irritates the glands and the hair follicles, exciting inflammation in them. The disease is usually first observed during puberty, a period in which important changes in the nutrition of the body are in progress, and, once established, it is apt to last for some time—often for several years. It is easy to conceive how slightly altered composition of the blood, due to imperfect assimilation of food, may alter the composition of the sebum and irritate the sebaceous glands.

In some people the papules appear as a result of eating buckwheat cakes or oatmeal. In others they are caused by greasy food—doughnuts, sausages, cheese, fried meats, ill-cooked and rich pastry—excess of sweets, nuts, and other indigestible substances.

Dietetic Treatment.—In addition to local means, the dietetic treatment of acne is most important. G. T. Jackson says: "The well-to-do are all prone to eat too much, and it is remarkable how rapidly acne will improve by reducing their diet to the simplest elements. In many of them a milk diet for a few days, provided milk agrees with them, will accomplish a marked benefit. It is a good rule to cut off from the dietary all pastry, cake, candy, sweets, hot breads and pancakes, greasy soups, articles fried in fat, twice-cooked meats, rich gravies—in fact, all those things that are most apt to tempt the palate." Alcohol in all forms should be prohibited, as well as tea and coffee. A tumblerful of hot water or a glass of Vichy should be drunk before each meal. With meals but little fluid should be taken, never over four or five ounces, but between meals water or aërated water should be drunk freely for its diuretic effect. Naturally, exercise, bathing, and the use of laxatives should be adjuncts to the dietetic regimen.

Eczema

Causation.—Eczema, both acute and chronic, which constitutes so large a proportion of all cases of skin diseases, is provoked by different causes, but in a great number of instances its origin is directly traceable to dietetic faults. These may be of three kinds—namely, the eating of (1) too much food; (2) insufficient food; (3) improper food.

1. **Cases due to Overeating.**—The ills of overeating have been elsewhere described (p. 371). Its relation to eczema consists in

the additional burden thrown upon the skin of attempting to eliminate waste products, which are accumulated in the blood faster than they can be got rid of. The cutaneous glands, like the kidneys, are constantly stimulated and overworked, and the character of their secretion is altered. The skin, for a long time irritated, finally succumbs to a definite eruption.

It is for this reason that robust persons apparently in the best of health and with too vigorous appetites will sometimes be surprised with the sudden appearance of eczema, which they have always attributed solely to " bad blood."

Treatment.—This class of cases is to be treated by reducing the quantity of food, and by prescribing a very simple diet. In bad cases of general eczema it may be best to put the patient upon a milk or bread-and-milk diet for one, two, or three weeks. From two to two and a half quarts are taken daily with toast or crackers. Marked improvement will occasionally follow this course. For others, simply reducing the diet by excluding meat and desserts for a time, may be all that is necessary. Meats—either beef, mutton, or chicken—should not be allowed more than once a day. Piffard reports that 56 per cent of his patients were accustomed to eat meat in excess three times a day.

Fish, either boiled or broiled, may be substituted for meat to advantage in neurotic subjects (Bulkley), for though it may excite urticaria, it does no harm in eczema in spite of the popular belief to the contrary. I have known the eating of shellfish, however, to intensify chronic cases considerably.

Typical Diet for Eczema.—The following simple diet may serve as an example:

Breakfast.—Bread and milk, or porridge, or wheaten grits, or cracked wheat, without cream, and salt or lemon juice may be added if preferred. Every other day a soft-cooked egg may be eaten.

Dinner.—No soup, *entrées*, or dessert. Roast beef or mutton or chicken may alternate with broiled fresh fish with white meat, one or two green, light vegetables, such as haricots, spinach, lettuce, green peas, or macaroni. As Jackson says: " It is a good rule to tell the patient he may eat what he likes, but not of more than two dishes at a meal. It is unlikely that he will then overeat." Fresh, ripe fruits, except apples, may be allowed.

Supper.—Bread or toast or crackers and milk, custard, or simple rice pudding, not too sweet. A little fresh fruit. Stimulants are not usually required, but if needed for nutritive or tonic effect, dilute liquor, brandy, whisky, or Hollands is the best form.

Malt liquors of all sorts, as well as wines, should be forbidden. It is generally believed that tea and coffee are harmful in eczema, and drunk in excess they certainly are so, not only from disordering and retarding digestion, but from their undue stimulating effect.

Unless they are taken in great moderation and but once a day, it is better to forbid their use entirely. The same is true of sweet chocolate, but cocoa may be allowed.

2. **Cases due to Insufficient Food.**—Too little food results in impoverished nutrition, and the skin, being one of the most sensitive organs of the body, is among the first to suffer. The habits of filth which so often accompany semi-starvation among the poor are contributing causes which combine to provoke skin eruptions.

The diet required for these cases does not essentially differ from those of the preceding class. An effort should be made to restore the impoverished nutrition of the body as quickly as possible by suralimentation if necessary (p. 471).

3. **Cases due to Improper Food.**—Improper food is also capable of exciting outbreaks of eczema, and this is particularly true of chronic or relapsing cases. Oatmeal, for example, while it may not cause the disease, is generally believed to be capable of intensifying it. It is not possible to always forewarn against the particular articles of diet which will do this, as they vary in different persons and often in the same person at different times, but, in general, food which is called "rich" is to be avoided, such as highly seasoned meats, soups, sauces, gravies, strong condiments, sweets, pastry, hot breads, pickles, preserves, and fancy desserts of all kinds. Bulkley especially forbids sweet potatoes, fried eggplant, cabbage, cheese, bananas, apples, soda water with sirups, as well as salt food, such as ham, corned beef, and salt pork. A little bacon or a salt herring, however, is permissible. All fried food, with the above exceptions, is strictly forbidden, and "fritters," fried oysters, etc., are highly injurious. In a word, all those articles which are liable to excite temporary dyspepsia and overload the urine with phosphates, urates, and calcium oxalate must be avoided. The staple diet should consist of whole-meal bread, fresh, plainly cooked vegetables, eggs, milk, and a little chicken, fresh fish, or meat not oftener than once a day.

There are obstinate cases of chronic eczema which fail to yield to any dietetic regulations, but it is always desirable to thoroughly try the value of dietetics, and very often the result will be surprisingly gratifying. In conjunction with dietetic treatment the urine should be always carefully examined, and the bowels must of course be regulated.

It is very important to control the general habits of the patient in regard to meals. He should eat at regular and proper hours and observe uniformity in the quantity of food consumed. He should be very careful to eat slowly and thoroughly masticate his food, and not drink so much fluid with meals as to dilute the gastric juice excessively. The general rules for the treatment of dyspepsia (p. 530) and its avoidance are especially applicable to all skin diseases which are in any way amenable to dietetic influence. It should also be remembered that eczema frequently is associated with gouty and strumous diatheses, and the reader is referred to the sections upon these subjects.

ECZEMA IN NURSING INFANTS

Bulkley points out that eczema in nursing infants is mainly due to dietetic errors of the mother, for whom, rather than for the child, treatment should be instituted. He prohibits the drinking of all forms of malt liquors and wines and rich chocolate. Anything which provokes indigestion and biliousness in the mother reacts unfavourably upon the skin disease of the infant. This is a very important truth too often overlooked. If the mother becomes constipated, has dyspepsia and a furred tongue, and excessive deposit of urates and oxalates in the urine, her diet must be changed, the bowels must be regulated, and tonics should be given. Other cases in infants are caused by the mother's milk being poor and thin, and the breast milk should be supplemented by cow's milk properly prepared, or it may become necessary to wean the baby completely. Mothers often nurse their infants too long, hoping thereby to postpone conception. When the breast milk is too poor in quality Bulkley believes in adding fat to the baby's nourishment in the form of a few drops of cod-liver oil or a little cream, and he recommends inunctions of almond, sweet, linseed, or cod-liver oil. Cod-liver oil is cited by some authorities as causing eczema, but this refers to its use in excess when the digestion is deranged and dyspepsia is aggravated by it. Eczema is often cured by adding fat to the food.

The common mistake of nursing infants too often is particularly apt to occur with eczematous babies, whose mothers mistake the child's crying for a manifestation of hunger, whereas it is often excited by the extreme itching of the eruption, which the infant is too young or too feeble to scratch. If fed oftener than once in two hours or more, the infant's digestion becomes deranged, and any existing eruption is made more unbearable. Bottle-fed infants are more likely to have eczema than sucklings, probably because they oftener have gastro-intestinal disorders. Underfed infants are less subject to the disease than are the overfed.

ECZEMA IN CHILDREN

Eczema in young children is often due to dietetic errors, and in all cases care should be exercised to cure it by regulation of the food. The commonest fault in feeding young children consists in giving them too much starchy food, which they cannot as yet digest, and the innumerable prepared infant foods, consisting largely of starches and sugars, are responsible for much of this trouble. Some parents, aware of this fact, go to the other extreme, and give the child too much animal food in the form of meat juice, broths, and eggs. A diet improperly balanced in either direction induces an anæmic condition with a special tendency to the development of eczema. Older children should be denied candy, chocolate, and indulgence in sweets of all sorts, and must be fed upon the simplest diet, in which starch, and especially sugar, should be reduced, and pure fat increased. The latter is to be prescribed in the form of cream, fresh uncooked butter, fat beef, and cod-liver oil. Bulkley recommends the use of whole-meal bread, cracked wheat, hominy, and corn grits with salt and butter or cream. Oatmeal is prohibited; likewise tea and coffee.

EXFOLIATIVE DERMATITIS

Exfoliative dermatitis should be treated upon substantially the same dietetic plan as eczema. An exclusive milk diet for a month or six weeks may prove beneficial. Jackson advises chewing flaxseed or taking, in milk, several ounces of flaxseed tea every day.

ROSACEA

Causation.—Rosacea is a chronic skin affection disfiguring the middle parts of the face, about the nose, mouth, cheeks, and sometimes the forehead, by red patches of dilated capillaries.

It is regarded as a reflex neurosis of the local vasomotor nerves. It is oftenest caused by erroneous diet, and especially by strong drink, which dilates the facial arterioles and also excites gastric catarrh. Jackson says: "The inordinate use of strong tea acts in the same way, and probably gives rise to as many cases as does alcohol."

Dietetic Treatment.—The dietetic treatment is very important. It involves the prohibition of all alcoholic drinks, as well as hot beverages of every kind, such as tea, coffee, and soup. Existing dyspepsia should be treated, and all rich food, desserts, sauces, pickles, strong condiments, dried, salted, or canned foods, fried substances, and sweets should be withheld. The patient must be kept for several weeks or months upon a low, non-stimulating diet of plainly cooked food, such as that advised for the treatment of eczema.

PSORIASIS

Causation.—Psoriasis is a chronic skin disease characterised by the appearance of isolated red patches of considerable size, covered by shining white scales. The ætiology of this eruption is not understood. It may be hereditary or follow nerve shock, but in many cases it is directly attributable to imperfect assimilation of nourishment, and accumulation of waste products in the system, such as occur in gout and rheumatism. The excessive consumption of oatmeal has been observed to cause it (Hardaway).

Dietetic Treatment.—This disease is less amenable to dietetic treatment than are some other skin affections; nevertheless, this must not be neglected, as it may prove a valuable aid to local measures. The diet should always be restricted both in quantity and variety. Obese and plethoric patients improve upon a purely vegetable regimen. In bad cases it will be best to put them upon a bread-and-milk diet for a week. Vegetable food may then be added, but sweets and meats should be withheld. Feeble, anæmic patients usually improve upon an animal diet, consisting largely of milk, with eggs, beef, and mutton. Bread may be allowed. Elaborately cooked and highly seasoned food must be forbidden, as well as all forms of malt liquors. If any alcohol is required it should be prescribed in the form of well-diluted whisky and taken only with meals, but as a rule patients are better without it.

Pruritus

Patients suffering from pruritus should partake only of non-stimulating food. They must particularly avoid tea, coffee, alcoholic drinks of every variety, condiments, fish, pastry, cheese, sauces, pickles, made dishes, and fried food. Tobacco should be temporarily withheld.

Furunculosis, or Boils

Furunculosis is often wrongly attributed to dietetic errors or high living, but it is now known to be of germ origin due to the action of the *Staphylococcus pyogenes* and other micro-organisms which penetrate the skin, through abrasions or otherwise, so that the supposed influence of diet is only remote, in that poor living tends to lower the general vitality and make the body more susceptible to any form of inoculation. Special dietetic treatment becomes necessary only in debilitated cases, such as complicate anæmia, diabetes, or convalescence from protracted infectious diseases, and the rules for it will be found under those headings.

DISEASES ESPECIALLY INFLUENCED BY DIET

Obesity (Polysarcia)

Causation.—Obesity is a diseased condition of the body, depending upon alteration in the proper balance of nutrition, with an accumulation of fat in and between the tissues.

It may affect either sex, but is much more common among women, in whom it is particularly noticed during and after the climacteric.

It may develop at any age after early childhood. When appearing early it is usually the immediate result of heredity. It is, however, most common after middle age, when the functional activity of the body is diminished and when habits of systematic exercise are replaced by a sedentary life of luxury and ease, combined with overeating.

Aside from heredity, an important cause of obesity is excessive eating, which is a fault among the majority of persons who have passed middle life. When the growth of the body has been completed there is a stage of equilibrium in weight which lasts for several years, and the waste matter of any excessive food taken is eliminated through the emunctories, which are kept active by exercise and work. After middle age, activity is considerably diminished, while the habit of fully satisfying a vigorous appetite may be continued, resulting in the consumption of a larger amount of food than is required for maintaining the vital functions. It is extremely difficult for people who feel in robust health and whose mental is proportionately greater than their physical activity, to realise that they not only require less food than they did ten, fifteen, or twenty years earlier in life, but that eating as they do they may be producing positive harm by overloading the excretory organs. It is for this reason that many persons accumulate weight after reaching a certain advanced period of life.

According to Sir Henry Thompson's view, overeating in the first half or so of life may be relieved by occasional bilious attacks, which enable the system to cast off accumulated waste, but later "the unemployed material may be relegated in the form of fat to be stored on the external surface of the body or be packed among the internal organs, and thus he or she may become corpulent and heavy."

The constant use of alcoholic stimulation in its milder forms, such as beer and ale, favours obesity, and in many individuals seems to be a direct cause of it. There are other cases in which it is difficult to attribute the accumulation of fat to any faults in either eating or drinking. Very stout persons are occasionally extremely moderate eaters, and in these cases the difficulty lies apparently in poor oxidation and insufficient exercise.

The condition of obesity is somewhat modified by climate and race. It is less common in the United States than it is among elderly women in England and Germany.

Not infrequently obesity occurs in connection with pronounced anæmia and hysteria. It prevents such patients from taking an ordinary amount of exercise. This is owing to the increased weight and difficulty of moving about, as well as to the lassitude and positive dislike for muscular exertion which is felt by them. Obesity once established is likely to increase unless properly treated.

So long as the fat is simply stored up as adipose tissue, and between and not within the cellular elements of the body, it is comparatively harmless, excepting as it indicates a disproportion between functional activity and the amount of fuel taken in to develop force, and excepting also as it may interfere with personal convenience in movement and cause greater muscular fatigue from the increased work thrown upon the muscles in supporting so heavy a body. In other cases (and this may be the outcome of any advanced case of polysarcia) the fat may invade the cellular elements of the body, particularly the muscles, and fatty degeneration is produced in the muscular tissues, which very seriously weakens and impairs their functional activity. The special danger in all cases of this class is that the heart muscle may become affected in this manner, which renders it liable to cease beating whenever the slightest additional strain is thrown upon the circulation. It follows that it is most desirable in the dietetic treatment of obesity to determine the original cause of fat accumulation, and to ascertain to what extent it is accompanied by fatty degeneration.

Bauer says: " The fat stored up in the body acts in like manner with the fat contained in the food, since it likewise lessens the waste of tissue and secondarily the oxidation. Thus we understand why abstinence can be longer borne by organisms rich in fat than by those poorly furnished with it, the former consuming less of the albumin of their organs. The stock of fat stored up in the body is moreover the cause why corpulent individuals frequently continue to gain in bulk although they are not in the habit of indulging in food immoderately.

" If an increase of albumin be desired without a considerable addition to the store of fat, a liberal allowance of albumin with relatively small quantities of carbohydrates must be provided. If, on the other hand, a substantial addition to the fat appear desirable, the food must contain less albumin and more carbohydrates, with a fair proportion of fats."

Voit claims that albumin circulating in the blood is more readily oxidised than either fats or carbohydrates, and that the fat existing in the tissues acts like free circulating fat, not primarily by saving proteids from oxidation, but by causing a larger proportion of them to enter into the organised tissues, thus saving tissue waste. The tissues use up the circulating albumin, and, not being exhausted thereby, go on and oxidise the fat besides, and in this manner the store of fat in the body is reduced on a meat diet.

An exclusive lean-meat diet increases the circulating albumin, and, the nitrogenous waste being correspondingly increased, fat does not accumulate in the body. If now fat be added to the diet, then fat is deposited in the body.

The carbohydrates, like fat, can protect circulating albumin from destruction and aid its transformation to organic albumin, but it is not proved that they themselves *make* fat, as at first supposed, for they are very completely destroyed even when eaten in excess. They merely protect other foods from oxidation under such conditions.

Meat and carbohydrates alone increase the fat in the body without the aid of fatty food, for fat, which originates from splitting up albumin, is spared further metabolism. Hence fatty metabolism in the body may be quite independent of fat indigestion.

Dietetic Treatment.—The question of the treatment of obesity, owing to the frequency with which the physician has to deal with it, is a matter of great importance, and demands special consideration. The best results from treatment are obtained in patients less than thirty years of age. For a long time it was believed that excessive consumption of carbohydrates was the cause of increased fat production within the body. The pig is fattened on corn, and cattle upon various cereals. Undoubtedly, many persons who are of spare habit can increase their weight by eating a larger proportion of starches and sugars. It is a fact, moreover, that starches contain oxygen in the exact proportion necessary for the formation of water and carbon dioxide, and on being disintegrated in the body, they naturally produce these two forms of waste matter which are promptly eliminated from the surface of the lungs and kidneys respectively. The proteid material of the food requires a larger percentage of oxygen for the metabolism involved in its complete conversion into urea.

It is an undoubted physiological fact that the fat of the body may be made from a variety of different foods, and that some individuals are capable of producing it from a particular class of food materials more readily than from others. Thus one person may become fat from overindulgence in saccharine food and another from eating purely starchy foods and taking large quantities of malt and beer, and still another from the excessive use of quantities of fat meat. Accordingly the rules which are formulated for the treatment of obesity must be regarded as referring to the majority of cases only, whereas there are many exceptions which must be individually studied.

Many special dietetic systems are in vogue for the treatment of obesity. In some cases if the total quantity of food is diminished no special diet is necessary, but in many persons obesity is not due to overeating, but to other causes. Some patients improve at once when they give up all alcoholic beverages. An ounce of food eaten daily in excess of that which is eliminated, and which is capable of being stored in the tissues in the form of fat, very soon produces a considerable increase in the body weight, which in a year's time would amount to many pounds.

As stated above, the majority of the obese eat too much and exercise too little, or at least they have originally eaten more than they consumed, i. e., although they may delude themselves to the contrary and claim to be small eaters, they have at some period consumed too many calories, hence it makes little difference whether the curative diet be restricted in fats or in carbohydrates, so long as the total caloric energy be cut down. As pointed out by von Noorden, the detailed mode of restriction may be left in great part to the individual patient's liking, so long as the general principles are adhered to of reduction in quantity of food and increase in oxidation. As a general statement, from one to two-fifths should represent the degree of reduction in quantity of food in an average case, and in general this may be accomplished by eliminating sugars and alcohol in toto and reducing to a minimum the consumption of fats and of bread, potatoes, cereals, and other forms of starch.

Among the different systems which have been advocated for the cure of obesity the best known are those of Banting, Ebstein, and Oertel. Schweninger's cure is practically Oertel's method by withholding fluid from the meals, and giving all fluid at least two hours after ingestion of food. Schleicher's system is also similar to Oertel's.

The principal systems which have been especially devised for the treatment of obesity will be separately discussed in detail. Nearly all of these systems agree in two principles: First, to reduce the total quantity of food ingested as much as possible without impairing the strength of the patient. Secondly, to diminish the amount of fluid drunk by prescribing what is called a dry diet. The treatment, moreover, is usually accompanied by systematic exercise or bathing, and it is highly important to keep the bowels active.

Some persons attempt to cure obesity by allowing the patient to eat any food he chooses, but insisting that he shall eat only one kind of food at any one meal. As a natural result, the appetite soon palls, and he eats less than he otherwise would. This is an unscientific method, and an unwholesome one for serious cases.

As a general principle, corpulent persons should restrain themselves to as great an extent as possible from drinking fluids, especially with meals. Exceptions to this rule occur when obesity complicates certain other diseases, such as gout or rheumatism, where the use of an increased quantity of fluid may be temporarily necessary in order to act vigorously upon the kidneys.

Hot-water beverages taken half an hour before meals, and again at night and on rising in the morning, are beneficial, and less fluid is required with the meals.

As a rule, never more than five ounces of fluid should be taken with a meal, or fifteen ounces per diem, and this amount may be still further curtailed by giving water between meals instead.

Soups of all kinds should be forbidden as well as alcoholic beverages, and what little fluid is allowed should consist of plain or aërated water. But little, if any, milk should be taken. The food should be as dry as possible without interfering with its flavour and nutrient value. Highly succulent fruits, such as watermelons, and vegetables like raw tomatoes, which consist largely of water, should not be eaten. Sugar should be absolutely forbidden, and fat should be used very sparingly, and only in the form of a little butter. The allowance of farinaceous food should be also cut down as much as possible. It will not usually be found practicable to do without bread for any length of time, but patients are often willing to restrict themselves to a very rigid diet for two or three weeks if the positive hope of cure or amelioration of symptoms can be held out to them, if they are made to understand the rationale of the treatment, and if they are given some objective point to anticipate when a promised improvement will admit of greater laxity in regard to diet. If desirable, gluten bread may be substituted for wheaten bread.

The deprivation of starchy foods can always be better and longer tolerated if a little fat is given, and the obese do not well endure deprivation of all fats, even when starchy food is supplied in moderation.

This is more often true of those engaged in mental work than of those employed in muscular exercise. Salts and fresh green vegetables—" vegetables which grow *above* the ground," except the legumes—should not be withheld.

Lean meat should form the basis of all diet, but an unrestricted flesh diet in obesity may give rise to dyspepsia and gastric and intestinal catarrh.

THE BANTING SYSTEM

The diet which Mr. Banting practised upon himself in 1862 with considerable success, and which bears his name, was exceedingly rigid in regard to restricting the quantity of food and in forbidding starches and sugars to the greatest degree possible. The patients were starved to the extent of being allowed only between twenty-one and twenty-seven ounces of dry food in the twenty-four hours, about one-half of which was meat. Only two ounces of bread could be taken, and the balance of the diet was composed of fresh fruits and the lighter forms of green vegetables. The fluid drunk in each twenty-four hours was reduced to thirty-five ounces. It should be remembered that the normal quantity of urine passed by an adult is, on the average, fifty-two ounces in addition to the water lost by perspiration and respiration. In his dietary, which was based on the suggestions of Dr. W. Harvey, the fats and albuminoids are not well balanced, and it may cause constipation and malnutrition.

THE EBSTEIN SYSTEM

The Ebstein treatment, as originally employed in Germany, has been attended with considerable success. The theory of this system is that animal as well as carbohydrate food is capable of being con-

Comparison of Dietaries for Corpulence with Ordinary Dietaries (Atwater)

Dietaries.	Nutrients.				Potential energy in nutrients.
	Protein.	Fats.	Carbo-hydrates.	Total.	
	Grammes.	*Grammes.*	*Grammes.*	*Grammes.*	*Calories.*
Banting system	171	8	75	254	1,085
Ebstein system	102	85	47	234	1,400
Playfair's standard for "subsistence diet"	57	14	341	412	1,760
Playfair's standard for adults with moderate exercise	119	51	531	701	3,140
Voit's standard for labouring man at moderate work	118	56	500	674	3,050
Atkinson's standard for man with light exercise	100	100	360	560	2,815
Atkinson's standard for labouring man at moderate work	125	125	450	700	3,520
Poor sewing girl, London; diet barely sufficient for subsistence	53	33	316	402	1,820
University professor, Germany; very little exercise	100	100	240	440	2,325
Well-to-do family, Connecticut; food actually eaten	128	177	466	771	4,080
Mechanics and factory operatives, Massachusetts; food purchased	127	186	531	844	4,430
Food actually eaten by college students:					
From Northern United States	138	184	622	944	4,825
From Eastern United States	104	136	421	661	3,415

verted into fat, especially when used in combination with starches and sugars. The latter are believed to furnish force for the body, and by their combustion to spare the complete oxidation of albuminates, which are therefore stored in the tissues in a suboxidised form. It is a part of this theory that fatty food does not give rise to or promote the storage of fat in the body, and hence it may be allowed in the dietary; in fact, Ebstein recommends its use on account of its effect in producing satiety. By sooner diminishing the appetite, there is less craving for other food and drink. In accordance with this belief, he proscribes the use of sugar, potatoes, and all forms of farinaceous food with the exception of three ounces and a half of bread, which is allowed each day. He permits the use of fats, such as fat meat, cream, butter, and fatty soups. Among vegetables he allows asparagus, spinach, cabbage, peas, and beans. A moderate amount of meat of any kind is also included. The quantity of fluids allowed is restricted. Ebstein allows the patient to take three meals a day.

Breakfast consists of a cup of black tea without sugar or milk and two ounces of buttered toast.

Dinner, which is given at noon, comprises a meat soup or broth, four to six ounces of boiled or roasted fat beef with meat gravy, not thickened, one or two fresh vegetables, in moderation, and for dessert salads and fresh or dried fruits. He allows a little light wine and black tea without milk or sugar.

Supper includes tea as before, a soft-cooked egg and a moderate allowance of fish, ham, or cold fat meat, an ounce of thin buttered bread or toast, and fresh fruit.

THE OERTEL SYSTEM

A more recent system for the dietetic treatment of obesity is that practised by Oertel and modified by Schweninger. The distinctive feature of the Oertel treatment is the attention which is paid to improving the condition of the circulation by strengthening the heart action, and this, he claims, so much improves the general condition of the patient that the fat once eliminated is not reformed. According to his theory, corpulent patients may be subdivided into two different classes, whose diet is regulated accordingly. They are:

"(*a*) Cases of fat accumulation in which the respiratory and circulatory apparatus have undergone no special derangement, and the patient is capable of muscular effort and locomotion. A much more serious form is that in which the condition of fatty heart is present, with consequent enfeeblement of circulation and visceral engorgement.

"(*b*) Cases in which, in consequence of advanced stasis and hydræmia (with deficiency of hæmoglobin), the amount of oxygen taken up from the lungs is extremely reduced, and the slightest muscular efforts are enough to disturb the respiration and provoke dyspnœa."

For the first class his maximum allowance of fat is fifty grammes and of carbohydrates two hundred grammes, with a minimum of one hundred and fifty grammes of albumin. For the second class the maximum allowance of fat is twenty-five to thirty grammes, with one hundred grammes of carbohydrates, but the albumin must considerably exceed one hundred and fifty grammes. In this class especially the amount of fluids drunk must be curtailed. By withholding fluid, Oertel argues, blood pressure is reduced, venous stasis is lessened, the vessels of the body will adapt themselves to the reduced quantity of fluid, and to supply the glandular organs and muscles with their normal proportion fluid will be "drained away from places where the tissue changes are less energetic, and which are less favourably innervated. Such vessels are, above all, in the fatty tissues—vessels branching in the panniculus adiposus."

Nutritive changes ensue in the fatty tissues, the fat is disintegrated, conveyed away, and burned up.

This is certainly an ingenious, and withal very plausible theory which has many facts of clinical observation to recommend it.

Besides holding the view that the fluid in the body must be reduced before the accumulated fat can be diminished, Oertel says:

"Since the force required to raise the body through a great height entails the destruction of large quantities of fat, the above exertion [mountain climbing] will also lessen the fat accumulation, on condition only that we give less fat and carbohydrates in the food than are used up in the work done."

He gives some fat and carbohydrate food, but not very much, with proteids, for he believes that, anæmia being present, an exclusive meat diet would not be completely oxidised. It is better, therefore, to restrict all three classes of foods, but not to entirely exclude either, and the proteids must decidedly preponderate.

He also believes that anæmia has weakened the vascular tone through supplying a blood deficient in circulating albumin, and hence a diet rich in proteids is further indicated.

The Oertel system includes almost twice the quantity of animal food allowed in the Ebstein diet, and double the quantity of carbohydrates and less than half the quantity of fats. It is distinguished from the Banting system also by the greater preponderance of fats and starches. The following table from Yeo contrasts these different systems of diet. For comparison, the diet of Voit is added, which gives the proportion of the three chief varieties of foods upon which a man in health will decrease in weight. The figures represent grammes:

Daily Diet

	Albuminates.	Fats.	Carbohydrates.
Moleschott, normal average	130	84	404
Voit, " "	140	44	165
Banting, " "	170	10	80
Ebstein, " "	100	85	50
Oertel, " "	155–179	25–40	70–110

It will be observed that in all these diets the starches and sugars chiefly are proportionately much reduced, and the more liberal dietary of Oertel is particularly suitable for those classes of cases in which exercise can be joined with dietetic treatment. The combined effect of the diet with exercise results in the absorption and oxidation of the fat deposited between the muscular tissues and in the renewal of more vigorous action of the muscle fibres, which are shielded from waste by the liberal proportion of proteid food which is admitted. The whole treatment is aimed especially at increasing the vigour and force of the heart action, and in many cases it succeeds admirably. In the more serious type of obesity the deposition of fat around the base of the heart as well as between and within the heart muscle fibres enfeebles the strength of the cardiac systole and results in engorgement of the venous circulation. The heart is unable to propel the blood through the arteries and capillaries, and there is very little *vis a tergo* remaining for the blood in the veins. Lack of exercise also retards the venous circulation. As a result, there is a constant venous congestion which is particularly noticeable in the viscera, and there may be dropsical accumulations in the different serous cavities or general anasarca.

Exercise.—In the treatment of such cases Oertel withholds fluid from the diet as much as possible, and to assist the elimination of water from the body the patient is made to exercise by climbing carefully graded paths, which are measured and adapted with reference to use by patients of different strength. During muscular exertion the destruction of non-nitrogenous food stuffs is increased.

Palpitation and dyspnœa, which are so frequent accompaniments of excessive obesity, are not especially dreaded, and exercise is pushed until these symptoms occur—that is, the patients are made to climb the graduated ascents, walking slowly and systematically and covering a prescribed distance each day. As soon as they experience palpitation, or if shortness of breath appears, they are to stop and rest standing until the breath is regained. In this way it is believed by Oertel that the heart action is actually strengthened, and the fat is certainly reduced. Of course, due care must be observed to prevent exhaustion, and the patients must be warned against any sudden movement or overexertion which might occasion fatal heart strain. This exercise by climbing ascents is sometimes called the "terrain cure."

In case the patient is unable to take any exercise at all, the object is attained by massage and friction, and the promotion of perspiration is secured by baths of different sorts. In the treatment of such cases, among the solid ingredients of the food, the fats and starches are still further reduced.

Anæmia is believed to be counteracted by the use of albuminous food, and the following articles are allowed when this is a prominent symptom: Lean roast and boiled beef and veal, mutton, game, and eggs. Vegetables, spinach, and cabbage may be eaten. From four to six ounces of bread per diem are given, and fats and starches are restricted as much as possible, and sugars are withheld altogether. The fluid prescribed consists of a moderate cup (about six ounces) of coffee or tea or milk twice a day, with twelve ounces of wine with an equal quantity of water, which may be taken at dinner. If patients perspire very freely, a somewhat larger quantity may be given, and no other beverages of any kind are permitted.

The fluid allowed should not all be taken with the meals, but may be drunk at intervals between the times of eating to allay thirst. In the less serious type of cases, where the heart action is unimpaired, Oertel allows the fluid to be gradually increased, and he gives four to six ounces of wine at noon time, with a half bottle in the evening.

Bathing should be carried out systematically, and the patient may be packed with cloths dipped in hot water in order to promote perspiration. The baths are given at least twice a week through a period of a month or more.

A typical *menu* under the Oertel treatment is the following:

Oertel's Diet for Obesity

Morning.—One cup of coffee or tea, with a little milk—altogether about six ounces; bread, about three ounces.

Noon.—Three to four ounces of soup, seven to eight ounces of roast or boiled beef, veal, game, or not too fat poultry, salad or a light vegetable, a little fish (cooked without fat), if desired, one ounce of bread or farinaceous pudding (never more than three ounces), three to six ounces of fruit, fresh preferred, for dessert. It is desirable at this meal to avoid taking fluids, but in hot weather or in the absence of fruit, six to eight ounces of light wine may be taken.

Afternoon.—The same amount of coffee or tea as in the morning, with at most six ounces of water, and an ounce of bread as an exceptional indulgence.

Evening.—One or two soft-boiled eggs, an ounce of bread, perhaps a small slice of cheese; salad and fruit, six to eight ounces of wine with four or five ounces of water.

After patients have undergone a special course of treatment for obesity and their weight has been sufficiently reduced, it is desirable to establish a diet for them which will prevent a return of the fat. For this purpose Oertel recommends the following regimen; it is intended for patients in whom obesity has complicated organic disease of the heart or lungs:

"*Morning.*—One cup of coffee or tea with some milk = 150 grammes (6 ounces), and bread = 75 grammes ($2\frac{1}{2}$ ounces).

"*Midday.*—Soup = 100 grammes ($3\frac{1}{2}$ ounces); lean meat, roasted or boiled, game or fowl = 200 grammes (7 ounces); fish, not too fat = 25 grammes (nearly 1 ounce); bread or starch stuffs = 100 grammes at most ($3\frac{1}{2}$ ounces); as dessert 100 to 200 grammes ($3\frac{1}{2}$ to 7 ounces) of fruit, fresh preferred—a smaller quantity if preserved, especially by Nägelis's method. Liquids are better avoided. At dinner time, only in very hot weather or in the absence of fruit, perhaps $\frac{1}{8}$ to $\frac{1}{4}$ litre of light wine may be allowed (6 to 9 ounces).

"*Afternoon.*—The same quantity of coffee or tea as before, with at most $\frac{1}{8}$ litre of water (6 ounces); occasionally 25 grammes of bread (nearly 1 ounce).

"*Evening.*—One or two soft-boiled eggs; meat, 150 grammes (nearly 5 ounces); bread, 25 grammes (nearly 1 ounce); a bit of cheese, a little salad and fruit. As a regular drink, $\frac{1}{8}$ to $\frac{1}{4}$ litre of wine (6 to 9 ounces), with perhaps $\frac{1}{8}$ litre of water ($4\frac{1}{2}$ ounces)."

Water should never be allowed in quantity, and what little is drunk should be distributed through the day.

THE SCHWENINGER SYSTEM

Schweninger's system is essentially that of Oertel, but the former absolutely forbids the use of drink of any kind with meals, and the little fluid that is permitted must be taken fully two hours afterwards.

His treatment is substantially as follows: Moderate exercise for an hour before breakfast, after a cold bath with friction.

Breakfast, 8 A. M.—Meat, eggs, or milk. A walk.

Second Breakfast, 10.30 A. M.—Meat or fish and a glass of white wine. A walk.

Dinner, 1 P. M.—Meat, vegetables, and fruit *compote*.

Supper, 7 P. M.—Meat and fruit *compote* or salad, a glass of white wine.

No other fluid is given with meals. Bread is eaten very sparingly.

Schleicher's Diet for Obesity

Breakfast, 7 A. M.—A mutton or veal cutlet or a portion of sole as big as the palm of the hand; the same quantity of bread without butter. 8 A. M.—A cup of tea with sugar. 10.30 A. M.—A sandwich of bread and meat or sausage.

Noon.—Meat, eggs, green vegetables, cheese, an orange. Two glasses of white wine. (No soup, no potatoes.) 4 P. M.—Tea, with sugar. 7 P. M.—A small quantity of bread and cheese. 9 P. M.—Cold meat, eggs, salad. Two glasses of wine, and sometimes more.

This is practically the diet of Schweninger, but without the absolute prohibition of drink at meals.

THE GERMAIN SÉE SYSTEM

Germain Sée, who holds some original theories in regard to dietetics, declares that the use of abundant drink is distinctly indicated in the treatment of obesity. He allows a diet of proteids and fats, withholding sugars and starches, and requires his patients to drink hot weak tea and water in large amount. He prohibits alcohol in every form, excepting a little dilute wine, which may be allowed in exceptional cases. His treatment is no doubt more serviceable in those cases of corpulency which complicate gout and rheumatism and in which, as above mentioned, it is desirable to eliminate the waste matter from the system as completely as possible.

THE WEIR MITCHELL SYSTEM

Weir Mitchell, for the treatment of obesity, relies mainly on rest and passive exercise in the form of massage and Swedish movements with a skimmed-milk diet, which latter may be given at increasing rate, gradually replacing the accustomed food, until in a week's time the patient is living wholly upon milk. Upon this diet, the patient may lose half a pound or more in weight per diem. Careful watch is kept of the strength. The patient should be frequently examined with special reference to loss of weight and to any unfavourable increase in the heart action or feebleness of the pulse. If the latter conditions arise, it may be necessary to increase the diet or to give stimulation. A small quantity of beef, chicken, or oyster soup is allowed in such cases to relieve the monotony of an exclusive milk diet. The patient is kept quiet in bed for ten days or a fortnight, and afterwards permitted to move about the room, but must spend most of his time upon a lounge. Massage is performed once or twice a day at first, and subsequently the more active Swedish movements are applied to the extremities. After from four to six weeks of this treatment the weight is usually reduced by a number of pounds, and the general condition and strength are found to have improved. The diet is gradually increased by the addition of lean meats, beef, mutton, poultry, shellfish, and boiled fish. For a long time, however, milk plays an important rôle, four or five glasses being taken daily.

Weir Mitchell argues that so sudden a loss of weight as occurs in his treatment would be serious were the patient walking about, but when resting quietly in bed the danger of sudden exhaustion of the heart action is reduced to a minimum. His patients bear the treatment fairly well, and are frequently much pleased with the pronounced improvement in appearance and condition which they recognise. The treatment is not adapted to persons leading active lives who are unable to relinquish their business or other duties, for it requires a considerable length of time and the entire abandonment of all labour.

THE YEO SYSTEM

The diet recommended by Yeo is as follows: All fats and animal food are to be strictly limited, and farinaceous and starchy foods should be reduced to a minimum. Sugar must be entirely prohibited, but a moderate quantity of fat is allowed to secure the proper dilution and digestion of the food. Hot water and hot aromatic drinks may be taken freely in the intervals between meals, especially in gouty cases. He allows the patient to drink a little hock and still Moselle, or light claret with alkaline table water. Beer, porter, and sweets of all kinds are to be prohibited, and no spirits should be drunk unless for some special need as a tonic. Meat is not to be eaten more than once a day, and not more than six ounces should be taken at any one time. The meat which Yeo allows is lean beef, mutton, lamb, poultry, game, and sometimes fish and eggs. Two lightly cooked or poached eggs may be taken once a day, or a little grilled fish. He allows thoroughly toasted bread in thin slices and crackers. Soups in general and milk, unless skimmed, milk puddings, farinaceous puddings, pastry, salmon, and mackerel must all be avoided. Fresh vegetables and fruits are allowed. He believes it is useless to attempt to give rules in regard to the actual quantity of dry food permitted, because it must necessarily vary in accordance with the weight and strength of the patient in each case. A quantity of food which might constitute an excess for one person would perhaps be insufficient to support the strength and activity of another.

Later a full diet of meat may be allowed, but sugars and starches must still be excluded to as great an extent as possible. The patient may be taught to supplement passive exercise by calisthenics.

THE DUJARDIN-BEAUMETZ SYSTEM

Dujardin-Beaumetz believes that the diets allowed by Oertel and Ebstein are too restricted to support the body in a condition of normal nutrition and activity, and his system of treatment is as follows: For the milder cases in which fatty degeneration has not yet invaded the heart and other viscera he gives half a pint of water or light wine diluted with Vichy, or some alkaline effervescent water, with each of the three meals of the day. Soup of all kinds is forbidden, wine or tea being recommended instead. If the gastric juice is apparently deficient, or if there is much dyspepsia, no fluid is allowed with the meals, but the patient is ordered to take a pint of weak tea without sugar or milk two hours after the completion of each meal. No other beverages are permitted excepting a small cup of black coffee with breakfast. Soup is also forbidden, and so is pastry. He allows dry bread in moderation, such as the outer part of Vienna rolls, or "soup sticks," which are chiefly crust, and he recommends animal food of all classes and several varieties of fresh vegetables and juicy fruits, such as oranges. For breakfast he gives three quarters of an ounce of dry bread, one and a half ounce of meat, and a cup of weak tea or a glass or two of light wine. Lunch is served at noon, and consists of double the quantity of bread and meat permitted at breakfast, with three ounces of fresh vegetables, salad, a small piece of cheese, and fruit. Eggs may be substituted for the meat, or fish may be given at either breakfast or luncheon. The quantity of the several foods allowed may be varied slightly.

THE MEAT AND HOT-WATER TREATMENT

This method is a treatment for obesity and chronic gastric catarrh, which consists in the restriction of the diet exclusively for several weeks to large quantities of rare beefsteak, and salt codfish and hot water for the first fortnight, three pounds of rump steak, one pound of codfish, with six and one third pints of hot water, are subsequently given for two or three weeks. The water is gradually reduced to four pints, and lean beef and fresh fish may be eaten with dry toast or zwieback, and a very little green vegetable food. After five or six weeks the hot water is still further reduced to a quart a day, and dry crackers and dry toast and stale bread crusts, poultry, and game are added to the diet, and the patient may be allowed to drink hock diluted with carbonic or Seltzer water. The hot water, if desired, may be flavoured with fresh lemon juice, and five or ten grains of bicarbonate of soda are given twice a day. This treatment is found impracticable by many persons, who rebel against the extreme monotony of it, and are unable to eat so large an amount of meat either with or without other food; it is principally adapted to persons who are habituated to overeating, and is not to be recommended for the majority of cases.

THE BOUCHARD SYSTEM

According to Bouchard's method, the frequent observation of the urine should form the basis of the treatment of obesity. When the nitrogenous waste is increased in the urine he reduces the allowance of animal food; but he also believes, in opposition to many other theories of treatment of obesity, that the total quantity of farinaceous and fatty food allowed should be five times greater than the quantity of animal food, and asserts that giving vegetable acids with the carbohydrates favours the oxidation of the latter. He therefore prescribes such fruits and fresh vegetables as are rich in the potassium salts of the organic acids. He forbids the use of vinegar and other acids, which he claims diminish the alkalinity of the blood and thereby increase the formation of fat.

The patient's exercise is also governed by the elimination of urea and phosphates. When these salts are present in excess, he argues that the oxidation of the tissues is being unduly stimulated; but if they are not present in too large quantity, exercise before meals is recommended. A review of the principles involved in this theory does not strengthen the belief in their value.

The oxidation processes in the body are still too obscure to enable one to take the urine as an absolute criterion of the conditions of metabolism, especially in those cases where a large reduction in the body weight is being obtained by the consumption of previously stored-up material. It is true that superfluous fat, when fully oxidised, leaves the body in the form of carbonic acid and water from the lungs, and in the form of water and carbonates in the urine; but it is not definitely known to what extent this combustion spares the proteid materials of the body from disintegration and allows the animal food products to pass directly into the urine as urea or other nitrogenous waste matter. While the urine should be carefully studied in these cases, a much better guide for the treatment of obesity is found in the observation of other symptoms and in the disappearance of previously existing abnormal conditions.

THE CHAMBERS SYSTEM

"*Day's Regimen for a Three Weeks' Course.*—Rise at 7. Rub the body well with horsehair gloves, have a cold bath, take a short turn in the open air. Breakfast at 8 or 8.30, on the lean of beef or mutton, cutting off the fat and skin, with dry toast, biscuit, or oatcake, a tumbler of claret and water or tea without milk or sugar, or made in the Russian way with a slice of lemon. Luncheon at 1 on bread or biscuit, Dutch cheese, salad, water cresses, or roasted apples (without sugar or cream), hung beef, or anchovies, or red herring or olives, and such like relishes. Drink, after eating, claret and water, unsweetened lemonade, or plain water, in moderation. Dinner at any convenient hour. Take no soup, fish, or pastry, but plain meat of any kind except pork, rejecting the fat and skin. Spinach, French beans, or any other green vegetable may be taken, but no potatoes, made dishes, or pastry. A jelly or a lemon water ice, or a roast apple must suffice for sweets and dessert. Claret and water at dinner, and one glass of sherry or Madeira afterwards.

"Between meals exercise, as a rule, in the open air, to the extent of inducing perspiration, must be taken. Running, when practicable, is the best form in which to take it."

Chambers also advised giving liquor potassæ with the proteid diet, or the remedy of Dancel, consisting of one half or a teaspoonful of sodium bicarbonate added to five or ten grains of tartaric acid in a small tumblerful of water, and drunk while effervescing. He restricted sleep to seven hours a day, for it is weakening for the obese to remain too long in bed in a close room. Turkish baths were also recommended. Chambers's further directions to be observed by the patient to prevent a possible return to corpulency were as follows: Continue to avoid fat meats, rich milk, butter, malt liquors, sweet wines, starches, especially pastry and puddings, and sweet vegetables, such as parsnips and beets.

The patient may have lean beef or mutton, venison, game, poultry, boiled fish, poor new cheese, green vegetables and fresh fruits, oranges, lemons, almonds, roast apples, salads, olives, buttermilk, claret, hock. Bread should be aërated or toasted. Captain's biscuits may be eaten. Among the green vegetables which may be eaten are tomatoes, celery, stuffed red and green peppers, radishes, asparagus, artichokes, oyster plant, squash, and spinach.

Of the various systems above described, that of Oertel is, on the whole, the best adapted for the greater number of cases. The Ebstein treatment diminishes the appetite and is useful for robust patients, but if there is enfeebled digestion and weakness, this diet is not to be recommended on account of the large proportion of fat and the relatively small amount of proteid foods. The essential value of all methods of dietetic treatment of obesity is based upon two objects to be attained: First, to enable the patient to fully oxidise and eliminate the fat which is already accumulated in various parts of the body, and, secondly, to make it impossible for it to be reformed.

From what has been said of the cause and nature of obesity, it follows that no one system of treatment is applicable in every instance. The effect of any treatment should be observed from day to day, care being taken that the patient while losing flesh does not at the same time lose in strength to a degree which may become dangerous—i. e., more than two or three pounds per week. Frequent examinations should be made of the heart action, the circulation, and the urine.

The thyroid-gland extract has a remarkable effect in reducing obesity in some cases, even without accessory treatment. The catabolism of the process is not understood, but the CO_2 elimination is increased, and in addition to increased consumption of fat tissues there is increased nitrogenous waste. The effect is not permanent, and the lost weight is soon regained if the patient fails to persist in dietetic treatment with exercise. The powdered gland is given in tablet form, in doses not exceeding five grains three times a day. It is best not to give more than five grains at first in twenty-four hours, for the remedy sometimes produces serious cardiac weakness and digestive disturbance. I have usually found that after a reduction in weight of about thirty pounds the use of the extract had to be discontinued.

Debove's theory of obesity is that the nervous system is at fault through failure to regulate metabolism. His treatment comprises (1) a period of reduced feeding, (2) a period of voluntary regulation. His sample diet is as follows:

For breakfast, a cup of tea or milk; mid-day meal, one or two slices of meat, a few vegetables or a little salad, a hundred to a hundred and fifty grams of bread, a little cheese, fruits as desired, and a cup of black coffee without sugar. For supper, a glass of hot milk, sweetened, 30 to 50 grams of bread, and fruits as desired.

"ANTI-FAT" REMEDIES

A host of quack nostrums are offered to a credulous public under the claim that they reduce corpulency. Some of them have achieved reputation because while they are taken the patient is also induced to regulate his diet; others merely because they have destroyed the appetite or digestion and have made it impossible to eat too much food. But the whole lot of "reduction pills," concentrated salts and purges, extracts of phytolacca berries, *Fucus vesiculosus*, and other so-called "specifics" for reduction of obesity, cannot be too strongly condemned as thoroughly unscientific, if not positively harmful or dangerous, as many of them are.

It cannot be expected that any chemical remedy can control the complex processes involved, and the substances which are in extensive use by credulous persons for this purpose diminish the appetite, impair the digestion, and seriously interfere with nutrition.

Excepting the thyroid extract there is no drug or remedy known which acts specifically either in retarding fat formation or in causing its destruction in the body, and when any such remedy appears to have that effect, it is acting indirectly by a general lowering of vitality.

Diet for Leanness

The foods which tend to produce fat in the body are chiefly sugars and starches. Eating fat in excess does not necessarily cause fat to accumulate in the system, for it may be completely oxidised.

To increase the albuminous constituents of the body without the accession of fat, a diet should be ordered in which proteid food predominates, with a moderate allowance of carbohydrates. To increase the body fat, however, the proportion of carbohydrate should considerably exceed the proteid food and a little fat should be added.

In seeking to remedy excessive leanness by dietetic treatment it is obviously necessary to first ascertain, if possible, its cause. It may be due to the use of improper food, to erroneous habits of eating, bad cooking, maldigestion or malassimilation, overwork and nervous exhaustion, disease of the various organs connected especially with nutrition, and besides these and other causes there are those in whom leanness seems to be constitutional or hereditary. They may enjoy excellent health, but are always so thin as to be the subject of comment. No diet seems to have much effect in increasing their weight. Another class of persons are those whose weight is constantly fluctuating and whose annual variation is as much as ten or even twenty pounds. In winter, in town life, when overworked, worried, or oppressed with mental strain, they lose weight rapidly, and in summer, in a brief holiday in the country, with little to do but eat and sleep, they gain at the rate of two or three pounds a week. This is true more often of those whose general tendency is towards obesity rather than towards leanness.

It is almost hopeless to attempt to remedy obstinate leanness by diet unless other favouring conditions can be secured. First among these is entire freedom from mental strain, and of almost equal importance is abundant and regular sleep. A warm climate and inactive life favour increase in weight. In most respects the diet for leanness must be the reverse of that for obesity, as would be naturally expected, and in prescribing starchy foods it must be remembered that the leanness is often caused solely by an entire inability to digest amylaceous or saccharine material owing to " nervous dyspepsia," gastric catarrh, etc. These conditions should receive careful treatment on the lines recommended on pp. 535 and 537. By a little care it will often be possible to discover some forms of starches which can be digested. It is a good rule in such cases to give the cereals or vegetables at one meal and meat at another, so that articles involving different rates and organs of digestion do not interfere with each other. All bread should be stale or toasted. Crackers and zwieback may be allowed. As a rule such patients can be made to digest starches before they can sugars—oatmeal will be better digested without sugar, and a cup of sweetened coffee with a meal of starchy foods may produce flatulency which lasts for hours.

It is desirable to increase the body weight (*a*) after serious acute disease, (*b*) in chronic wasting disease (especially tuberculosis), (*c*) in conditions of nervous exhaustion (neurasthenia). To increase the body fat alone the carbohydrates especially should be increased (perhaps doubled), and the fats also should be moderately increased in the dietary; but if the body proteid is to be increased (i. e., the volume and tone of muscle), proteid food should be increased, together with carbohydrates (as proteid sparers), and muscular exercise and oxidation should receive attention.

When the digestive organs admit, the following articles may be prescribed in the diet for leanness:

Abundant fat meats, butter, cream, milk, cocoa, and chocolate. Bread, potatoes, legumes, well-cooked cereals, especially oatmeal and cornmeal, farinaceous puddings with sugar and cream, cake, sweets, sirup, honey, sweet wines, port, porter, stout, ales, and beer. Malt preparations are also useful. Sweet fruits may be eaten. To be avoided are pickles, acids, condiments, much bulk of green vegetables, and strong liquors.

The following regimen is employed by William S. Ely in the treatment of the underfed, or rather ill-nourished, neurasthenic patient. The patient is kept in bed in order to reserve as much nerve force for digestion as possible, and dietetic treatment is begun by giving, every two hours by day and every three hours by night, four to eight ounces of milk, or chocolate made with milk, or two raw eggs, these foods being alternated. At the end of a week the daily ration may be increased to two quarts of milk, two of chocolate with milk, and a dozen raw eggs. The patient receives daily baths, massage, passive movements, and electricity.

This regimen emphasises the fundamental principle that muscular as well as mental rest must be enjoined if any dietetic treatment for leanness is to be successful. Excessive leanness may not be incompatible with the enjoyment of perfect health, and, upon the whole, it is less uncomfortable than excessive stoutness; yet in the very lean, bodily resistance against certain forms of disease, especially chronic ailments, is diminished, the subject of leanness is apt to suffer from cold and often from digestive disorders, muscular fatigue may be easily induced, and in youths who have grown rapidly to extreme height, disproportionate leanness leads to stunted development in other directions, especially that of normal chest expansion. Other persons, more especially young women, complain of their leanness upon æsthetic grounds.

The important principle to impress upon the subject of leanness is that he must learn to make a storage battery of himself; that if he expends his energies too fast in any direction, the food which is their ultimate source will never be stored as a source of latent energy. The difficulty may be hereditary, constitutional, or acquired, but it can only be overcome by appreciating the full significance of this principle.

Diet in Acute Rheumatism

Causation.—It has not been proved that any special articles of diet lead to the development of rheumatism, although indulgence in sweets, starchy foods, and malt liquors is sometimes held responsible for it. Poor living seems to favour the attacks, but the prevailing opinion is that acute rheumatism is an infectious disease.

If this fact be established, there is no reason that diet should exercise any primary ætiological influence in producing rheumatism or in preventing recurrent attacks, beyond the obvious fact that a diet which disorders digestion or gives rise to malnutrition places the system in a condition more susceptible to the inroads of any microbic disease—in other words, it lowers resistance. This statement, however, by no means precludes the fact that during an acute attack diet may exert profound influence as it does in many other febrile diseases which it does not originate.

Dietetic Treatment.—While the fever lasts and other symptoms are acute, such as pain and swelling of the joints, the patient should be put upon a fluid diet. The majority of cases do best at this time with an exclusive milk or bread-and-milk diet. Those patients who cannot take milk, however, may be allowed soups and broths flavoured with vegetable extracts, chicken tea, milk toast, barley or oatmeal gruel, clam broth.

Thirst is often a prominent symptom, especially if there be much fever, and it is advisable for the patient to drink fluid freely to assist in washing out the waste products from the body. Lemonade and slightly acid drinks of various kinds, such as dilute phosphoric acid or the effervescent mineral waters, are recommended. Boiled milk and Seltzer or Vichy may be drunk, or oatmeal or barley water flavoured with lemon. Alcohol should be avoided while the acute symptoms last, unless the complication of inflammation of the endocardium or pericardium enfeebles the heart action to such a degree as to make stimulation necessary. If convalescence is prolonged and anæmia is considerable, alcohol may be given as a tonic two or three times a day in the form of a glass of claret or Burgundy (one to two ounces), or diluted whisky.

During convalescence the appetite is not usually vigorous, and it is not necessary to urge the taking of much food at first. The diet should be principally farinaceous, but not saccharine.

Such articles may be given as rice (plain or spiced), arrowroot, oatmeal, cornmeal, semolina, wheaten grits, panada, milk toast, simple unsweetened puddings, wine jelly, blancmange, and malted foods.

The return to solid diet should be gradual, and for a long time the patient should abstain from eating meats as well as from pastry and sweets. Fagge states that no meat or fish should be allowed for at least a week after subsidence of the fever and acute symptoms, or, better, for a fortnight, and many believe that beef tea is harmful. Meat can undoubtedly induce a relapse.

When convalescence becomes established, eggs, fish, oysters, and the white meat of broiled or roasted chicken may be given, and one or two such vegetables as asparagus, spinach, or stewed celery, with a baked apple or fresh fruit, but sweets and alcohol should long be withheld.

The patient should be fed often, having one or two extra lunches during the day, for anæmia is apt to prevail for some time, and abundant nutriment is required.

Diet in Chronic Rheumatism

In the dietetic treatment of chronic rheumatism, especially if the patient is anæmic, animal food cannot be excluded, but the basis of the diet should be farinaceous food with a few fresh green vegetables. Fish, eggs, and fowl may be eaten, but dark meat is not desirable. Sweets and alcoholic beverages should be omitted from the *menu*, and all foods should be plainly cooked and eaten in moderation.

Arthritis Deformans

Causation.—Arthritis deformans is a chronic disease in which the joints of the body, and particularly those of the extremities, are affected. The alterations in joint structures are produced mainly by impoverished nutrition, and the disease is especially one of advanced life, occurring in persons in whom various evidences of senility have begun to appear. The structural changes in the joints involve proliferation of the cellular elements of the cartilages, with thickening and erosion and with the production of osteophytes. In mild cases there is not much impairment of general health. In severer cases the patient is confined to the house and, on account of pain or immobility of the joints, is unable to take ordinary exercise. Digestion and nutrition suffer considerably in consequence.

Dietetic Treatment.—Since the disease is one of debility and impoverished nutrition, it follows that a low diet is harmful and a nourishing diet, with increased frequency of meals, is desirable. James Stewart says: "The practice of limiting the amount of nitrogenous food is not to be commended. Provided there is no general or local contraindication, the patient should be directed to take as much nitrogenous food as can be digested with facility." And Garrod wrote: "I consider it of the utmost importance throughout the whole course of the disease to support the system and to allow the patient as nourishing a diet as he is capable of properly digesting." Good roast beef, beefsteak, mutton, fowl, fish, eggs, and milk may be eaten.

Alcoholic beverages taken with meals in proper moderation are beneficial for their strengthening and tonic effect, and bitter tonics may be combined with them to advantage. The objection which exists to the use of alcohol in gout and acute rheumatism does not apply with such force in this disease. Malt liquors may be given, such as ale or stout, and it is often desirable to prescribe a good Burgundy, port, or sherry. If it is well borne by the stomach, cod-liver oil should be given in teaspoonful doses, an hour after meals, three times a day. It is an excellent food in this disease, and its use should be long continued. Other forms of fat may be used, such as butter, cream, or bone marrow, olive oil, etc.

When acute exacerbations occur the quantity of food and stimulants should be reduced, but otherwise it is important that the diet should always be ample.

Patients do well to try the effect of a course of treatment at the hot springs of Virginia, Arkansas, Mount Clemens, Michigan, or Banff.

Gout

Gout is a constitutional disease which has local manifestations appearing from time to time in the joints, especially the metacarpophalangeal articulation of the great toe, but it must be remembered that the gouty diathesis is a condition which once acquired may exist for years, producing many other and more serious symptoms or structural changes in the body than the local inflammation of one or more joints.

Causation.—Gout has been defined as a condition dependent upon disturbed retrograde metamorphosis of the nitrogenous ingredients of the food—a high-sounding phrase, which, it must be confessed, carries with it very little genuine explanation of the nutritive processes involved. Whatever may be the theories in regard to the production of an attack of acute gout, it is universally admitted that careful regulation of the diet is the most important factor in its treatment. Gout and the various conditions allied to it are dependent upon retention in the blood or other fluids of the body of forms of waste matter which normally should be oxidised and completely converted into the soluble materials which are excreted in the urine. For some reason the oxidation of waste matter is suspended, and, as a result, a variety of intermediate products of imperfect solubility may be deposited in the joints or tissues of the body. The active manifestations of gout are due to an accumulation of insoluble urates in the joints. In conditions which are closely allied to gout, such as the uric-acid diathesis, there is a deposition of crystals of uric acid in some portion of the urinary tract or, in other conditions, deposits of insoluble cholesterin are formed from the bile and accumulate as gallstones in the gall bladder.

The direct relation existing between uric acid and gout has been most exhaustively investigated by Garrod, and this relation may be briefly summarised as follows: First, the gouty diathesis is associated with a more or less constant excess of uric acid in the blood; secondly, the quantity of uric acid normally present in the urine is diminished by at least one half during a severe attack of gout, and increases beyond the normal as soon as the acute symptoms subside. An acute attack of gout is therefore preceded by accumulation of uric acid in the blood, which is a substance that in itself represents incomplete combustion of nitrogenous waste material in the body. The retention of this form of waste in considerable quantity proves markedly irritating to the nervous and other organs of the body.

Sir Dyce Duckworth writes: "We perhaps come nearer a complete understanding of this matter if we regard as present in the gouty a peculiar incapacity for normal elaboration within the whole body, not merely in the liver or in one or two organs, of food, whereby uric acid is formed at times in excess, or is incapable of being duly transformed into more soluble and less noxious products," and he agrees with Ralfe that the failure to complete the metabolism of uric acid is dependent primarily upon disturbed innervation.

In referring to the habit of overeating Sir Henry Thompson says that in early life it may cause occasional attacks of biliousness, but after the first half of life has been spent the remaining half may be affected in a different way, and "recurring attacks of gout perform the same duty, or nearly so, at this period of life that bilious attacks accomplished in youth."

On the other hand, in persons who are subject to attacks of gout starvation may bring it on (Senator), and "poor man's gout" is by no means a disease induced by plenty.

Sugar eaten in excess is not of itself a direct cause of gout, but sweets combined with certain other foods, such as special fruits and wines, will precipitate an attack in a gouty subject with certainty. According to the view of Sir Dyce Duckworth, it is the combination of sugar with vegetable acids which is injurious.

Sugar, under some conditions of fermentation in the stomach and intestines, forms lactic acid, which is capable of splitting so as to produce carbon dioxide, which, according to Ralfe, forms acid salts of sodium and potassium from their neutral compounds.

Lack of exercise is often assigned as a cause for gout, and with many persons it is true that outbreaks of gout may be intensified in this way; but it is not uncommon for the disease to affect men who lead lives of considerable activity or who practise athletics, but who at the same time consume large quantities of nitrogenous food. By free perspiration the amount of fluid present in the blood is reduced and the solids become both relatively and absolutely increased, making it difficult or impossible for them all to become thoroughly oxidised.

Symptoms.—The most distinctive symptoms of gout are the local joint manifestations of pain, swelling, redness, and tenderness. These symptoms usually occur together in an acute attack, but either one may occasionally be absent. Other symptoms may appear from time to time, such as disorders of the mucous membranes, especially of the stomach and bowels; a tendency to catarrhal affections of the mucous membranes of the respiratory passages; chronic endarteritis; alterations in the composition of the urine; and various forms of irritation of the nervous system and the skin.

Children who inherit the gouty diathesis are very apt to present some one or more of this group of symptoms, especially neuralgic pains, digestive disturbances, and skin diseases, which appear at an early age and long before the gout is fully developed with typical localised joint symptoms. The symptoms connected with this diathesis are believed to arise from obscure alterations in the composition of the blood which are more or less remediable by dietetic treatment.

Preventive Treatment.—The prophylactic treatment of gout in those who inherit a constitutional predisposition to the disease is very important. From birth onward the children of gouty parents should be abstemious, have the diet carefully balanced so that neither animal nor vegetable food predominates in great excess. As the child grows older, confectionery and sweets in general should be avoided, especially with other food or at the conclusion of meals, as well as alcohol in every form. In youth all varieties of beer, ale, cider, etc., are particularly injurious. Tea and coffee, if allowed at all, should be taken in moderation, and some persons can often precipitate a violent attack of gout by a single glass of champagne or sweet wine.

If they are accustomed to the use of alcoholic beverages and it is impossible for them to go without them, those which are least injurious are a dry white wine or old Bordeaux, but all wines containing sugar must be absolutely prohibited.

Cyr says: "If a glass of beer, spirits, or wine is habitually followed by pain in a joint or nerve it is gouty."

Theory of Dietetic Treatment.—An important question in regard to the theory of gout is still under discussion—namely, whether the increased quantity of uric acid is to be attributed to overproduction or merely to faulty elimination. It is conceivable that the fluids of the body, by becoming less alkaline than normal, may fail to retain the salts of uric acid in solution, and are consequently precipitated in the joints and elsewhere. The matter is of vital importance in the selection of the proper diet for gouty patients. If the disease is caused merely by imperfect oxidation of nitrogenous food, the indication is clearly to diminish the quantity of such food ingested and to promote oxidation by exercise and fresh air. If, on the other hand, oxidation processes are fairly normal, but the blood is in a morbid state in which it becomes less alkaline than normal and loses its solvent power upon the nitrogenous waste matters, it is possible that other causes may be responsible for the condition produced. Albumins contain both sulphur and phosphorus which are destined to leave the body in the form of salts of sulphuric and phosphoric acids respectively. If these acids fail to be wholly neutralised while yet in the blood they will lessen its alkalinity, and in this way overindulgence in albuminous food by furnishing an excess of sulphur and phosphorus may diminish the alkalinity of the blood and produce uricæmia. This explains why the use of alkaline waters is so generally beneficial in gout and lithæmia. Such fluids assist in regulating the normal alkaline reaction of the blood. This is the line of argument which has been advanced by many physiological chemists, and it applies in equal force to the method of formation of renal calculi and gravel. The acidity of the urine is increased by a meat diet and reduced by a vegetable diet. With the latter it may even become strongly alkaline. Whether we adopt the theory of deficient oxidation or of diminished alkalinity of the blood, the indications for dietetic treatment of gout are the same—namely, reduction of proteid food and increase of vegetable food. It does not follow that albuminates must be entirely given up in all cases of gout, but they should be so restricted that the normal balance of the metabolism of the blood shall be restored. It will be found necessary for those who live luxurious and idle or sedentary lives to give up nitrogenous food absolutely while those who are accustomed to take active muscular exercise may be allowed animal food in very moderate quantities once a day.

Dietetic Treatment.—Although no one food is invariably injurious at all times, it is almost universally agreed that for the gouty, fat and nitrogenous food should be greatly restricted and saccharine food should be entirely prohibited.

It may be established as a general rule that the diet of the gouty should consist principally of easily digested fresh green vegetables and sometimes certain fruits, in addition to which a moderate quantity of lean meat (beef, lamb, and mutton) may be eaten to prevent the necessity of taking an excessively bulky diet, which in order to furnish sufficient nitrogen for the needs of the body would unduly tax the digestive system. Fruit is less apt to disagree if taken by itself, not with sugar or other food. Luff, of London, believes that the mineral salts of such vegetables as spinach, turnip-tops, Brussels sprouts, string beans, cabbage, and celery act chemically in preventing formation of gouty deposit in the tissues by increasing the solubility of sodium biurate and retarding the conversion of quadriurates into biurates.

It is a serious mistake to prescribe any treatment for the gouty which tends to lower the general vitality of the system too much. The diet, therefore, must be so adjusted as to secure the right proportion of the different classes of foods. Atonic cases require a generous diet with more proteids.

Gout is often combined with excessive corpulency, and when this is the case no chronic disease, with the exception, perhaps, of diabetes, requires more strict regulation of the diet and hygiene of the patient. While it is undesirable to allow animal food in large quantities in gout, it is also true that vegetables are fattening, and if the diet is too restricted in both these classes of foods the obese patient suffers from lack of nutrition, and digestion becomes still further impaired in consequence.

The theory has been held that but little fat should be eaten by the gouty, for it fixes oxygen which would otherwise complete the oxidation of albuminates, and hence it favours accumulation of proteid waste products. On the other hand, it has been shown that the accumulation of uric acid is not due to lessened oxidation, but that it is increased by proteid metabolism, and its elimination by the kidneys is actually promoted by fats. Clinically, however, it is found best to control the use both of albumins and fats.

Sugars and gelatinous material, like fats, all tend to retard the complete combustion of proteid food, and the latter therefore remains in an imperfectly oxidised condition which may give rise to uricæmia. The combination of the latter classes of foods, therefore, is particularly injurious in gout. On the other hand, Ebstein favours the use of fat in moderation, on the ground that it appeases the appetite and makes the consumption of a large quantity of carbohydrates unnecessary. If fat is allowed at all in the diet, it is best to give it in very small amount; otherwise it interferes with the local digestion in the stomach and tends to aggravate the dyspepsia which is so common in gouty subjects. It will be better borne in those cases which are not complicated by a tendency to obesity.

In the dietetic management of gout in robust subjects it is of quite as much importance to reduce the quantity of food consumed as to restrict the variety.

Robust gouty patients must be made to restrain a too vigorous appetite, and especially the eating of all sorts of foods between meals, for, as Balfour says (The Senile Heart), "there is nothing so destructive of gastric comfort as the continual pecking induced by gouty bulimia."

They should never be allowed to eat to complete satiety at meals, and all rich sauces, pastry, and strong condiments and fried food should be avoided. The majority of gouty patients have been in the habit for a long time of eating too much meat, and some of them of partaking too freely of carbohydrates. Overeating is almost as bad for patients as drinking too much. "Gout is evidence of an overfed, overworked, and consequently clogged machine" (Osler). As Bence Jones says: "It is best to allow a minimum of albuminous food to produce the least amount of uric acid and a minimum of carbohydrates, in order to give the uric acid formed opportunity to be oxidised as much as possible."

When an acute exacerbation of gout occurs it is necessary to curtail all variety in diet, and put the patient upon light farinaceous food with abundant diluents, alkaline waters, weak tea. Gruels of sago, arrowroot, or barley may be given, with bread or toast. When the fever subsides and the acute symptoms abate, bouillon, clam juice, simple broths made of lean mutton or chicken with rice, may be allowed. Later, a little whitefish or breast of chicken. Meat should be given only when absolutely necessary for nourishment, for, as Garrod says of it, "everything beyond what is absolutely required for the nourishment of the body only feeds the disease."

Sir Dyce Duckworth's treatment of the acute disease is briefly as follows: He recommends such substances as rice, bread, arrowroot, sago, tapioca pudding, and semolina. He allows milk, weak tea, and infusion of cocoa nibs. Later, chicken broth may be given, followed by fish and a mealy roasted potato. No meat should be given until all acute symptoms are over, and then it should be allowed but once a day. Elderly persons may have a little dilute whisky or brandy, not to exceed two ounces per diem. He also favours the use of hot water, as in the treatment of dyspepsia, but discountenances the eating of fruits, especially with sugars.

When the acute attack subsides and chronic gout supervenes Garrod replaces the farinaceous diet gradually by fruit, fish, fowl, and finally by meat, but any dishes containing free acids or sweets are liable to cause a relapse.

DIET FOR THE GOUTY DIATHESIS AND CHRONIC GOUT

In the following dietary a liberal variety of foods will be found, some of which may be selected and changed from time to time according to need in the intervals between the exacerbations or in chronic gout. Should an acute attack occur at any time in the course of the disease, the diet must be at once restricted, as described above. The number of dishes allowed at any one meal should be few. In dealing with any case of chronic gout for the first time it is injudicious to make radical changes in the diet too suddenly.

Soups.—Soup should be free from all fat, and it is better made of vegetables than meat, and *purées* of potatoes, celery, etc., may be recommended. If the taste of meat is desired, as suggested by Yeo, it is best imparted to the soup by one of the meat extracts which contain simply the highly flavoured extractive matter without contributing to the bulk of proteid food. A teaspoonful or two of Valentine's meat juice or Liebig's extract of meat in a half pint of vegetable soup accomplishes this result.

Milk.—Milk wholly disagrees with some gouty persons, but in those who digest it well, if it be not too rich in fat or if it is taken skimmed or diluted, it forms an excellent food. Many are, however, opposed to its use in any form, even when rendered alkaline by the admixture of alkaline waters or a few grains of bicarbonate of sodium. Yeo gives a small salt-spoonful each of potassium bicarbonate and common salt in a breakfast-cupful of hot milk and water. Others give it with warm water. The attempt has been made to place gouty patients upon an exclusive milk diet. This sometimes, but not often, aids those who are robust and young, but it is injurious to older patients.

Cheese, being a concentrated, proteid food, should not be eaten.

Eggs.—Garrod allows eggs and bacon for breakfast, and Ralfe recommends an occasional "savoury omelet." Eggs cooked with milk and custard puddings (unsweetened except with saccharin) may sometimes prove harmless, but Senator is opposed to them on account of the fat and lecithin which they contain.

Shellfish and Crustaceans.—The soft part of oysters and clams may be eaten, but crabs, lobsters, and shrimps may not be allowed, least of all in salads.

Fish.—Some writers maintain that fish should constitute the chief nitrogenous food, while others prescribe it very moderately, if at all.

Broiled or boiled fish, such as bluefish, whitefish, bass, shad, are permissible occasionally for variety, but fish having firm flesh and those which contain considerable fat are not good. Salmon, mackerel, halibut, codfish, should therefore be avoided, although Garrod allows salmon served with salt and Cayenne, but without sauce. Rich sauces must not be eaten with fish or salads. In lieu of them, a simple dressing of an infusion of aromatic herbs and pepper, or a plain bread sauce, may be employed.

Smoked and pickled fish are forbidden. Fish roe, such as shad roe and caviare, is admissible.

Meats.—Meat cannot be prohibited entirely for months at a time in chronic gout, especially for a middle-aged man, although the young may thrive better without it. It should be only eaten once a day in any case, and roasting or broiling is the best form of cooking it. Twice-cooked meats should not be eaten. Beef, lamb, and poultry may be allowed sparingly. Generally speaking, white meat is better than dark meat. Veal, pork, fat bacon and ham, game, and dried, smoked, pickled, or salted meats must all be forbidden. Only one kind of meat should be eaten at a meal.

Fats.—Fats should be used sparingly, and all food fried or cooked in grease must be forbidden. Fat meats and fat fish are to be avoided. A little well-cooked bacon may occasionally be eaten, and butter may be taken only in moderation. The objection to the use of fats and oils is that, unless the general nutrition is very poor, they interfere in gouty subjects with complete oxidation of proteid elements.

Farinaceous Food.—Farinaceous food is allowable, and in the acute stage of gout it should constitute the main diet. Bread (not fresh), rice, sago, tapioca, oatmeal, cracked wheat, may all be eaten. Pastry, cake, hot rolls, hominy, griddle cakes, preserves, and confectionery of all kinds are forbidden.

Sugar.—Sugar has not proved to be always harmful to the gouty, but eaten with a mixed diet, especially with fruits or drunk with wines, it undergoes fermentation processes which are at once distinctly harmful. It is generally admitted that carbohydrates eaten in excess with other food are more injurious than fats in excess.

Sweets, jams, and jellies of all kinds are forbidden. When sugar positively disagrees, a little glycerin or, better, saccharin or diabetin (levulose) may be substituted for it.

Vegetables.—Of vegetables, although a great variety are eaten, there are a few which are prohibited on account of the fact that they contain oxalic acid, which is closely allied to uric acid, and which produces oxaluria. These are sorrel, radishes, asparagus, rhubarb, tomatoes, and spinach. The two latter are allowed by some authorities, however. Beets are forbidden. Vegetables, such as cabbage, onions, old peas, beans, and corn, if they occasion flatulence, must be eschewed. The following may be eaten: French peas (*petit pois*) and young French beans, string beans, celery, young tender green corn, carrots (very moderately), turnips, parsnips, well-baked and mealy potatoes (except sweet potatoes) sparingly, cucumbers, broccoli, beet tops, cauliflower, celery plant, eggplant, okra, artichokes. Salads, provided they are not dressed with much oil, are allowable. Vegetables which act injuriously on account of their acids are made still more harmful by being cooked with sugar.

Fruits.—Some writers allow fruits of almost every kind, both raw and cooked, but Sir Dyce Duckworth and many authorities declare that fruits in general are harmful. Sir Andrew Clarke forbade their use *in toto*. If they produce no dyspepsia, and are ripe and fresh, a few fruits may be eaten, such as stewed pears, or apples stewed, baked, or roasted; but all those fruits which contain large quantities of sugar, such as grapes, figs, bananas, prunes, etc., must be forbidden, as also acid fruits, especially strawberries. No fruits cooked with sugar can be allowed. Melons are forbidden. Garrod expressly forbids all stone-bearing fruits, and says that subacid fruits furnish alkaline salts that split up in the blood and reappear in the urine, chiefly as potassium carbonate, and stimulate the kidneys. Melons are usually the least hurtful of fruits.

Fothergill wrote: " The potash in the strawberry renders its juice a desirable drink for the gouty and for strumous children," but there are many patients who cannot eat a half dozen strawberries without an exacerbation of inflammation in a gouty joint.

If any fruit is eaten it should not be in connection with other food or with sugar. Hence all candied fruits are proscribed. Nuts are forbidden.

Pickles, vinegar, spices, strong condiments, salted foods, mushrooms, and truffles must all be forbidden.

Eating between meals and at irregular intervals is injurious. Fresh air and exercise are often more needed than extra luncheons of bouillon, broths, wines, etc.

Ralfe gives the following *menu* for breakfast and lunch:

Breakfast.—A poached egg, bacon, or fresh fish, tea (coffee and cocoa disagree) without milk or sugar.

Light Lunch.—A clear soup, vermicelli or julienne, sandwiches, cold meat with salad.

Dinner is to be eaten not too late, and fully three hours before retiring.

Cantani's treatment of gout is based on the belief that all substances should be withheld from the diet which retard the oxidation of nitrogenous food or lessen alkalinity of the blood. He therefore prohibits all fatty, farinaceous and saccharine food, including bread and potatoes, sweet fruits, etc., but allows fish, eggs, broth, and fresh green vegetables to be eaten. Especially to be avoided are milk, cheese, all acid foods, pickles, sweets, pungent condiments, bread, rice, potatoes, all farinaceous foods, and coffee.

Sir Dyce Duckworth gives the following excellent *menu* for goutiness or chronic gout in Allbutt's System of Medicine:

" Six or eight ounces of hot or cold water may be taken half an hour before breakfast. Breakfast should consist of one or two ounces of well-toasted stale bread without butter, grilled whitefish, grilled mutton chop or beefsteak, or cold chicken, game, beef, tongue, or lean ham. One or two small cups of tea or coffee, with a little skimmed milk and without sugar may be taken. Saccharin may be used as a sweet flavouring agent, but is commonly disliked. Six ounces of bouillon or clear soup may be taken by weakly patients between breakfast and luncheon, and a gluten or almond biscuit with it. For luncheon order cold meat or a poached egg with spinach or lettuce, or other green vegetable, as watercress and mustard and cress, or a small omelet. Crust of bread or hard biscuit in small amount is allowable and a small quantity of fresh butter. A glass of good Bordeaux or Moselle wine (dry) may be taken with as much water. A cup of tea with a little skimmed milk and a rusk or gluten biscuit may be taken in the afternoon. For dinner no soup is to be taken, as a rule, but occasionally about eight ounces of a thin *consommé* may be allowed, then a little grilled or boiled fish, without starchy or fatty sauces, but flavoured sometimes with anchovy or some other sauce, oysters, or caviare, a little grilled or roasted meat, mutton, game, or fowl, with a small proportion of fat, green vegetables, no potatoes, and some stewed fruit flavoured with saccharin or made less tart by the addition of half a teaspoonful of Rochelle salt. Two glasses of claret or of a dry Moselle diluted with water are allowable. Later in the evening a cup of hot weak tea, without milk, or as much hot water should be taken."

BEVERAGES

Water.—It has been already stated that to favour the washing of waste matter from the system it is desirable to drink considerable quantities of fluid, and gouty people who are corpulent usually perspire with freedom; their urine therefore becomes concentrated, and there is a tendency to the precipitation of uric acid, urates, and oxalate of lime. It must be observed that the presence of uric acid in the urine does not always indicate an excess of that acid, and it may happen that the urine is too concentrated or otherwise altered to hold it in solution, and hence precipitation results. An excess of acid phosphate may combine with the sodium and potassium which are necessary to hold the uric acid in solution in the form of urates, and it is deposited in insoluble crystals. Copious draughts of hot water at bedtime or taken on rising in the morning are often prescribed, but it is doubtful whether the temperature of the water makes any difference in the desired result so long as plenty of fluid is taken.

Fluid should be drunk half an hour before meals, when the stomach is empty. Besides serving to cleanse the mucous membrane of the alimentary canal, the diuretic action of water will be greater when absorbed at such times.

Sir Dyce Duckworth holds somewhat different views in regard to water drinking, although he does not make clear his reasons for so doing. He says: " I feel sure that Sydenham was right in condemning water drinking for the gouty. ' Water alone is bad and dangerous, as I know from personal experience. When taken as the regular drink from youth upward it is beneficial.' " He prefers to allow a moderate quantity of wine—from four to six ounces of good sound Bordeaux, and adds: " The least excess is harmful, but a little good wine is better for most gouty persons than water drinking, especially after middle life." This, of course, was written for Englishmen in the upper classes, whose ordinary consumption of wine is greater than that of Americans in the same social position. Much depends upon one's previous habits of life, and in this country examples of gout may not rarely be found among patients who have never been in the habit of drinking alcoholic beverages daily, and such persons do best to abstain from them entirely.

Tea, Coffee, etc.—Tea and coffee are admissible among beverages for the gouty, and it will be found that they are less likely to cause dyspepsia if taken quite weak without sugar. A quarter of a grain of saccharin may be added instead. Senator forbids tea and coffee, and prescribes " acorn coffee." Infusion of cocoa nibs is less to be recommended on account of the excessive fat which it holds. Esbach states that he has found oxalic acid in it also, amounting sometimes to 0.4 per cent. Chocolate is forbidden.

Patients who are still able to lead active outdoor lives may drink more alcohol than those of sedentary habits, without aggravating their symptoms. In general the quantity consumed is as important as the quality, and it should be definitely prescribed and kept within bounds.

Alcoholic Drinks.—With regard to the use of alcoholic beverages it is their acid and saccharine ingredients rather than the alcohol itself which disagree. Strong liquors, diluted, may not be injurious, but nothing is worse than rich sweet wines and malt liquors.

It is, however, true that alcohol in all forms lessens the elimination of tissue waste, and decreases the volume of urea and uric acid excreted. According to Pfeiffer, both beer and wine may lessen this volume by one half; on the following day it is increased, and subsequently diminished again. The longer wines have been fermented, or the more complete the conversion of the sugar to alcohol, the less hurtful they become to the gouty.

While free perspiration exists in warm weather, and free diuresis as well, alcoholic drinks of all kinds are less harmful. Whatever form of alcohol is taken, it should be drunk to the exclusion of all others, for mixtures are particularly bad.

Strong beer, ales, porter, stout, all malt extracts, and sweet cider must be absolutely prohibited. Sir Henry Thompson and Germain Sée regard cider as beneficial as a solvent of uric acid, but by others it is looked upon as injurious on account of the malate of potassium which it contains, and which it is claimed favours the formation of uric acid (Yeo). Undoubtedly the alcoholic drinks which are best tolerated by the gouty are good French Cognac or old Scotch whisky, well diluted with water, Apollinaris, or soda water. Scotch whisky is by many found to agree better than any other variety. Weak brandy and soda may be substituted, or unsweetened Plymouth gin. It is the part of wisdom to abstain entirely from alcohol. Very many persons are so habituated to its use that they are unwilling to abandon it, and a compromise must be effected. It is easier for them to give up certain foods than drink. There are some wines which should be absolutely prohibited, among them all which are re-enforced by, or which contain, a large proportion of saccharine material. Strong port, sherry, champagne, Madeira, Canary, claret, and Burgundy are comprised in this list.

Port wine has even acquired the reputation of being a primary factor in producing gout, when a hereditary diathesis does not exist. It is an incompletely fermented wine to which alcohol has been added for preservation, and all wines of this class are the worst forms of alcohol for the gouty. Garrod says that exceptionally a sound sherry, Amontillado or Manzanilla, may be prescribed. There are patients, too, who maintain that they do better with port as a daily beverage than with any other form of wine, but their example would be a very unsafe one to follow, and their experience is due to constitutional idiosyncrasy.

Duckworth says: "Rhenish wines are acid and harmful; those of the Moselle district are, however, less acid, and rather better borne. Australian, Californian, Hungarian, Greek, and other Mediterranean wines are too strong, and after a time generally disagree."

An absolutely dry champagne may sometimes be permitted, or very dilute and weak pure claret. The stronger clarets containing more tannin, and all wines with much free acid, are injurious. Among the light wines, several may be permitted in moderation, but they should be diluted with an alkaline water in order to completely neutralise any acidity.

Such wines should be either long bottled or drunk from the cask, for newly bottled wines are more injurious.

The best Bordeaux and lightest Hungarian wines, light hock and a still Moselle, such as Zeltinger, may be drunk, for these wines are quite thoroughly fermented, and therefore contain no sugar or free acid, though they have salts, such as cream of tartar. These wines should only be allowed in extreme moderation, not over half a pint in a day.

Yeo says: "The more distinguished the diuretic effect of the wine, the better, as a rule, will it agree with the gouty."

Ralfe's practice is to allow no wine of any sort with dinner, but afterwards two claret-glassfuls of some light wine are permitted; and he says that a tablespoonful of brandy in half a tumblerful of water before meals increases the secretion of gastric juice. If the patient is weak, or suffers from insomnia, he gives brandy or whisky at bedtime in some effervescing water.

He states that in his experience patients who have been long habituated to the daily use of port, sherry, or ale, often become worse when a sudden change is made to claret or hock. In such cases he advises changing gradually by substituting at first a drier port or sherry.

Usually such red wines as St. Julien and St. Estephe are preferable to the higher class, such as Lafitte or La Rose.

Different persons show peculiar idiosyncrasies in regard to the gout-producing influence of certain wines. Some will always have gouty inflammation set up within a few hours in a particular joint by one form of liquor or wine and not by others.

Saline Waters.—Alkaline and saline mineral waters have a well-deserved reputation for benefiting gout. Many persons, especially obese gouty subjects, are helped by taking one or two "courses" of treatment a year for two or three successive years at Carlsbad, in Bohemia, or elsewhere. Carlsbad water may be drunk at home, four or five ounces being taken on rising in the morning, or an equivalent of the evaporated salts—chiefly sodium sulphate.

The water of the Kreuzbrunnen at Marienbad has essentially the same composition with that of Carlsbad, and contains even more sodium sulphate. Elderly persons may be injured by a too vigorous use of these salines, and they should take only milder alkaline waters containing less sodium.

The German Fachingen water has proved very serviceable. It contains 3.5 per cent of bicarbonate of sodium and 6 per cent of bicarbonate of lime.

Vichy is good for strong patients, but not for the feeble or anæmic. It also contains considerable sodium bicarbonate, and the Vals water has more sodium carbonate than many alkaline waters. These waters favour the elimination of uric acid as a salt rather than in the free state.

Saratoga alkaline water is among the best in this country for gouty patients. It contains carbon dioxide, sodium and alkaline carbonates, and chlorides. The waters of the St. Clair Spring in Michigan, and St. Catherine Spring in Ontario, are good alkaline salines for gout. Many lithia waters are also recommended, but they contain little lithium. Apollinaris and Johannis water are good. All beverages drunk by the gouty should be well diluted, and mildly alkaline mineral waters are especially valuable for this purpose.

Aids to Dietetic Treatment.—The individual peculiarities of digestion should be carefully studied in each case by the physician, and the patient must be very thoroughly examined in regard to the minutiæ of all his hygienic and dietetic habits. Meals should be taken at stipulated hours—the breakfast on rising, dinner not later than three o'clock, when practicable, and late suppers should be avoided. Between the acute attacks it is absolutely necessary to maintain digestion in a normal condition. The bowels must be kept open, and the condition of the skin should be actively maintained by cold bathing and friction. Exercise should be taken in the open air. The urine should be frequently examined, with especial reference to the hour of the day at which it is passed and the relation which its composition bears to the food eaten.

Diabetes Mellitus

Nature of the Disease.—Diabetes mellitus is a disease characterised by the passage of a large quantity of urine containing grape sugar or glucose and usually of high specific gravity—1.035 or more—excessive thirst, and sometimes exaggerated or perverted appetite; progressive emaciation; muscular weakness and langour. The disease runs a chronic course, and the majority of cases terminate fatally in from two to four years. Death may result from inanition or from " diabetic coma " or other causes. The knowledge of the disease has been very largely obtained from experimentation upon the lower animals, in which diabetes can be artificially produced. The treatment is almost entirely dietetic and hygienic, for as yet no medicinal remedy has been found which is curative, and very few have been discovered which are even palliative in any number of cases. Diabetes is therefore essentially a dietetic disease, for although not usually caused by errors in diet it may be exceptionally so produced, and most cases are more or less benefited by dietetic treatment, while some may undoubtedly be cured by it.

Diabetes was described more than a century ago; and Rollo inaugurated the dietetic treatment by withholding vegetable food. In 1838 Gmelin and Tiedemann established the existence of the relation between the digestion of carbohydrates and the formation of sugar. In 1848 the eminent physiologist Claude Bernard began elaborate researches which first threw definite light upon the relations of the liver to the consumption of sugar and the formation of glycogen, and since that day a number of physiologists and clinicians in many countries have contributed extensively to the knowledge of the disease. Notwithstanding this fact, however, the true cause of this affection is still obscure, and aside from dietetic treatment but little advance can be claimed in regard to the controlling influence of medicine. The method of production and elimination of the sugar and the influence of the disease upon general nutrition is understood, but its real exciting cause and the fundamental reason for the interesting departure from the normal metabolism of starchy foods which is its basis is still unknown.

Frequency.—Diabetes is not a very rare disease, and a few cases occur from time to time in the experience of almost every general practitioner. It is reputed to be of more common occurrence to-day than it was fifty years ago, but this fact is possibly due to the much more careful and frequent urinary analyses which are made as a matter of routine by all physicians, that often reveal a latent diabetic condition which might otherwise have been overlooked. In regard to those cases which are of neurotic origin, the general increase in the proportion of diseases of the nervous system which has been observed in the United States must be taken into consideration. Diabetes may occur alone or in association with a variety of diseases, particularly those of the liver, pancreas, lungs, and nervous system.

Causation.—The influence of heredity can be traced as a factor in about one third of all cases. The disease may occur in any climate and in any age with either sex, but it is commonest in males in the proportion of three to one. In females it occurs oftenest between twenty and forty years; in males, between thirty and forty-five years. It is somewhat more common among the wealthy than the poor because of sedentary habits combined with overindulgence in eating. The obese, particularly those who have much omental fat, are more liable to diabetes than are thin persons who are more active.

Cantani has observed the unusual prevalence of diabetes in southern Italy, where carbohydrates are so extensively used, and he believes that the liver is exhausted by metabolising such food, while at the same time it is weakened by failure to receive proteids. This view will hardly withstand the criticism that in many other countries the natives have lived for generations upon carbohydrates without developing diabetes.

Among the various determining causes of the disease have been reported blows and shocks affecting particularly the nervous system, injuries to the back of the head and blows over the liver, as well as general concussion, such as that produced in railway accidents; exposure to cold, wet, and fatigue; convalescence from fevers; emotional strain, worry, mental fatigue, and anxiety. Tumours and hæmorrhage at the base of the brain and circumscribed lesions of the floor of the fourth ventricle have been known to occasion the disease. A number of cases have been associated with disease of the pancreas, as stated below (p. 672).

Overindulgence in Food.—There is some doubt whether any one article of diet can determine an attack of diabetes, although inordinate eating of candy, preserves, raisins, fruit, confections, etc., may occasionally cause temporary glycosuria.

Fowler wrote some time ago: "I have been in the habit of supplying my classes with saccharine urine simply by taking about four ounces of dried dates or about a tablespoonful of pulverised glucose upon a fasting stomach."

The order of harmfulness of carbohydrates in diabetes may be stated as follows, commencing with the most injurious, ending with the least: 1, glucose; 2, saccharose; 3, starch; 4, lactose; 5, inulin; 6, lævulose.

Rich food of either an animal or vegetable nature keeps the liver constantly overtaxed, and unrestrained indulgence in sweets, new wines, and sweet fruits is said to excite diabetes. Sugar may be present in the urine in the proportion of from five to ten parts per thousand, but so long as its occurrence in this manner is of brief duration, and so long as it can be immediately traced to indiscretion in the abuse of saccharine foods, it is of little practical significance. It has been claimed that continued eating of predigested starchy foods containing too much glucose may result in diabetes.

In transient glycosuria the ingestion of excess of cane sugar does not, according to Worm-Müller and others, produce glucose in the urine, but saccharose.

In diabetes lactose reappears in the urine as glucose, but under normal conditions if eaten in excess it causes a transient lactosuria.

Achard and Weil proved experimentally that lactose injected hypodermically in solution is not assimilated in diabetes, and a plain milk diet almost always increases the glycosuria, in spite of which the patient may gain in weight, owing to improved digestion.

RELATION TO GOUT AND OTHER DISEASES

The frequent association of gout and diabetes has long been observed, and in "gouty glycosuria" (Brunton) comparison is made between the chronic hyperæmia of the diabetic liver and the acute hyperæmia of the gouty joints.

Occasionally persons past fifty years of age who are gouty may present the symptom of glycosuria without other accompanying manifestations of diabetes, such as emaciation and debility. This symptom may persist for a number of years and end in recovery, or the patient may die of some intercurrent disease in no way connected with diabetes.

In a long series of cases of diabetes reported by Ord, gout occurred in over one third, and in some there was arthritis deformans. In these cases not only does the urine contain sugar in excess, but the urea and uric acid are largely increased. It is interesting to remark in this connection that similar dietetic treatment benefits gouty, obese, and diabetic patients, for they live best upon a nitrogenous diet with alkalies. The occurrence of an excess of uric acid in the urine (uricæmia) is often a forerunner of diabetes (Coignard, Comillon). Diabetes is also often associated with neuralgia, phthisis, hepatic engorgement, and congestion. There is no one form of disease of the liver in which diabetes is uniformly or frequently associated. In about one third of the cases a history is obtainable of mental strain or overwork, and in about one third there is a history of alcoholism.

PHYSIOLOGICAL EXPERIMENTS

In order to understand fully the dietetic treatment of diabetes, it will be necessary to discuss somewhat at length certain physiological experiments and theoretical causes in relation to ætiology. These topics will be found to throw some light upon the relations of diet to the symptoms. The experiments of Claude Bernard above alluded to were made to determine where the sugar which has been ingested by an animal is destroyed. He was the first to accurately determine the amount of sugar normally present in the blood. According to his estimate, when this quantity does not exceed three parts in one thousand, the limits of health are not surpassed, and sugar does not appear in the urine, as it promptly does when the proportion is increased.

He fed animals heavily upon sugar, killed them, and examined the blood from various blood vessels. In this manner he ascertained that a good deal of sugar is destroyed by the passage of the blood through the lungs, but he also found it to be carried by the hepatic vein, while the portal vein contained a trace only. He demonstrated that the liver, excised from the body and washed free of all blood by a stream of water injected through the portal vein, would, after standing for a few minutes, still yield sugar. He thus proved that the liver is capable of forming sugar by some process which is continued independently of its blood supply. He next searched for the source of the sugar formed by the liver, and discovered the substance, to which he gave the name of "glycogen." Glycogen, or animal starch, is a normal ingredient of the liver cells, in which it is stored in the form of amorphous granules around their nuclei. When treated by diastatic ferments or boiled with dilute mineral acids, it is converted into a grape sugar or glucose. Hensen, of Kiel, discovered glycogen independently of Bernard and at nearly the same time. This substance, which is isomeric with starch, occurs in the skeletal muscles as well.

Bernard also found that the quantity of sugar which he could collect from the hepatic vein at any time did not increase when the animal was fed upon a large amount of sugar; this circumstance led him to argue that the liver arrests the sugar ingested on its way to the general circulation, and thus acts as a regulator of the amount of sugar contained in the blood.

Man takes his food at comparatively infrequent intervals, and it is important that the energy derived from the ingestion of a large meal of carbohydrates should not be immediately expended, but should be stored in some form which will enable it to be gradually used in the intervals between digestion of meals, and in any emergency when food is withheld for a longer time than usual. The liver affords this means of storing a considerable amount of energy by converting the sugar—brought to it in the portal system which has been absorbed from the intestinal wall—into glycogen, a temporary product which is stored and held back in the liver cells, but which can be readily paid out in small quantities from time to time into the hepatic blood as it leaves the liver. In this manner an excess of sugar ingested or an excess of sugar derived from the digestion of starchy food is normally kept from immediately entering the circulation, and its use is economised by holding it back until it is required for force production. The ultimate destination of the sugar reformed from the glycogen of the liver is that it is consumed either in the capillaries or intercellular spaces or in the muscular and other tissues of the body by obscure ultimate processes of nutrition, which result in its splitting up into carbonic acid and water with the evolution of heat. In support of this view Claude Bernard proved that there was less sugar in systemic venous blood than in arterial blood.

Bernard extracted with glycerin a diastatic ferment from the liver and blood, which he supposed had the function of converting the glycogen into glucose; this action he called the "glycogenic" function of the liver. The sugar absorbed from the intestines and arrested in the liver he supposed to be there converted into glycogen by the glycogenic ferment. Glycogen is also formed from peptones. Foster says that glycogen may be accumulated in the liver upon a mixed diet, and that it may be in part formed by dehydration of sugar derived from metabolism of proteid food. It is a fact that when diabetes is once established, the elimination of sugar in the urine will sometimes continue in both man and animals kept upon an exclusive nitrogenous diet.

The foregoing experiments, verified by many physiologists, have given rise to three principal theories regarding the origin of glycosuria, which are as follows:

1. It is due to impaired glycogenic function, and the sugar taken as a food is at once passed into the general circulation unaltered.

2. It is due to increased glycogenic function; there is an overproduction of sugar from the glycogen, the latter being derived both

from sugar and peptones, and the newly formed sugar is swept into the blood.

3. The conditions of absorption of carbohydrates and of the functional activity of the liver may remain normal, and yet the final combustion of sugar by the tissues or its assimilation by them may be imperfect and lead to its accumulation in the blood and subsequent appearance in the urine.

The three conditions mentioned above imply either diminished activity of the liver, increased activity of the liver, or a normal liver, the fault being in other tissues of the body.

Either one will give rise to the presence of an abnormal amount of sugar in the blood (glycohæmia), which is excreted by the kidneys (glycosuria). To aid in substantiating these theories, it should be proved: (*a*) That there is a definite relation between the quantity of sugar that leaves the liver and the quantity of glycogen remaining in the liver. (*b*) That the "glycogenic ferment" resembles diastase. (*c*) That the glucose passing through the hepatic vein is identical with the sugar which can be formed from starch by fermentation. (*d*) That there is a definite relation between the quantity of hydrocarbons (and peptones) entering the liver and the quantities of glycogen and glucose subsequently obtained. The experiments of Bernard have been in the main confirmed by other physiologists, but there is exception taken to some of them, and his theories are not universally accepted.

It is probable that in the majority of cases the primary difficulty is to be found in altered metabolism in the liver.

Pavy strongly favoured the view that diabetes is due to a faulty action of the liver in not preventing the sugar which is brought to it by the portal vein from reaching the general circulation.

The essential difference between the theories of Bernard and Pavy in regard to the glycogenic function of the liver concerns merely the final destination of the glycogen. Both agree as to the primary conversion of sugar from the portal vein into glycogen, but while Bernard believed that the glycogen is reformed into glucose and consumed in the tissues, Pavy held that the normal use of glycogen is in the formation of fat.

Pavy believed that a small amount of sugar may be absorbed by the lacteals during the digestion of sugars or starches passing through the thoracic duct directly into the venous circulation without entering the liver. This he considered a normal condition. It, however, requires the use of far more delicate tests than those commonly employed in clinical work to detect the minute traces of sugar in the urine which Pavy claimed are normally present.

Pavy has propounded another ingenious theory to account in part for diabetes, even though other theories be not wholly abandoned. It is that the intestinal epithelium of the villi ordinarily exerts a sort of glandular control over the sugar absorbed from the bowel, and converts it into glycogen and fat as it reaches the blood. Failure to perform this function results in the production of glycosuria. This failure, Pavy holds, is due primarily to faulty nerve action affecting the calibre of the arterioles and capillaries with hyperoxidation, which favours the too rapid conversion of carbohydrates into glucose, causing glycosuria. This theory has been somewhat severely criticised by Paten, and is opposed to Seegen's views, but it does not exclude belief in the storage of carbohydrates as glycogen in the liver—it is merely accessory to it.

If the liver of an animal be rapidly excised and cut into small fragments to prevent further fermentation, it will be found on analysis to contain sugar in a small proportion which varies, according to different observers, between 0.2 and 0.6 of 1 per cent (Bernard and Seegen); hence but little sugar is to be found in the liver during life, or immediately after death, and it has been suggested by Flint that whatever sugar may be found is immediately washed out by the hepatic blood stream. If the excised liver be not boiled, but be allowed to remain at the body temperature for some minutes, or if the portal circulation be suddenly cut off while the liver remains in the body, it is found that the formation of sugar continues for at least an hour, owing to a process of fermentation which produces it from glycogen. From these and other experiments it is believed that the glycogen stored in the liver is constantly but gradually converted into sugar, which is carried off in the general circulation in such small quantities that it is often difficult to detect its presence in the blood.

Glycogen is found in the muscles, and in some other tissues of the body, and it has been suggested that sugar might be formed in the blood vessels, quite independently of the liver, by a ferment carried in the blood, but the hepatogenous origin of the glucose is the view generally accepted at present.

THE PANCREAS AND DIABETES

Extirpation of the pancreas in man has been shown by William T. Bull to sometimes produce diabetes, and experimental extirpation of this gland in dogs has the same result. In many, but not all fatal cases of diabetes, more or less pancreatic disease, usually of the nature of chronic interstitial inflammation, has been observed. The gland is known to produce an internal secretion—i. e., a secretion passed into the circulation, which is a glycolytic ferment—and when the gland is diseased this ferment is reduced in quantity, sugar fails of conversion to glycogen, and diabetes results. Opie believes that the islands of Langerhans are the structural portions of the pancraes concerned with the production of the ferment, and degenerative changes have been observed in diabetes in these islands of polygonal cells which are supplied with a rich capillary network.

THE NERVOUS SYSTEM AND DIABETES

It is a curious fact that the irritation or puncture of a very circumscribed area in the floor of the fourth ventricle in the medulla is followed by the appearance of sugar in the urine. This spot is called the "diabetic centre," and it is in close relation with the sympathetic and vasomotor nerves that control the capacity of the hepatic blood vessels. In animals in which fatty degeneration of the liver cells has been artificially produced by metallic poisoning, puncture of the diabetic centre produces glycosuria. Glycosuria is also observed in men after the inhalation of chloroform and in animals after the inhalation of irritant vapours and after stimulation of the pneumogastric nerve. Schiff produced glycosuria experimentally by the removal of the spleen from animals, but it does not follow this operation in man. He also tied off successive portions of the liver from connection with the circulation, and found the production of sugar proportionately decreased. The frog is capable of surviving extirpation of the liver for three weeks, and at the end of this time no sugar is found in the blood (Schiff). If the vagus nerve is divided in the neck, or if the spinal cord be divided above the origin of the great sympathetic nerve, diabetes may result. Bernard suggested that glycosuria might be cured if it were possible to galvanise the sympathetic nerves. The foregoing experiments demonstrate that glycosuria may be caused by a variety of nerve lesions and irritations. It is also frequently associated with modifications in the activity of the hepatic circulation.

THE CIRCULATION AND DIABETES

The occurrence of diabetes in connection with acute inflammations of the liver and passive hepatic congestion secondary to advanced cardiac disease favours the hypothesis that glycosuria may be developed by an increase in the amount of blood flowing through the liver, which is thereby stimulated to an active conversion of its glycogen into sugar, or else the blood passes so rapidly through the liver that the sugar absorbed from the food by the branches of the portal vein does not have time to be converted into glycogen, but goes through the liver into the general circulation unaltered. Thus, whether the glycogenic function be increased or diminished in glycosuria, either condition would demand altered activity of the portal circulation.

VARIOUS THEORIES OF DIABETES

Huppert, Pettenkofer, and Voit advocate the following theory: Sugar, like urea, is a normal product of the decomposition of albuminous bodies. In health the sugar is oxidised; in diabetes less oxygen than normal is absorbed, owing to the destruction of the red blood-corpuscles occasioned by malnutrition; therefore sugar accumulates in the blood. Sugar is formed from the albuminous constituents of the body which undergo rapid chemical change. This fact they regard as proved by the increase in the quantity of urea eliminated. Von Mehring found sugar in the urine of a diabetic patient after a twenty-six hours' fast.

Porter believes that the renal epithelial cells, which he claims are frequently enlarged in diabetic patients, take an active part in the manufacture of glucose because the blood of diabetic patients never contains enough sugar at any one time to account for all which is found in the urine. The epithelial cells are supposed to manufacture the sugar out of carbon dioxide and water. This theory lacks confirmation, however, and it should be observed that a very small amount of sugar, which furnishes a mere trace in the blood at any one time, but which is constantly eliminated from the large quantity of blood continually passing through the kidneys, may amount in the course of twenty-four hours to a number of grammes. In view of the established facts in regard to the glycogenic function of the liver, it seems unnecessary to believe that the renal epithelium exercises any special metabolic power in diabetes; moreover, the kidneys may appear quite normal in severe cases of diabetes.

Brunton reports several cases due to the presence of a tapeworm. He thinks that the increased appetite caused by the presence of the worm may have been instrumental in causing the glycosuria from overeating, but it is possible that the peripheral irritation of sympathetic nerve fibres may have been conveyed to the diabetic centre in the medulla, and thence reflected to the vasomotor system of the liver.

Some recent experiments and clinical observations justify the belief that the skeletal muscles play a more important rôle in the production of diabetes than has heretofore been supposed.

During their activity they normally consume glycogen in considerable quantity. If they fail to perform this function properly, it accumulates in the system.

Külz has shown that muscular activity favours the consumption of sugar in the organism of the diabetic, and that much less sugar is eliminated while such patients are taking vigorous exercise.

It must be admitted that there are many hepatic diseases and lesions in which a large part of the secreting surface of the organ is destroyed, and in which glycosuria may never be present, but in these conditions it is possible that while a part of the liver is totally destroyed there may be some remaining cells which are still endowed with normal functional activity, whereas in the disease under discussion it is probable that none of the parenchyma of the liver maintains its normal control over metabolic processes, and hence, whatever sugar is brought to the organ by the portal vein passes into the general circulation unaltered. In the graver forms of diabetes, in addition to the functional disturbances of the liver, there is believed to be present also a condition of malnutrition in which sugar either fails to be consumed or, as suggested by Yeo, " we may suppose that in these cases a morbid ferment is formed in the system, possibly in connection with some radical fault of stomach or intestinal digestion, and that this determines the rapid reconversion of glycogen into sugar."

Symptoms.—The most important symptoms of a typical case of diabetes which are to be combated by diet are (*a*) extreme thirst, (*b*) the large quantity of urine voided and rapid emaciation and loss of strength.

(*a*) *Thirst. The Mouth.*—Thirst becomes excessive, and is not quenched by drinking, although patients will drink almost any available fluid—even their own urine—in their endeavour to relieve it.

The absorption by the blood vessels of fluid from the tissues is held to be the main cause of this thirst (Vogel), which is most intense one or two hours after meals, when sugar formation is most active, and ten or fifteen quarts of water may be consumed daily if patients are not restrained from drinking freely.

The saliva is thick, frothy, and acid, and often contains sugar.

The mouth becomes sticky or dry, even to the extent of interfering with articulation, and there is often a sweetish taste, which may be accounted for by the sugar present in the saliva and the blood of the capillaries which circulate among the taste bulbs.

The tongue is at first moist and sticky and coated with prominent papillæ; later it may become dry, dark red, and fissured. The appetite is at first excessive; it amounts to bulimia in some cases; at other times it is capricious or intermittent, and subsequently it fails completely when the digestion becomes impaired through the symptoms of gastric and intestinal catarrh.

(*b*) *The Urine.*—The average quantity of urine voided is between two to three times the normal amount—that is, from 3,000 to 4,500 cubic centimetres. If water is being drained from the tissues the quantity of urine voided may exceed the amount of fluid ingested, but obviously this condition cannot last very long. Exceptionally as much as 5,000 to 6,000 cubic centimetres or more may be voided within twenty-four hours.

Frequent calls to micturate at night greatly interfere with the patient's rest. As a rule, the more sugar present the paler is the urine, and it grows turbid soon after standing, from the development of yeast fungus (*Torula cerevisia*), derived from the atmosphere. The sediment, if present, is usually light, and the odour may resemble whey or hay. The urine is sweetish; the reaction is usually acid, but may be neutral or alkaline, and the acidity is usually proportionate to the quantity of sugar; it is increased by development of carbon dioxide and acetic acid, products of fermentation. After standing it does not become alkaline from ammoniacal fermentation, but undergoes saccharine fermentation. In a majority of cases the specific gravity is considerably higher than the normal, rising to between 1.035 and 1.050 or more. Bouchardat reports a case with a specific gravity of 1.074, and Pavy one with a specific gravity as low as 1.010, which is certainly exceptional. It should be remembered that the quantity of urea present as well as sugar affects the specific gravity.

The urea is proportionate to the amount of proteid food elements ingested, and as patients are usually fed upon nitrogenous food, urea is naturally increased beyond the normal average. Sometimes two or three times the normal quantity is excreted. Urea, however, always exists in small proportion in comparison with the whole quantity of urine voided. There are some instances in which there is apparently an increased waste of the albuminous tissues of the body, resulting in the production of more urea.

The quantity of sugar present varies greatly; an average may be stated as from thirty-two to thirty-five parts per thousand of urine, but the total may even exceed five hundred grammes per diem.

The effect of a heavy meal of starchy food in increasing the sugar is promptly shown by the urine, usually within two hours, and it lasts during several hours. In some cases very little sugar is eliminated, and yet the symptoms are very severe; in others a great deal is voided and the symptoms are not at all severe, but as a rule applying to a majority of cases, the severity increases or diminishes with the quantity of sugar passed. After grape sugar has disappeared during dietetic treatment, inosite is sometimes found in the urine, as in simple polyuria. Other substances found occasionally in connection with sugar are acetone, alcohol, alkapton, diacetic acid, aceton, β-oxybutyric acid, peptones, and fat (lipuria). More or less albuminuria is observed.

While dietetic treatment is in progress the urine should be periodically tested with careful relation to the ingested food, and specimens should be examined which are passed from two to four hours after eating various articles of diet in order to observe as exactly as possible the influence of such diet upon the elimination of glucose.

The Skin and Bowels.—Because so much water is eliminated in the urine there is scarcely any perspiration, and the skin becomes dry and wrinkled, the face looks drawn and pinched, and the eyes are hollow. In advanced cases a sweetish, sickening odour is exhaled from the skin and in the expired air. From lack of intestinal secretion the bowels are usually constipated, although diarrhœa may alternate with constipation in the later stages of the disease.

Hunger.—At first the food eaten does not supply the needs of the body and there is constant craving for more.

To obtain the requisite carbon from fats a labourer, taking his ordinary allowance of proteids, would in addition have to eat about three hundred and fifty grammes of fats, which would be manifestly impossible. The diabetic is practically in this position when all carbohydrates are denied him, and a much larger bulk of food is necessary for him than if he could eat food containing more carbon but less protein. This accounts in a measure for the extreme hunger which is felt by many diabetics when suddenly deprived of their accustomed starchy foods.

Later Symptoms.—In the later stages of the disease dyspeptic symptoms are prominent with flatus, sour eructations, and a disgust for all kinds of food. The teeth decay, the gums become tender, and mastication is difficult.

The alimentary canal is frequently the seat of chronic gastric catarrh, with thickening of the mucous lining of the stomach and small intestine. Diarrhœa may be caused by the excretion of sugar from the intestinal mucous surface. Occasionally nausea and vomiting are present, and the ejecta may contain acetone. The secretion of bile is lessened. Emaciation sooner or later becomes extreme and progresses, although the appetite remains normal or may be still increased.

The loss of weight, which is so pronounced a feature of most advanced cases of diabetes, is attributed in part to the non-burning of carbohydrates, and in part to the loss of their albumin-protecting action (Graham Lusk). In health, oxygen is used to consume sugars, which in diabetes, when sugars are withheld, burns the fat of the body instead, so that the quantity of oxygen inhaled and carbon dioxide exhaled may remain nearly identical in the two conditions, while emaciation progresses. In addition to lack of nitrogen of the tissues the wasting is also in part to be accounted for by the drain of fluid from the system which takes place when once over-action of the kidneys is established. Phthisis is often present and increases the rapidity of the emaciation. Exceptionally, early in the disease the patient, owing to the greater appetite and the large amount of fluid drunk, may increase somewhat in weight. Muscular weakness and debility rapidly supervene to a greater extent than is to be accounted for by the usual loss of flesh.

In general, it may be said in the milder forms of diabetes that the sugar in the urine is derived from carbohydrate foods, while in the more serious forms it is also derived from the nitrogenous metabolism. The sugar which is eaten as food or which is formed by starch in the alimentary canal, after absorption is mainly used under normal conditions in the production of force, but in diabetes it is eliminated unaltered from the body, and there is consequent lack of heat production and muscular power.

Since a large amount of heat-producing material passes from the body without complete oxidation, the body temperature is not infrequently subnormal, and it may so remain throughout the disease unless there be some inflammatory complication. The axillary temperature may be 97° or even 95° F. The occurrence of any acute joint or visceral inflammation or of any acute fever causes a reduction in the quantity of sugar eliminated while the pyrexia lasts. The explanation of this fact is by some observers thought to be due to increased combustion of sugar in the body during the pyrexial stage, but Bernard attributed it to an interference with the glycogenic function of the liver. The pulse becomes rapid and feeble and the temperature is subnormal.

When great feebleness compels the patient to become bedridden, bedsores and excoriations from frequent passage of acid and saccharine urine add to his discomfort.

Diabetic coma is the precursor of sudden death in a certain number of cases, and it is also to be regarded as the worst possible symptom which may arise. Many theories have been offered in explanation of this symptom, and the one which is at present in vogue is that it is produced by an acid intoxication produced by accumulation in the system of β-oxybutyric acid, constituting an acidosis (Naunyn). This acid is found in the tissues and blood, and also, in combination with bases, in the urine. The acid is derived from tissue albumins, and possibly fats, and over 200 grammes may be present in the tissues in a fatal case. Gangrene, asthenia, or intercurrent diseases cause a number of deaths.

There are other symptoms affecting the nervous system, the eyes, etc., and there are many complications which may arise in the course of the disease, but a consideration of them would lead too far from the object of the present discussion, which is to deal with those symptoms which bear a more immediate relation to the metabolism of the food.

Some of the complicating diseases with which diabetes may be associated make it impossible to adhere to a rigid regimen without producing more harm than good. Such, for example, are acute gout and chronic nephritis, in both of which a meat diet is injurious, and if carbohydrates are also cut off the patient has little or nothing left to eat. In these cases the diet must be determined by whichever constitutes the graver complication (see p. 505).

Course.—The course of diabetes is so protracted that there is abundant opportunity and usually necessity for trying dietetic experiments, for it will be found impossible to establish rules for dietetic treatment to which exceptions may not arise from time to time in the course of any individual case. The disease is sometimes well established long before its symptoms become sufficiently urgent to attract the attention of the patient. Persons who believe themselves to be in perfect health and who apply for life-insurance examination may be informed for the first time of the presence of glycosuria, and many cases are now discovered through incidental examination of the urine in connection with some other disease, which would have been overlooked a few decades ago, when clinical urinalysis was very imperfect.

If treatment is begun before the symptoms are well advanced the lives of many patients may be prolonged—in some cases for more than ten or twelve years—whereas, of seven hundred cases reported by Prout which occurred over thirty years ago, only two patients lived beyond ten years. Frerichs reported one case which extended through twenty years and several more in which the disease lasted between ten and eighteen years. Occasionally diabetes is extremely acute, and may prove fatal within three weeks, but in such instances it is probable that glycosuria has been present for a long time without discovery.

Prognosis.—Between 50 and 60 per cent of all cases are fatal in less than three years; undoubtedly a few which are recognised sufficiently early may be completely cured, but glycosuria, like albuminuria, indicates a weakness of the system in a special direction, and, the disease having once occurred, the patient should be under reasonable supervision for many years. It has been aptly said that "the only chance that a diabetic has of being cured is to believe that he never is cured"—that is, to be constantly on the alert to avoid all indiscretions in hygienic and dietary matters. There seems to be a relation between the general bodily nutrition and the chance of recovery or improvement. Usually stout, middle-aged men yield best to treatment; thin persons withstand the disease less well, and rapid emaciation is always more to be dreaded than the presence of sugar. The prognosis is more favourable in those cases which are readily amenable to the influence of a strict dietetic regimen. The prognosis is more favourable if the sugar does not speedily return if the dietetic treatment be interrupted, and also if the amount of urea excreted is large and the quantity of uric acid small. Cases which occur in connection with gout are relatively light. In emaciated cases the malnutrition is so great that the patients easily acquire other diseases, especially pulmonary tuberculosis, and many die from complications rather than from the immediate effect of the disease itself.

Diagnosis.—To determine the presence of permanent glycosuria, the patient should be placed for two days upon a standard diet containing no other carbohydrate food than 100 grammes of wheat bread (von Noorden). The urine passed during twenty-four hours is then collected and analysed by polarisation and titration or fermentation. If sugar be present, the carbohydrate allowance should be varied for a day or two, in order to determine its effect upon the quantity of sugar eliminated, and serve as a guide for dietetic treatment. Temporary glycosuria may be caused by a variety of conditions, such as excessive indulgence in sweets, poisoning from amyl nitrite, mercury, chloroform, alcohol, etc. It has been observed during pregnancy and after anthrax, diphtheria, scarlatina, typhoid fever, etc. In the transient form of glycosuria the urine contains much less sugar than in diabetes mellitus, and all the severe symptoms of excessive thirst, emaciation, and extensive tissue waste, leading to local disease and usually death, are wanting.

In polyuria or diabetes insipidus there is no sugar in the urine, and the specific gravity is very low—1.002 to 1.005.

Primary peptonuric diabetes is described by Quinquand as a disease presenting the clinical features of mellituria—thirst, marked cachexia, polyuria, etc.—but instead of sugar, the urine contains peptones; it polarises to the left, and is of low specific gravity.

Temporary lactosuria sometimes occurs as an accompaniment of the puerperal state, and is not of special dietetic significance.

Treatment.—The treatment of diabetes to-day is much more successful than it was thirty or forty years ago, when every case was regarded as necessarily fatal. The treatment should be (1) prophylactic, (2) dietetic, (3) hygienic, and (4) medicinal.

Prophylaxis.—Until more is known of the ætiology of diabetes definite prophylactic rules cannot be established; but in general, where there is distinct heredity to be feared, or when the lithic-acid diathesis exists, all excitement of the nervous system, mental or physical, as well as indulgence in alcohol and sweets, should be strenuously avoided.

Dietetic Treatment.—General Observations.—When prescribing any dietetic regimen for diabetic patients, the general condition of bodily nutrition must be carefully considered. Obese, naturally robust, and sometimes gouty patients will be benefited by very strictly limited and carefully regulated diet, but emaciated and feeble patients cannot always endure the severity of a strict diabetic diet without too great loss of vitality, and it becomes necessary to maintain their strength even at the cost of sometimes increasing the amount of sugar in the urine. Obese persons make their fat largely out of carbohydrates, and hence a nitrogenous diet is particularly well suited to their condition, whereas emaciated, weak patients gain no flesh upon an exclusive nitrogenous diet, and it may barely support life for them.

Some persons with diabetes have been said to excrete more sugar on a diet of animal food than on the hydrocarbons, but it will generally be found that such patients have eaten some farinaceous food, bread, etc., with their meat, and the combination seems particularly favourable to the maintenance of a secretion of saccharine urine once established. Such patients may be temporarily given a diet in which fat in great part replaces meat, the fat being eaten with those vegetables which contain a minimum of starch and sugar (see p. 135).

Regulation of the diet should be faithfully tried before any medication is resorted to, for the latter frequently becomes superfluous, but a *placebo* may be given if necessary. During the siege of Paris in 1871 it was observed that a number of diabetics improved considerably owing to the enforced restriction in their diet (Bouchardat).

Cantani advises a preliminary fast of twenty-four hours before commencing dietetic treatment, but the value of this expedient is questionable.

Phenomenal improvement follows in many cases upon a diet which excludes starches and sugars almost completely, but this is a difficult regimen to enforce, for the craving for carbohydrates, especially for bread, becomes so fierce that patients whose veracity is otherwise unimpeachable will resort to lying or any form of deception to obtain this coveted food.

It is a matter of common experience that the most difficult of all food for a man to be deprived of, when once accustomed to it, is bread. This has always been found to be the case in arctic expeditions in which men have been reduced to a starvation dietary, and it is usually observed in any form of largely restricted diet, although patients who are living upon an exclusive diet of milk appear to have somewhat less craving for it than diabetics, who are allowed a greater variety of food, especially meat. This is due in part to lifelong association of certain kinds of food with one another at meals and the habit of eating this one article of food with more constancy than any other, but it is also undoubtedly referable to a positive craving of the system, which is particularly marked in diabetes, for a kind of food which the tissues need but cannot assimilate. For this reason it is generally advisable to allow patients from two to four or even six ounces of bread a day in divided portions; otherwise the craving for it does them positive harm, and a loathing for all food results, or they break all restraints and injure themselves more by overeating.

It should be remembered that diabetic patients are very susceptible to the influence of the nervous system, and that worry and anxiety about themselves, with too close an observation of their own diet, will often react unfavourably. Moreover, it is undoubtedly much harder for these patients to restrain themselves from eating varieties of food which are not wholesome for them if they sit at a general table where others are indulging in various luxuries of the season. It is sometimes possible for them, as has been proved by Cantani, to maintain good health for many years upon a strictly nitrogenous diet, but in attempting to enforce any rigid dietetic system one is compelled to have some regard for the environment and general habits of life of the patient, and it is easy to make the individual so miserable by too harsh rules as to defeat the very object in view, and the adoption of a too restricted system of diet may result in disastrous failure. For these reasons it is now customary to allow patients a more liberal dietary in diabetes than was at first permitted after the discovery of the real nature of the disease and the influence of carbohydrates upon it, but they should always be given carefully written directions as to what articles they may eat and what must be avoided.

While it is necessary to secure the intelligent co-operation of the patient in regard to carrying out his treatment, it is highly undesirable that he should devote too much time and attention to it, and, when possible, it is better to have some one else select and provide food for him in order that his mind may not be constantly occupied with questions of dietetics which tend to restrict the appetite, and sometimes to materially interfere with the beneficial effects of the diet. There is the more need for supervision of the diet by a second person, because the craving of diabetic patients often attains an ascendency over their will power and habits of truthfulness; in fact, a lack of mental force and even imbecility are quite characteristic of the advanced disease.

Deception should be suspected in those cases in which there is more urine passed than is to be accounted for by the quantity of fluid allowed in the diet, and in those cases which apparently ought to improve upon dietetic treatment, but in which after repeated trials no headway is made in regard to controlling the amount of sugar in the urine. I have known hospital patients to steal bread and potatoes and consume them surreptitiously in spite of repeated warnings, and also to acquire such a craving for fluid as induced them to drink their own urine.

With regard to the suddenness with which the diabetic regimen should be adopted by the patient, it is found to be the rule that it is easier for most patients to begin with the fully restricted diet at once than to gradually eliminate one article after another from the *menu*. The urine should always be thoroughly examined, both qualitatively and quantitatively, for sugar, urea, and albumin, before the restricted diet is commenced, and periodic examinations must be made during the course of the treatment in order to determine the effect upon the disease of withholding different articles of food and drink.

At first it is well to make such examinations daily, and subsequently, if the patient is doing well, once or twice a week is sufficient.

The effect of no dietetic system is immediate, and at least two days may be required for the patient to come fully under the influence of treatment, because the materials already present in the body when the new diet is commenced may serve as a source of sugar for some little time afterwards.

The general principles for the dietetic treatment of diabetic patients are, first, to exclude from the diet, when possible, all those articles which are most likely to result in the formation of sugar; secondly, to devise means for relief of the craving for starchy and saccharine foods which patients kept on a nitrogenous diet are certain to experience before long, and to see that while reducing the amount of sugar in the food, the patient is not suffering to a dangerous extent from lack of nutrition. It is difficult to formulate rules of diet which can be adhered to in all cases. There are many patients confined to an exclusive nitrogenous diet who lose flesh and strength so rapidly that although the advantage of reducing the glycosuria is attained, a new danger arises from anæmia and emaciation.

For convenience of description of dietetic treatment cases of diabetes may be subdivided into three classes: (*a*) Those patients who pass a considerable quantity of urine containing a large percentage of sugar, but in whom the general health is still good. (*b*) Cases in which, in addition to the passage of considerable sugar in the urine, there is more or less dyspepsia, emaciation, and debility. (*c*) Cases in which the constitutional symptoms become rapidly severe after the first appearance of sugar in the urine.

(*a*) In the first class of cases the dietetic treatment is productive of the greatest benefit, and not rarely the patients begin to gain flesh and strength; they sleep better; the daily quantity of urine falls perhaps from three hundred ounces to seventy, and it approaches the normal composition; the excessive appetite and thirst diminish; the digestion improves, and in one to three weeks the sugar may entirely disappear. Such patients are not to be regarded as cured, however, as soon as the sugar disappears—not, in fact, until they can eat starches in ordinary quantity without exciting the appearance of glycosuria. According to the statement of Dujardin-Beaumetz, patients of this class may be cured who have been eliminating as much as three thousand grains of sugar per diem. Whenever sugar, or amylaceous food absorbed as sugar, passes through the circulation unaltered, it is of no value to the system, and, as Bauer says, it serves merely as "useless ballast."

(*b*) The second class of cases is also amenable to dietetic treatment, but the benefit is not so immediate and usually not so great as in the first group, and it may be impossible to cause the total disappearance of the sugar, although it may be reduced to two hundred or three hundred grains a day. When the amount of urine is lessened by the changes of *menu*, the specific gravity remains high, and sugar is abundant, the prognosis is very grave. The patient cannot tolerate the diet, and drugs must be resorted to.

(*c*) In the third and most severe class of cases dietetic treatment is sometimes of avail, and it should be always undertaken, for it may prevent the patient from becoming worse, although it is unable to accomplish a cure.

But usually the treatment of these cases is unsatisfactory, because the patients, who are often young subjects, continue to form sugar from nitrogenous food after starches and sugars have been proscribed, and it is practically impossible to devise any special combination of food, or to find any single food upon which they can support life and from which they are not able to produce sugar. Their nutrition is extremely poor, and they go rapidly from bad to worse. Not seldom they are thin, neurotic subjects when the disease first attacks them, and therefore have very little capital to draw upon. In extreme cases a careful comparison between the amount of food ingested and sugar eliminated has furnished evidence that they are even capable of manufacturing sugar or glycogen out of the muscular tissues of their own bodies, as well as from proteid foods.

A clinical comparison of the different varieties of diabetes above described, with the theories which have been discussed in regard to the possible method of the production of the disease, emphasises the conclusion that cases of diabetes may not all have exactly the same ætiology.

By different writers all gradations of diet have been recommended, so long as the carbohydrates are restricted, from the absolute meat diet of Cantani to the skim-milk diet of Donkin and the more liberal *menu* of the majority of authorities.

Some patients who have a very good appetite when allowed a mixed diet lose it altogether when put upon an exclusive nitrogenous regimen. There are those who can live contentedly on an exclusive diet of proteid food and fats for a certain length of time—say ten days or a fortnight—if the principle of the treatment be explained to them and they are anxious of being cured, but sooner or later they almost always find it intolerable to wholly abstain from starchy and saccharine foods, and many prefer to live less long, but in more comfort than such restriction implies. This is probably attributable more to long-continued habit or heredity than actual inability to support life on a purely nitrogenous diet, for, as stated elsewhere (p. 320), the Eskimos thrive upon a diet absolutely free from starches and sugars of every kind. It is believed by Ebstein and others that an exclusive meat diet may be injurious on account of a tendency to produce acetonæmia, and it may favour the increase of uric-acid deposits in those having the uric-acid diathesis. To obtain enough carbon from such a diet for the needs of the system, a very large quantity of proteid food must be consumed.

When chronic nephritis complicates diabetes the difficulty of dieting is much enhanced, for meat is injurious for the nephritis, and starches are prohibited in diabetes. This condition has been aptly described as the "Scylla and Charybdis of the diabetic." As a compromise such patients must usually be put upon a milk diet.

Dujardin-Beaumetz states that when the quantity of sugar eliminated falls to ten grammes a day, less rigorous withholding of starches is needed.

Mild cases of diabetes seldom occur in children, hence the diet for them must be even more closely confined to proteids than for adults.

Many elaborate diet tables have been prepared, and for those whose means permit of indulgence in delicacies considerable variety may be secured without the use of carbohydrates; but for the poor in hospitals and at home it is a difficult problem to furnish inexpensive variety without occasional recourse to starchy foods.

Foods allowed in Diabetes

Soups and broths made of meat of any kind without vegetables, ox-tail and turtle soup, gumbo, curry.

Eggs in any form.

Crustaceans, crabs, lobsters, shrimp.

Fresh fish of all kinds and fish roe. Caviare, anchovies. Salt fish, cod, mackerel, and herring may be allowed, unless they increase thirst too much.

Fresh meat, fowl and game of all kinds. Ham, bacon, smoked beef, tongue, sweetbreads, kidneys.

Fats.—Olive oil and all animal fats and oils, such as butter, cream, cod-liver oil, bone marrow. Some authorities, however, exclude all fats. Senator objects to them on the ground that they form glycerin. Cantani excludes butter because it may contain some milk sugar. But usually such rigidity is unnecessary. In some diabetic patients the power of fat digestion is apparently increased, so that they tolerate larger quantities than in health. (See Appendix.)

Vegetables.—Spinach, cress, sorrel, chicory, romaine, dandelions, beet tops, horseradish, radishes, celery, sea-kale, artichokes, vegetable marrow, okra, lettuce, endives, pickles, cucumbers, gherkins, cranberries. The following vegetables are allowed by some writers, prohibited by others: green French string beans, asparagus, summer squash, onions, leeks, carrots, cauliflower, cabbage, sauerkraut, kohlrabi, parsley, parsnips, eggplant, tomatoes.

Because potatoes contain somewhat less starch than is found in bread they may sometimes be allowed in moderation when the latter is found to disagree. Germain Sée gives five ounces of potato meal daily as a substitute for bread.

The following statement made by Fagge is useful: "The general rule is that all white parts of vegetables in which chlorophyll has not been developed by exposure to sunlight contain no sugar, and are not harmful. But by boiling in a large quantity of water, even the forbidden kinds of vegetables, if they contain sugar only and not starch, may be rendered much less injurious." There is a decided advantage in using such green vegetables as are allowed in diabetic diet on account of their adding to the bulk of waste matter in the intestine and preventing constipation, which almost inevitably results from a meat diet.

Miscellaneous.—Kidneys, tripe, pig's feet, truffles, mushrooms, sweetbreads, terrapin.

Cheese, cream cheese, milk curds.

Jellies made of gelatin, calf's foot, with wine, but unsweetened except with saccharin, coffee jelly, lemon jelly.

Fruits, if acid, not sweet. In England, where gooseberries are eaten much more than in this country, they, as well as apples, red currants, and sour cherries, are sometimes allowed. Many of these fruits contain more levulose than grape sugar. Sour oranges, lemons, grape fruit, olives, sour apples, peaches in brandy (without sugar), raspberries, and strawberries are allowed by some, but are usually forbidden. Muskmelons and watermelons may sometimes be eaten.

Nuts.—Oily nuts, such as almonds, walnuts, Brazil nuts, hazelnuts, filberts, pecan nuts, butternuts, cocoanuts.

The articles above enumerated afford considerable choice, and it is to be distinctly understood that only so many of them are to be allowed at a time as may serve to divert the craving of the patient from his chief enemy—concentrated hydrocarbons. Some patients will be found who can eat any of the above articles with impunity, while others can take but very few, and others can consume certain foods for a short time without increasing their sugar elimination, which suddenly will be found to agree no longer, when some other food must be at once substituted.

It is apparently true that there are some individuals for whom one or two articles of starchy food can be found which do not produce sugar in the urine. Fothergill reported several cases of this kind. One of his patients passed urine free from sugar while eating vermicelli pudding and arrowroot. Another one took raspberry jam with impunity. When such cases are thoroughly investigated, however, it is usually found that they have reached an intermittent period in the activity of the disease which is not infrequent in this chronic affection, and in which for the time being the patient is very much better, and the urine remains for a little while practically normal. Such instances occur in the milder types of cases.

A Useful Diabetic Diet in Detail

I recommend the following dietary (alternatives in brackets):

Breakfast, 8 A. M.—A sour orange [grape fruit, melon]; eggs, scrambled, with much butter; fresh mackerel [salmon or other fat fish]; two slices buttered toast, three inches square, one-third inch thick = about one ounce; coffee, with cream and saccharin.

11 A. M.—A glass of cream diluted with water or Vichy to the consistency of milk [a glass of eggnog with saccharin].

Luncheon, 2 P. M.—Bacon and eggs [sardines]; spinach [radishes, celery], olives, lettuce, with oil dressing, and cheese; nuts.

Tea, 5 P. M.—A cup of tea with cream and saccharin; a baked apple with cream; a slice of buttered toast (as at breakfast).

Dinner, 8 P. M.—Meat soup; fresh fish with butter sauce; cucumbers with oil; *entrée*, marrow bones; meat (any sort); a baked potato (three inches long), well mashed, with much butter; string beans [cauliflower, vegetable marrow, Brussels sprouts, onions, asparagus with butter sauce]; (fat corn-beef and cabbage or pork and sauerkraut may be allowed once a week); game; sliced tomatoes with oil; baked custard [blancmange made with diabetic milk and saccharin; fruit jelly made with gelatine and imbedded fruits, unsweetened]; black coffee; very dry Moselle or champagne.

This dietary should be varied from time to time. As the tolerance for carbohydrates increases the fats may be reduced, and *vice versa*. If after a test diet of animal food exclusively there is still glycosuria and weight rapidly diminishes, meats should be replaced to the extent of not more than one-half by carbohydrates and fresh fruits and vegetables. If, with a test diet of carbohydrate-free food, to which 100 grammes of bread is added, no sugar is excreted, but it is excreted with 200 grammes of bread added, then a moderate toleration for bread is demonstrated, and it may be given up to this limit of, say, 100 grammes per diem.

In the poor man's anti-diabetic dietary, pork, bacon, tripe, cabbage, sauerkraut, carrots, turnips, onions, leeks, and milk cheese may form the basis of the heavier meals. Lard, suet, and margarine should be used freely in the cooking.

Forbidden Foods

Sugar in any form—sirup, molasses, confectionery, jams, and sweets of all kinds; honey, for it contains dextrose and levulose.

Starches.—All the elementary forms of starchy and farinaceous food, such as rice, sago, tapioca, arrowroot, oatmeal, cornmeal, hominy, samp, buckwheat, barley, semolina, macaroni, spaghetti, vermicelli. All pastry, cake, puddings, pies of every description—in short, everything made of flour excepting a little bread as specified above.

Vegetables.—Potatoes, beets, carrots, parsnips, turnips, peas, beans (except string beans), lentils, cauliflower, broccoli, Brussels sprouts, rhubarb. Some writers, like Dujardin-Beaumetz, occasionally allow a well-baked potato in mild cases. It contains only 15½ per cent of starch, or one fifth as much as rice, and one half as much as peas and beans.

Shellfish.—The soft parts or livers of clams, oysters, and mussels contain glycogen. By some these foods are entirely forbidden, but many diabetic patients can take them occasionally without injury.

Liver of all animals (it contains glycogen), *pâté-de-foie-gras.*

Fruits.—In regard to the use of fruits there is some difference of opinion. Sweet fruits, such as figs, dates, plums, prunes, bananas, apricots, all preserved, candied, or sugared fruits must be absolutely interdicted. Pears, melons, and berries are forbidden by many, but allowed by others.

Nuts.—Chestnuts, peanuts.

Substitutes for Bread

After all, the problem of selecting a suitable starchy food for the diabetic is governed as much by the necessity of furnishing some form of food which will satisfy the craving for farinaceous material as for the actual nourishment which it may contain.

The most difficult of all starchy food for the patient to forego is bread. Much ingenuity has been expended in attempts to devise substitutes for it, and many preparations for making artificial breads, biscuits, rusk, or cakes with eggs and butter are sold in market for this purpose. Some of these are palatable for a time, but many have been found to contain 60 or 80 per cent of starch—fully as much as wheaten bread—while others contain no nutriment at all.

Some authorities, as Germain Sée and Dujardin-Beaumetz, advise giving potato meal instead of bread, five ounces per diem, which may be cooked in any form without sugar.

Von Noorden has recently strongly recommended the substitution of oat flour or oat flakes for bread. The flakes are cooked in salt water with addition of butter and egg albumen, the following quantity being allowed daily: Oats, 250 grammes; albumen, 100 grammes; butter, 300 grammes.

Torrefied starch may be used by some diabetics. The starch is prepared by baking a large ball of flour so thoroughly that the starch granules in the interior of the mass are burst open by the heat. Torrefied bread or toast consists of thin cut pieces of bread which are toasted through and through until almost black before a hot fire until both the gluten and the starch are disorganised to some extent. Well-browned bread crust is of the same nature.

The breads made from flour especially prepared for diabetics are: (*a*) Gluten bread; (*b*) bran bread; (*c*) almond bread; (*d*) inulin bread; (*e*) soya bread.

(*a*) *Gluten Bread.*—Gluten bread was first used by Bouchardat. It is made by washing wheat flour in such a manner as to remove the starchy granules, leaving the gluten behind. Such bread is certain to contain more or less starch, and not seldom it has both starch and sugar. It is much more tiresome to eat than any ordinary bread, and unless prepared by a very reliable manufacturer it has little to recommend it. It is not agreeable to masticate, for it is often unpleasantly tough and stringy. It is difficult to panify, but it may be aërated. Gluten biscuits are more palatable than gluten bread, but most of these preparations have the disadvantage of not keeping fresh for more than a week or ten days.

Gluten flour is used for thickening broths, egg puddings, etc.

The following are receipts for utilising gluten flour:

Jeffries's Gluten Biscuit for Diabetics

Gluten flour	1 cup.
Best bran, previously scalded	1 cup.
Baking powder (or the equivalent of bicarbonate of soda and cream of tartar)	1 teaspoonful.
Salt	to taste.
Eggs	2.
Milk or water	1 cup.

Mix thoroughly.

James Stewart's Diabetic Bread.—"Take one quart of sweet milk or milk and water, one heaping teaspoonful of good butter, one fifth of a cake of compressed yeast beaten up with a little water, and two eggs well beaten. Stir in gluten flour until a soft dough is formed, knead as in making ordinary bread, put in pans to raise, and when light bake in a hot oven."

Protene Diabetic Bread, made in England by the Protene Company, has its basis in casein, and is said by Robert Hutchison to be "entirely free from carbohydrate." It may be toasted with advantage to taste.

Liebig proposed to prepare bread for diabetics by pouring a malt infusion over thinly sliced wheaten bread. The sugar which is thus formed is washed away, and the gluten residue may be eaten.

It is very difficult to obtain a reliable gluten flour. Much that is sold in open market contains more starch than wheaten bread—it may hold 60 or 70 per cent (Harrington and Professor Leeds).

The gluten flour obtained in the market in London or Paris contains about 15 per cent of starch, whereas that sold in the United States frequently has two or three times as much.

In 1903 the New Hampshire State Board of Health reported that of thirteen samples of "diabetic" and "gluten" flours, seven contained nearly the average starch percentage of ordinary wheaten flour, and only two were almost free from it.

Tyson, who has investigated the matter thoroughly, states that the gluten breads made by Theodore Metcalf, of Boston, and the Sanitarium Food Company of Battle Creek, Michigan, contain less starch than other American preparations. Pavy recommends a gluten bread and biscuit made by Bouthrou. A wholly starch-free flour does not exist.

James Stewart gives the following test for starch to be applied to gluten flour: A little of the flour is shaken well with boiling water, and cooled. A few drops are then added of an aqueous solution of iodine and potassium iodide (Gram's solution). If starch be present, a decided blue colour develops.

Dujardin-Beaumetz declares that gluten bread contains more than three times as much sugar-forming material as potatoes, and hence he prescribes the latter instead.

Van Abbott recommends the use of gluten macaroni, gluten vermicelli, and gluten semolina, which can be made into puddings without sugar.

Fromentine is another form of diabetic flour made from wheat germs. They contain less starch than mature wheat, but hold an oil which is purgative and which prevents proper panification, and causes the bread to sour easily.

Poluboskos is another form of flour said to contain a minimum of starch.

Embryonine or *legumine* is a substance isolated from the casein of legumes, and which is sometimes given for diabetes.

(*b*) *Bran Bread.*—The use of bran bread was first suggested by Prout, but, like gluten bread, it is apt to contain a good deal of starch, and in addition tough cellulose, which is of little nutrient value and which may prove irritating to the mucous membrane and alimentary canal, causing diarrhœa. It is, moreover, somewhat tasteless, and patients quickly tire of it. Bran bread cakes may be purchased prepared expressly for the use of diabetics. They are made according to Dr. Camplin's receipt, as follows:

Camplin's Bran Bread.—"Boil one quart of wheat bran in two successive waters, wash in a sieve with hot water until the water runs through clear. Squeeze in a cloth after each washing. Spread thinly on a dish, and dry in a slow oven. Grind in a fine mill, and sift by brushing through a very fine sieve. Grind the residue again and sift. Take of the powder three ounces, three new laid eggs, butter two ounces, and half a pint of milk. Mix the eggs with a little of the milk, warm the butter with the rest. Stir the whole and flavour with nutmeg or ginger. Bake in thin cakes in a quick oven for half an hour." More eggs may be used, and Roberts adds sodium bicarbonate. The object of drying the bran before it is ground is to make it friable, otherwise it is too soft to be easily powdered. These cakes or biscuits may be eaten with butter or cheese, and taken with meals two or three times a day.

(*c*) *Almond Cakes.*—Pavy first suggested the use of almond cakes for diabetics, which he prepared by making a meal of sweet almonds. This meal when washed in acidulated water is freed from sugar, and may be made into cakes or crackers. Seegen gives the following receipt for almond cakes:

Seegen's Almond-flour Cakes.—" Take of blanched sweet almonds a quarter of a pound, reduce to powder in a stone mortar, steep in linen in boiling water, acidulated with vinegar, for fifteen minutes to remove sugar. Mix the paste with three ounces of butter and two eggs, add the yolks of three eggs, a pinch of salt, stir well. Whip the whites of three eggs and stir in. Put the dough into greased moulds, dry at a slow fire." Almond-flour preparations contain so much fat that they often prove indigestible after a few days' trial, and they are relatively expensive.

Many physicians prefer to discard the use of all substitutes for bread, such as bran and almond cakes, and to allow the patients a limited amount of plain bread.

A nut flour, the Chicago Sanitary Flour, is recommended by N. S. Davis, Jr., of Chicago. Analysis by Prof. J. H. Long shows it to contain:

Water	8.01
Fat	19.82
Albuminoids	55.65
Sugar	6.25
Mineral salts	6.32
Fibre and other non-nitrogenous matter	3.95
	100.00

It is thus seen to contain no starch, and most of the 6.25 per cent of sugar is lost by conversion to CO_2 in the fermentation process of breadmaking. It is useful not only for diabetics but for those having flatulent dyspepsia.

(*d*) *Inulin Bread.*—A form of bread has been made by Külz from inulin and lichinin. Inulin is derived from the root of elacampane (*Inula helenium*).

Külz's Inulin Biscuits.—" Fifty grammes of inulin are to be put in a large porcelain basin, and while standing over a water bath to be rubbed up with thirty cubic centimetres of milk, and as much hot water as may be necessary, into a uniform dough, with which the yolks of four eggs and a little salt are to be mixed. To this the whites of four eggs are to be added, having first beaten them to a foam and carefully worked them in. The dough is finally to be baked in tin moulds, previously smeared with butter. The taste of the biscuits may be improved by the addition of vanilla or other spices" (Dietary of the Sick. Von Ziemssen's Handbook of General Therapeutics). These biscuits are not agreeable to the taste and patients soon tire of them.

(*e*) *Soya Bread.*—A meal is made from the fruit of the *Soya hispida*, a bean which is grown in China and Japan and also raised in Austria. It is very rich in protein. It has a peculiar taste and holds a purgative oil.

The published percentage composition of the more important ingredients of soya bread is as follows:

Water	45.000
Protein	20.168
Fats	9.350
Starch and sugar	2.794
Phosphoric acid	0.863

Soya bread is nutritious on account of the large percentage of fat which it contains, but according to an analysis made by an expert chemist it contains carbohydrates in considerable amount. This, in fact, is true of all the breads and biscuits made of substitutes for flour. Potatoes contain, bulk for bulk, a little more than one-third as much starch as wheaten bread, hence six ounces of baked potatoes may be substituted for two ounces of bread, if the patient prefers.

Substitutes for Sugar

Külz states that certain of the sugars and allied bodies may be used with the food without increasing the glycosuria, being very thoroughly consumed within the body. Such, for instance, are inulin, inosite, mannite, and levulose or sugar derived from fruits. A preparation of the latter is sold under the name of "diabetin." Another sugar substitute known as "crystalose" is much prescribed at Carlsbad.

Glycerin has also been used, but Senator and Frerichs are opposed to it. If given in quantity, such as one or two ounces a day, it occasions intestinal disorder, and may prove too laxative. It also causes a continuous sweet taste in the mouth.

Saccharin is employed with success to take the place of cane sugar for sweetening foods for diabetic patients. It may be used to sweeten coffee and other materials. It is a crystalline nitrogenous body derived from coal tar, which is sparingly soluble in cold water, more soluble in hot water, and very soluble in glycerin. It is about three hundred times as sweet as cane sugar, and when taken not to exceed four or five grains daily it is quite harmless. Eaten in large quantity it disorders digestion and causes gastric pain. A convenient formula is given by James Stewart for saccharin pastilles:

Saccharin	gr. xlv.
Sod. bicarb. sicc.	ʒ ss.
Manniti	ʒ xijss.

M. Make 100 pastilles; one will sweeten a cup of tea or coffee.

Cooking.—Care should be exercised in the preparation and cooking of the food for diabetic patients that injurious ingredients are not added for the purpose of flavouring or thickening. For this reason all the articles of diet should be cooked as simply as possible, and rich sauces containing flour should be forbidden. Melted butter may be used as a substitute. Roast beef should not be basted with flour, and meat soups must not be thickened. Vegetables which have been boiled for a long time in a large bulk of water have most of their sugar dissolved out, and on that account are less injurious.

Very acid fruits may be sweetened with saccharin or cooked with a little sodium or potassium bicarbonate to neutralise their acidity.

Beverages

Water.—It is an important matter to decide to what extent to restrict the quantity of water and other fluids drunk by diabetics. When so much urine is voided that the patient's rest at night is disturbed by acts of frequent micturition, it is always annoying, and may be even serious. The increased work thrown upon the kidneys is less harmful than might be at first supposed, for the water of the urine is excreted chiefly by a simple process analogous to filtration, which no doubt taxes the renal epithelium less than the excretion of some of the solids of the urine. At all events, protracted cases of diabetes do not necessarily exhibit serious renal degeneration.

For these reasons, if the water drunk is restricted, it should be so more on account of relieving the patient of an uncomfortable condition than from fear that the act of passing so much urine may be injurious *per se*, and the restriction should never be enforced too suddenly. As a rule, when dietetic regulation reduces the glycosuria and improves the patient's condition there is, *pari passu*, a reduction in the quantity of urine voided. In other words, this symptom takes care of itself. A reasonable restriction of the fluids allowed is to be recommended, but when thirst is extreme it becomes unendurable torture to withhold them rigidly, and, moreover, the water is apparently needed to wash out the sugar which would otherwise accumulate in the blood and tissues. In fact, the occurrence of impending coma has been postponed by flushing the circulation by means of large draughts of water or enemata of salt water.

When the thirst leads to excessive drinking, salt foods and condiments should be withheld, and some relief may be obtained by sucking a slice of lemon or by using a little potassium bitartrate and lemon juice, or dilute phosphoric acid in water. The patient should drink only from a small glass, for there is more satisfaction in draining it than in taking the same quantity of fluid from a large goblet which one is not allowed to empty.

The meat diet, if not too salt, diminishes the desire for fluids very much as compared with a vegetable diet, for usually thirst increases in direct proportion to the amount of sugar contained in the blood.

It is important not to distress the patient so much by denial that the nervous system suffers in consequence.

Beverages forbidden.—As a rule, patients always do better without alcohol, and strong spirits should be absolutely interdicted as well as sweet and sparkling wines of every kind, all wines with "bouquet," especially Madeira, port, sweet sherry, Sauternes, and champagnes. No punch or liqueurs, cider, beer, ginger or sweet ales. Soda water with sirup is prohibited. No chocolate, unless especially prepared without sugar.

Beverages allowed.—If it becomes necessary to give alcohol as a tonic or stimulant, an acid claret or Burgundy, hock, or still Moselle may be prescribed diluted with mineral water; or a little much-diluted brandy, whisky, or unsweetened gin may be allowed. Weak brandy sometimes allays thirst better than water. Dry sherry, Chablis, and Burton bitter ale are prescribed occasionally, and the California Riesling or Zinfandel may be used. Bass's ale may be allowed because the sugar which it originally contained has been entirely converted into alcohol and carbonic acid (Flint).

Tea, alone or with lemon. Coffee, and infusion of cocoa nibs, sweetened with a quarter of a grain of saccharin, are allowed. Chocolate may be manufactured especially without sugar. Buttermilk may sometimes be given. Sour lemon or orange juice in Vichy with a pinch of sodium bicarbonate makes an agreeable and cooling draught. Saccharin may be added. In Germany acorn coffee is sometimes used.

As an adjunct to the dietetic treatment, the alkaline mineral waters are extremely serviceable, especially those from natural wells. The baths and waters of Carlsbad and Neuenahr, Ems in Germany, and Vichy and Contrexeville in France have achieved a considerable reputation for the cure of diabetes, and after making all due allowance for the improvement consequent upon proper regimen, dietetic regulation, and systematic habits of life which are enforced at these spas, there seems to be special benefit derived from the waters themselves. Other waters which may be drunk are Apollinaris, Johannis, Saratoga Vichy, plain soda or potash water, Seltzer, the alkaline calcic Waukesha, or the different lithia waters.

SPECIAL DIABETIC DIETS

Skimmed Milk.—An exclusive diet of skimmed milk was first tried by Scott Donkin. At first a gill should be given every two or three hours, or from six to eight pints daily, to be increased up to twelve pints. The small amount of milk sugar contained in it is said to do no harm. Some authors advise the milk diet as a last resort, others recommend trying it at once. Senator says that the sugar of milk does not increase the glycosuria, and undoubtedly some patients are much more tolerant than others of the sugar of milk.

Tyson says it is harder than any other starchy food to convert into glucose in the system. He recommends giving eight ounces of skimmed milk every two hours between 7 A. M. and 7 P. M., or more if necessary. If preferred, the curds and whey may be separately taken.

After six weeks a gradual return to a mixed nitrogenous diet may be permitted. But few patients, however, can be found to accustom themselves to this diet or to endure it for more than two or three days. Koumiss has been successfully substituted for the skimmed milk. In it the milk sugar is already converted into alcohol.

Buttermilk is sometimes given, and like koumiss it allays the thirst to some extent. The milk sugar has been converted into lactic acid.

By many writers, as Dujardin-Beaumetz and Flint, milk in any form is prohibited, while others recommend its use in moderation while a rigid diet of proteid and fat must be adhered to.

Ebstein's Diabetic Diet

Early Breakfast.—One cup of coffee or tea (black), without milk and sugar. White bread toasted, thirty to fifty grammes; or brown bread well buttered—butter, twenty to thirty grammes. The yolk of an egg, a little fat ham, or some German sausage, if required. If any food be needed between this meal and dinner, let it be a cup of broth, with the yolk of an egg.

Dinner.—Broth, with yolk of egg or marrow (the marrow bone is boiled for half an hour, to solidify the marrow). Peptone may be added to the broth. Meat, one hundred and eighty grammes, free from bone, roasted, boiled, or stewed—beef, mutton, pork, veal, fowl, or venison (fat meat preferred). Gravies, to be made with cream or yolk of egg, not flour. Fish to be served with melted butter. Vegetables prepared with much fat; *purées* of leguminous plants; salads, dressed with vinegar and oil. The food should be well salted and spiced. After dinner, a cup of coffee or tea.

Supper.—One cup of tea or broth. Meat (roasted), or cheese, or an egg, or fish, caviare. Bread, thirty to fifty grammes, with butter, twenty to thirty grammes. Apples, pears, and stone-bearing fruits are allowed in small quantities.

Beverages.—Ebstein forbids absolutely the use of beer, limits the use of spirits, and allows about half a bottle of wine daily. If the patient can digest milk well, it is allowed in moderate doses, and cream is especially recommended.

In the following diet, recommended by Düring, it will be noticed that, contrary to some other symptoms, fat is excluded as much as possible.

Düring claims that prolonged boiling so alters the carbohydrates as to prevent them from being eliminated in the urine as sugar, and he gives his patients a diet consisting largely of rice and fruits which have been soaked in water and boiled for several hours. The details of his regimen are as follows:

Düring's Diet for Diabetes

Early Breakfast.—Milk, with a little coffee but no sugar (lime water, to prevent milk from souring in the stomach); stale white bread *ad libitum*, or, if it is not well borne, oatmeal, barley, or rice gruel made with water, a little salt, but no butter.

Second Breakfast.—White bread, stale and well baked; an egg, lightly boiled; rice or oatmeal gruel, with or without milk, a breakfast-cupful; or half a glass of good red wine (with water in certain cases).

Dinner (taken between two and three o'clock).—Soup, with rice, barley, or oatmeal; meat, roasted, two hundred and fifty grammes (game, ham, and smoked meats, as free from fat as possible, are permissible); no condiments, *no fatty sauces; compote* of dried apples, plums, cherries; dried peas or white beans in some cases; green vegetables, asparagus, French beans, carrots, cauliflower, cabbage (boiled in water with salt, not with fat or stock); dessert of a little raw fruit, apples, cherries, and one small glass of red wine diluted with water.

Supper (about 7 P. M.).—Gruel of barley, oatmeal, or rice, with salt (but no butter), and strained, which in some cases may be made with milk. Ice or iced water, to relieve thirst between meals.

Naunyn's Diet

Naunyn divides diabetes somewhat arbitrarily into three varieties —mild, severe, and intermediate. For the most severe cases he gives a diet of fat meat; the intermediate cases are treated at first on an exclusive diet of fat meat, then, as the sugar disappears from the urine, he adds eggs, milk, and a small allowance of bread to the diet. In mild forms he directs the use of a few green vegetables, salads, fruits, and other articles, unless the sugar reappears in the urine, when the patient is to be put back upon a rigid nitrogenous diet. He claims that in mild cases of diabetes patients do not require more than from sixteen to eighteen ounces of meat a day, with two or three ounces of bread and six or seven ounces of vegetables.

Hygienic Treatment.—Patients should guard themselves as far as possible from catching cold, and when possible should live in a moderately warm and temperate climate. If their surroundings permit, it is important to take moderate exercise and to remain in the open air. Flannels should be worn next to the skin in winter, and the body should always be kept warm, for there is less heat-producing power than normally. The skin should be maintained in good condition by frequent warm baths or hot and cold douching, dry rubbing, or massage. All muscular and nervous or mental fatigue is to be avoided. It is claimed by Külz that muscular exercise tends to increase the consumption of sugar or glycogen in diabetes and to lessen its elimination by the kidneys. This applies to the more robust cases only, for in the severe type of the disease with great emaciation much exercise becomes harmful or impossible.

Medicinal Treatment.—The medicinal treatment of diabetes is exceedingly unsatisfactory. In a certain proportion of cases of diabetes cure may result by exclusive dietetic treatment. There are others in which the use of medicines is found to be of some service, but it may be stated positively that there are no cases which are curable by medicines without proper dietetic treatment.

Opium and codeia are successful in some instances in reducing the amount of sugar. Commencing with half-grain doses, the latter is to be gradually increased until ten or fifteen grains are taken in a day; alkalies, such as the citrate and acetates, are also occasionally found beneficial. Clemen's liquor arsenici bromati has attained success in some hands. Digestive tonics, aromatic bitters, mineral acids, and cod-liver oil are frequently indicated, and strychnine and ergot are to be employed as vasomotor tonics when desired. They regulate the arterial tension, and may reduce the quantity of urine and relieve the thirst.

The nitrogenous diet is apt to excite diarrhœa, which may be controlled by such remedies as salol, salicylate of bismuth, or castor oil.

For the intense craving for food experienced by some patients, with a hollow, sinking feeling at the epigastrium, Roberts recommends a two- or three-grain asafœtida pill three times a day.

Rhachitis (Rickets)

Causation.—Rickets is a disease of malnutrition. The fault may lie in a hereditary weakness of the digestive organs, or the influence of some disease, but the majority of cases are directly caused by improper or insufficient food. This food may be the breast milk of a mother or wet nurse, who is herself enfeebled by chronic disease, by oft-repeated pregnancies, or whose mammary secretion is modified by dietetic errors—loss of sleep, emotional or neurotic disorders, or the milk supply may simply be insufficient from too long-continued nursing or the intervention of pregnancy, or some other factor. The poor, for reasons of economy, often suckle their children for too long a period—in fact, until they are two years of age—but even before weaning them they allow them to go to the table and share in the general diet of fried fish, pickles, potatoes, pork, raw fruits, beer, etc. Children treated in this manner are especially prone to develop rickets. In all doubtful cases the milk of the mother or nurse should be analysed before weaning, and an effort should be made to improve its quality. If the child is already weaned, the cause of the rhachitic condition may be a poorly selected diet, such as a patent " baby food," with insufficient fat and earthy salts and excess of starch.

Rickets has been experimentally produced by Cheadle, Guérin, and others in young animals by depriving them of animal fats and earthy salts. It is caused by withholding all lime salts from the food (Voit), but especially calcium phosphate, and young, growing animals failing to receive a fresh supply absorb lime salts from bones already ossified for the benefit of the newer ones, and thus all the bones become soft. Baginsky found that this process is exaggerated in young animals by the presence of lactic acid in the food, and Wegner proved that phosphorus has a similar effect. Forster has calculated from the lime ordinarily present in milk that an infant four months of age receives a gramme each day. Indigestion lessens hydrochloric-acid secretion and increases lactic-acid formation, and lessens absorption of lime salts.

Starchy and saccharine foods not only contain little or none of the necessary lime, but easily undergo lactic-acid fermentation, which it has just been shown intensifies the rhachitic processes.

Bottle-fed infants are very subject to rickets, especially if the milk be sterilised, and breast-fed infants may become rhachitic if the milk is watery, of low specific gravity, too poor or too rich in fat or in lactose.

Prophylaxis.—The best prophylactic against rickets is nursing through the first year by a healthy mother or a carefully selected wet nurse. It is a very common practice in this country for mothers to wean their babies too early, and without a physician's advice to resort to one of the much-advertised patent infant foods, with the result above described.

Dietetic Treatment.—The dietetic treatment of rhachitis in a weanling must consist, first of all, in supplying good fresh cow's milk modified to resemble as closely as possible the best mother's milk. It is highly important that the milk should contain sufficient fat, and it must be modified accordingly by the addition of cream or oil. (See Modified Milk, p. 90.)

If the child must be bottle fed, the milk should be carefully Pasteurised in order to diminish the liability of its fermentation in the alimentary canal, and among the poor, who cannot afford to purchase prepared milk in this way, the milk as soon as purchased should be heated, and a few grains of bicarbonate of sodium may be added to it. A plug of previously baked cotton should be used in the bottle in place of a cork. When given, the milk should be diluted with barley water, or, if constipation is present, with oatmeal water. These waters are made by boiling a tablespoonful of pearl barley or of good oatmeal in a pint of water until the meal is completely softened. A little salt is then added, and the mass is strained through a fine cloth. It is advisable also to add milk sugar. The proportion of milk for the diluent should be half and half for the first six weeks of infancy; after this the proportion is to be gradually increased, and when six months of age it should be given three parts milk and one part diluent. The quantity of milk is to be continuously increased, and at the ninth month it may be in the proportion of four to one, and at the end of the year dilution is no longer required.

Very young infants who are fed by artificial means should not be given any farinaceous food. In the first two or three months of infant life the saliva—from deficiency in ptyalin—is incapable of digesting starch, and starch is also poorly digested by the pancreatic juice in the intestine. Starch, therefore, acts as a foreign body and a gastro-intestinal irritant, and passes through the alimentary canal unaltered.

It is advisable in all rickety children to restrict the giving of farinaceous foods until some time after the period when they are often allowed, and, as a rule, children having rickets should not be fed any starchy food until after the twelfth or fourteenth month. They need fats much more than starches or sugars.

There are some apparent exceptions to this where infants become seemingly robust while fed upon amylaceous foods at a very early period, but they are less healthy as they grow older or exhibit malnutrition or some constitutional weakness. Such exceptions by no means controvert the value of the rule in general, as above stated. When starchy food is given to young infants it should always be predigested with diastase or "malted."

Preparations of condensed milk which contain large quantities of sugar are sometimes given to infants by mothers, and they produce a prompt increase in weight, but the appearance in these cases is deceptive, and the muscles and other tissues are less firm and strong than they should be. This is proved by the fact that children erroneously fed in this way succumb far more easily to various diseases of infancy, especially to diarrhœal troubles, which they may acquire later on. After the first year a little of some malted or predigested form of starchy food may be added to the milk.

Whenever amylaceous food is mixed with the milk it should be previously converted, as far as possible, into dextrin or glucose, and it should be added rather with the object of mechanically preventing the formation of coagulæ of casein than with the idea of feeding the infant upon a substance which its digestive organs are not yet fitted to act upon. J. Lewis Smith says: "If a heaping teaspoonful of barley flour be boiled in twenty-five teaspoonfuls of water, and when it is lukewarm ten or fifteen drops of diastase be added to it, the gruel in a few minutes becomes much thinner from the digestion of starch, and it is a useful adjuvant to the milk employed in the nursery, especially for infants over the age of six months." At this time or later a little albuminous food in the form of mutton or chicken broth or the expressed juice of rare roast beef or beefsteak.

After a year or fourteen months the diet should consist of cow's milk, cream, beef juice squeezed from a fresh steak, and broths, and stale bread crumbs in milk may be added. Later still, the child may take scraped beef or a raw beef sandwich made with thin layers or bread and butter with meat pulp between them. Beef tea, mutton, and chicken broths are good. Fresh fruit juice, especially orange juice, is excellent. A little sweet currant jelly added to the meat will improve its flavour for older children who object to taking it. When a year and a half old the child may be given eggs, either beaten with milk and sweetened or soft-cooked. If attacks of diarrhœa supervene, it will be well to stop the meat broths temporarily and put the child for a few days on a diet of koumiss, zoolak, or pancreatinised milk. In some cases maltine is found to agree well with rhachitic children, and if diarrhœa does not exist they should be given pure Norwegian cod-liver oil three times a day in doses of a few drops for a young infant, up to a teaspoonful for a child a year or two old. Older children should have abundant fat, in the form of fresh butter on bread, or cream upon stewed fruit or baked apples. Fothergill wrote: "The liquid fat of fried bacon is most digestible, and the child should be allowed to dip its bread in it or have it crumbed into the fluid fat." Or it may occasionally be given a piece of bacon to suck.

The fat of bone marrow might be used for the same purpose.

Inunctions of two or three teaspoonfuls of olive oil may be given daily over the legs and abdomen.

Rhachitic children, on account of their poor nutrition, usually have a deficient number of teeth or their teeth are imperfect or quickly decay. It is therefore important that when they have passed the first dentition food should always be given them in a state of fine subdivision, otherwise it will be bolted without mastication and gastro-intestinal disorder will result. Meat should be thoroughly hashed or pounded in a mortar, and solid meat should never be given the child to masticate until it is over two years of age. Potatoes should only be given baked in a soft and mealy form.

Some breast-fed infants may become rickety, while others badly fed by artificial means may not, and the extraordinary instances of toleration of improper food which one constantly finds among the children of the ignorant poor, at times severely test one's faith in dietetic rules, but much allowance must be made for the constitution of individuals and for race characteristics. The subsequent history of wrongly fed children often points directly to original faults in diet which have affected the general nutrition of the body, although the immediate effect of such errors may not have been apparent.

AIDS TO DIETETIC TREATMENT

Rhachitic babies, as well as older children, should be weighed at regular intervals as an important guide for their correct feeding.

In rickets more or less gastric catarrh is commonly present, which interferes with normal digestion and absorption, and appropriate medicinal remedies should be employed to regulate this condition when necessary. There is often excessive acidity in the stomach which must be neutralised by sodium bicarbonate. The hygienic treatment of the children in conjunction with dietetic measures is of the utmost importance. Rickety children must practically live outdoors in all seasonable weather, and it is better for them to remain out in fresh, cold air than to be kept at home in a damp, dark, overheated, and badly ventilated tenement. They should be frequently bathed in order to keep the skin in as good condition as possible, and prevent the occurrence of skin diseases, which are a common accompaniment of malnutrition. They should be kept quiet and not worried, and if they are weak and feeble, great care should be exercised in handling them and in placing them in proper positions upon beds which are firm but not hard, in order to prevent the weakened bones from becoming deformed by pressure.

SCURVY

Causation.—Scurvy is a disease dependent upon malnutrition, which is customarily attributed to lack of fresh vegetables in the dietary; but this statement is somewhat vague, in that it is not exactly known which articles of diet are most liable to produce the disease by their absence, although many believe that the cause is due to deficiency of salts whose acids—citric, malic, lactic, acetic, and tartaric—form carbonates, but no preventive food has been found which is absolutely successful in all cases. At all events, it is a disease due to omission and not to consumption of certain foods, and it depends rather upon the quality than quantity of food. In opposition to the theory that the want of fresh vegetables acts as a cause of scurvy in man, the fact is stated by Lieutenant Greely that among the Danish Eskimos, who have a population of ten thousand, not a pound of vegetables nor a dozen pounds of bread per man are eaten annually, and yet they are practically free from the disease, and the same statement is made in regard to the most northern tribes of Eskimos of pure blood who were studied by Lieutenant Peary, and also in regard to the natives of the Alaskan archipelago and some tribes of North American Indians who do not include either vegetables or cereals in their food. It is an undoubted fact that the disease is much oftener present among people who have lived for some time in bad hygienic surroundings and in damp, dirty quarters, and who have been subjected to mental depression, monotony of occupation and diet, or excessive work and fatigue, as well as the abuse of alcohol. It has often been known in prisons. It is therefore possible for scurvy to occur in any part of the world among men affected by these conditions, but it is much less common at the present time than formerly.

In the British arctic expedition of 1875–'76 over 48 per cent of the men suffered from scurvy, and a still larger percentage existed among those who were exempt from field service and outdoor life.

When the potato crop failed in Great Britain and Ireland in 1846 scurvy became very prevalent. In the war of the Crimea twenty-three thousand cases occurred among the French troops alone.

Woodruff, referring to scurvy in the United States Army, writes: "If transportation is so deficient that only bacon, hard-tack, and coffee can be carried, actual scurvy is the result. The company commander must secure something else for his men. The lack of fresh vegetables and fresh meat is the chief fault. Why fresh things are needed is not known, but it is believed to be due to the fact that the body thus received certain salts and unknown substances necessary as stimulants or tonics to the tissues, which salts and substances are destroyed by the usual methods of preservation. It is not to be denied that men may live for many years without tasting such articles of diet, though it is rare for a man to be denied all three—meats, fresh vegetables, and fresh fruits. If they are so denied they are not possessed of that health which permits of the highest mental and physical development."

Scurvy contributed 15 per cent to the death rate from diseases in the late civil war, and it was formerly prevalent among seafaring men when upon long voyages, who lived upon salt pork or pickled meats; but the disease is encountered much less often at the present time, owing to the better means of preserving foods, securing variety in diet, and better hygiene. The regulations of boards of trade usually require that antiscorbutic foods and remedies should be carried upon vessels, and the development of scurvy on board ship, unless in exceptional cases of shipwreck or in voyages prolonged beyond the expected limit, subjects the captains or owners to indictment for criminal negligence. The English law early required that lime juice should be carried on long voyages, and this formerly earned the nickname of "lime juicers" for British sailors. Many almshouses have similar regulations.

Scurvy has been known to occur from failure of intestinal absorption, in which case it is less easily preventable.

Garrod holds that scurvy is caused by absence of potash, for in this disease the blood is deficient in potassium salts. He regards this fact also as an explanation of the muscular weakness which is a prominent feature, and observes that all good antiscorbutics—fresh milk, meat, lemons, and fresh vegetables—contain abundant potash.

Garrod's theory is modified by Immermann, who believes that a temporary lack of these salts may cause trophic disorders, which may continue for some time after the deficiency in salts has been made good, and Duchek has even found that in exacerbations of symptoms occurring in scurvy there may be an increased elimination of potash salts in the urine. The body is capable of retaining and reusing its various salts for a considerable time, so that withdrawal of the potash does not necessarily induce scurvy at once (Bauer).

Northrup and Crandall investigated the causes of scurvy in a number of infants, and report that they find the employment of proprietary foods which for various reasons are substituted by the mother for fresh food is the most important cause of scurvy, and "even fresh milk in small proportions is not sufficient to insure perfection." Their report continues:

"The exact diet is known in thirty-three cases. We find that twelve of these children (36 per cent) were fed on a proprietary food exclusively, six (18 per cent) had received an exclusive diet of condensed milk or evaporated cream, while three received a combination of these two foods. Over 63 per cent, therefore, were fed upon a diet of proprietary foods and condensed milk. Two children received sterilised milk exclusively, and three a weak mixture of milk and water. One was fed on condensed milk, one on boiled and peptonised milk, and one on barley water.

"It is a significant fact that the country which furnishes most of the literature of scorbutus in children is the same which is posted from end to end with advertisements of proprietary foods."

Louis Starr furnishes a list of the common dietetic causes of scurvy in infants, as follows (they will be seen to be very diverse):

"The different proprietary infants' foods administered without or with slight addition of cow's milk; these foods are responsible for the greatest number of cases, and the variety most harmful depends greatly upon the degree to which it is used; oatmeal or wheat gruel; barley and other farinaceæ administered with water alone or with water and insufficient cow's milk; condensed milk and water; sterilised milk; properly modified milk mixtures, but subjected to a temperature of 212° F. from thirty minutes to an hour or more; too dilute milk-and-cream mixtures; laboratory mixtures with too low albuminoid percentages." Scurvy is found more frequently in infants reared in luxury than in the very poor.

Scurvy in infants presents definite peculiarities due to subperiosteal effusions of blood along the femoral and tibial shafts, which are accompanied by hyperæsthesia, local pain, tenderness, swelling, and immobility. Occasionally the cranial bones, ribs, and bones of the arms are involved. The pain and immobility formerly led to mistaken diagnoses of rheumatism, spinal cord disease, etc. Hæmaturia may occur.

It is astonishing to see the promptness with which improvement follows the giving of a rational diet in these cases, and a little fresh orange juice will often produce a remarkable change for the better.

Prophylaxis.—So long as the hygienic conditions are good and the food is of the best quality and variety, and if proper discipline and regular habits of eating and sleeping are insured, scurvy may be prevented among soldiers and sailors, although fresh vegetables may not be obtainable. On American ships potatoes are always used. Cranberries keep well and are excellent antiscorbutic food.

The introduction of canned and compressed vegetables in seamen's rations has done much to prevent scurvy, but fresh food is always to be preferred to preserved food of any kind. Dried legumes are quite useless. For travellers in the far North, Nordenskiöld advised the use of cloud berries (*Rubus chamæmorus*).

Dietetic Treatment.—In mild cases of scurvy of comparatively short duration patients rapidly improve under proper dietetic treatment if it can be obtained. The juice of two or three limes or lemons, or a few fresh vegetables eaten daily, may be all that is necessary, and the former is one of the best preventives as well as curative agents.

A. E. Wright dissents from this view, at least in regard to such cases as may suffer from bleeding from the gums. He claims that the acids, tartaric and citric, have a decided inhibitory action upon intravascular coagulation when given per os, and maintains, contrary to general experience, that in scurvy with persistent hæmorrhage the use of fresh lemon juice tends to keep up the oozing of the blood. He says that the neutral citrates and tartrates do not act in this manner, and they should therefore be prescribed instead of fresh lemon juice.

Stomatitis is often the most prominent symptom, and if the mouth is very tender, the gums are swollen and bleed readily, and the stomach is irritable, the diet must be limited to fluid or some solid food which requires no mastication. Beef tea, broths and meat soups thickened with vegetables, fresh vegetable *purées*, eggs, and milk are recommended. To these substances the juice of two or three fresh oranges, limes, or lemons should be added. If the patient is able to masticate food thoroughly and the stomach is not too feeble, fresh meat, baked or mashed potatoes, cabbage, sauerkraut, pickles, salad, and "greens," such as water cress, fresh mustard, or radishes, may be given. The citrate of iron, vinegar, acetic acid and potassium chlorate and bitartrate have all proved beneficial. During the civil war the expressed juice of sorghum was tried with some success.

The treatment of scurvy in children consists first in throwing away all proprietary foods, and then if the disease has not progressed too far, improvement and cure rapidly follow change to a normal diet of mother's milk or fresh cow's milk, expressed beef juice, and a little fresh orange or peach juice.

The following dietary is recommended by Louis Starr for scurvy in an infant eight months old:

"At 7 A. M., cream, ½ ounce; milk, 4½ ounces; milk sugar, 1 drachm; water, 3 ounces. At 9 A. M., one or two teaspoonfuls of fresh orange juice, according to effect on the bowels. At 10.30 A. M., same as at 7 A. M. At 11.30 A. M., two teaspoonfuls of raw-beef juice, free from fat, and with a little salt. At 1 P. M., one to two teaspoonfuls of fresh orange juice. At 2 P. M., same as at 7 A. M. At 3 P. M., two teaspoonfuls of raw-beef juice with salt. At 5 P. M., one to two teaspoonfuls of fresh orange juice. At 6 P. M., same as at 7 A. M. At 8 P. M., two teaspoonfuls of raw-beef juice with salt. At 10 P. M., same as at 7 A. M.

A substitute for orange juice may consist in scraped ripe apple or fresh grape juice. Iron is indicated. The body may be gently rubbed with warm olive oil."

Hæmorrhagic Purpura

With regard to idiopathic purpura, which sometimes appears in well-nourished subjects, it has been stated that a non-stimulating diet, by reducing the activity of the heart, may prevent the recurrence of hæmorrhages. Bauer says: "Such patients should take all foods and drinks cool, and never in large quantities at a time; they should abstain altogether from alcohol, and milk is to be recommended for its easy toleration in these cases."

MISCELLANEOUS DISEASES

Addison's Disease

The ætiology of this affection is somewhat obscure, but in the majority of instances it results from tuberculosis or other disease of the adrenal bodies, perhaps associated with functional or organic change in the neighbouring sympathetic ganglia.

At first no dietetic treatment is required, but in advanced cases there is always weakness of the digestive system, and vomiting may be a common symptom. There is also progressive inanition, which becomes extreme. The diet, therefore, must be of a light and easily digestible character. In some of the advanced cases the best results are obtained from an exclusive milk diet. For others, when milk is not well borne, the diet should consist of beef or mutton broth, with eggs beaten with milk or sherry, gruels with added milk extracts or peptonoids, custard, rennet, milk toast.

Nourishment should be given at short intervals, at least once in three hours, and the patient should be encouraged to take all that he can possibly digest. The intermittent vomiting may necessitate the use of nutrient enemata. Wine or spirits are usually required for tonic and stimulant effect; the special variety is immaterial.

Osteomalacia

The dietetic treatment of the condition of osteomalacia is suggested by what is known of its ætiology, but the results are seldom encouraging. It is characterised by progressive softening of the bones, a disease in which the salts, especially the carbonate and phosphate of lime, are reduced to about 30 per cent of the normal quantity.

It is not definitely known in what manner these salts are dissolved out of the bony structures, and excess of both lactic and carbonic acid have been regarded as probable solvents. It is not proved that a deficiency of salts in the diet causes the disease, which has been observed in well-fed subjects. It is, however, customary to arrange the diet with regard to furnishing an abundance of salts together with such articles as milk, eggs, and meat.

It is advisable also to prescribe cod-liver oil, either alone or in combination with various phosphates or hypophosphites, and this food proves on the whole the most serviceable. Trousseau thought that it cured one or two of his cases.

It is a rare affection in its worst type, although cases of moderate severity are less uncommon.

Exophthalmic Goître

It is only very advanced cases of exophthalmic goitre with considerable cardiac palpitation that require careful dieting. The indications for treatment are to support the strength and avoid flatulency and constipation, and any substances liable to increase palpitation or excite the nervous system should be withheld. Hence, stimulants of all kinds should be avoided. Tea, coffee, alcohol, condiments, and tobacco are all forbidden, as are also sugar, sweets, pastry, fried food, and "made dishes."

The food should be plainly cooked, and should consist of abundant meats, milk, fats (such as cream, butter, and cod-liver oil), carefully prepared cereals, fresh fruits, and green vegetables.

The theory has been advanced that proteid foods should be withheld in this disease, on the ground that they may intensify the nervous symptoms, but this does not accord with the experience of the writer in these cases. It would doubtless be ill-advised to order an exclusive proteid diet, but anæmia is often a prominent feature and the goitrous case is always made worse when the heart muscle is weakened by anæmia, hence it is desirable to employ a mixed dietary of animal and vegetable food, avoiding such substances only as may produce dyspepsia, as indicated above.

Chronic Lead Poisoning

Causation.—Chronic lead poisoning is common among all artisans or mechanics who work much with lead in any form, but especially white lead. Plumbers and house painters are therefore particularly subject to it. It may also be acquired by eating improperly tinned or badly soldered canned food, although such cases are usually acute. It is sometimes caused by using drinking water which has passed through new lead pipes. When present in the strength of only one one-hundredth of a grain to the gallon it may cause palsy.

The cheap ale, or "four ale," as it is called, sold in London to the lowest classes, is sometimes kept in contact with pewter pipes until it contains toxic quantities of lead.

Lead is sometimes contained in poisonous amount in beer or wine which has been contaminated by the metal during its careless manufacture. Some persons are exceedingly susceptible to lead, and cases are recorded of poisoning from the medical use of a few doses of lead and opium pills, and also from that of cosmetics containing white lead.

Dietetic Treatment.—Chronic lead poisoning is nearly always accompanied by constipation, and it is highly important to overcome this difficulty by such foods as will keep the bowels actively open. Fresh fruits and coarse cereals (such as oatmeal, cornmeal, wheaten grits, Graham bread), and molasses are recommended, with such other foods and regulations as are given under the heading of the Treatment of Constipation (p. 582).

Water should be drunk in large quantity, not only to increase the digestive secretions and keep the fæces moist, but to act as a diluent and aid in washing out the poison.

Lemonade, acidulated with dilute sulphuric acid, fifteen drops to the tumblerful, or with a similar dose of aromatic sulphuric acid, is much in vogue as a prophylactic beverage, for it forms an insoluble lead sulphate from the more soluble carbonate or other salts of lead which may have reached the stomach by being taken with food or drink. This insoluble salt is not absorbed, and hence poisoning may be averted.

Men employed in the manufacture of white lead or other preparations of lead believe that drinking milk freely as a beverage is prophylactic against poisoning, but it is doubtful whether it acts otherwise than as a good diuretic.

Lead colic is sometimes benefited by lavage.

Dietetic Complications arising from Associated Diseases

There are certain diseases and conditions which are not infrequently associated in the same individual, the dietetic treatment of each of which may be directly opposed to that of the other. Such, for example, are: Diabetes and chronic Bright's disease, the former requiring chiefly meat, the latter none; extreme leanness and chronic gastric catarrh, the former condition requiring fats, starches, and sugars, the latter prohibiting them; obesity and chronic albuminuria, the former requiring animal food, the latter none (unless it be milk); acute rheumatism and extreme anæmia, the former requiring no solid animal food, the latter demanding it; intestinal dyspepsia and gallstones, the former benefited by a meat diet and no starches or vegetables, the latter doing better with opposite diet; ascites and chronic albuminuria, where the quantity of fluid ingested as well as the diet may present very opposite requirements.

When such complications arise it is possible to compromise for a time upon a milk diet, this being the most natural food, and one which, on the whole, is capable of more universal adaptation than any other. In other cases, as, for example, in the first instance mentioned above—of diabetes accompanied by severe Bright's disease—one must be governed by the patient's general condition, the gain or loss of body weight, the strength of pulse and muscle tone being the important guides for one or other system of dieting. The lesser evil, whichever it may be, must naturally give way to the greater, and a generous mixed diet may sometimes be found to serve the patient better than one too much restricted by theoretical considerations.

No subject taxes the skill and ingenuity of the dietist more severely than the treatment of such complications, when ordinary rules appear most contradictory.

DIET FOR SURGICAL PATIENTS AND AFTER OPERATIONS, ETC.

Food and Anæsthetics

Preparation for the Administration of Anæsthetics.—When an anæsthetic, such as ether or chloroform, is to be given, care should be exercised that the stomach is empty, otherwise vomiting is apt to occur at a critical moment when the patient is weak, and, being unconscious, the natural reflexes of the process, including the closure of the epiglottis, are not well carried out, and food is very easily drawn into the trachea and excites serious, if not fatal, choking. For this reason the patient is usually prepared for the anæsthetic by giving a light and easily digested breakfast, consisting solely of milk with, perhaps, a little farinaceous food, or a cup of coffee and a roll, and three or four hours later the anæsthetic may be administered with safety.

Feeble patients sometimes require an ounce of brandy or whisky half an hour before the operation—long enough before for it to become absorbed.

It is never desirable to give an anæsthetic within three hours after the ingestion of a full meal. It impedes anæsthetisation, besides causing the danger of vomiting and choking. In many cases it is better to allow five or six hours to intervene. In an emergency where an accident occurring shortly after a heavy meal requires the immediate use of anæsthesia, it may be well to give an emetic first for the purpose of completely unloading the stomach while the patient is conscious.

The instances of fatal choking from vomiting and aspirating food into the larynx are fortunately rare, as they are preventable, but they are by no means unknown. Since their occurrence is almost always due to negligence on the part of the anæsthetiser for not observing proper precautions, they are inexcusable. Ether, by some specific action, is more likely than chloroform to prove irritating and excite vomiting while being inhaled. When retching is violent it may be sometimes overcome by " crowding " the anæsthetic—that is, by causing it to be inhaled more energetically for a moment, until reflex irritation is overcome.

Diet after Anæsthesia.—Ether, much more than chloroform, is apt to occasion prolonged nausea and vomiting after its administration has ceased, and this may last in very susceptible persons for a day or two. In all cases where ether is employed to produce profound narcosis, even when only used to assist physical examinations for diagnostic purposes, it is well that caution should be observed for some hours afterwards in giving food, and a light fluid diet of milk, beef tea, or a cup of cocoa, tea, or coffee only should be allowed when any tendency to nausea or vomiting exists. Under ordinary circumstances no food is required until the effects of the anæsthetic have mainly passed off, and with continued gastric irritation it is necessary to confine the patient to a fluid diet for twenty-four hours or more, and give but little of that. If the patient has been much exhausted by hæmorrhage during the operation or by prolonged anæsthesia, nourishment may be sometimes given sooner, but in concentrated predigested form. Brandy and soda is useful under these conditions, and often allays gastric irritation. Very hot water is to be recommended for the same purpose. In cases of laparotomy for operations upon any part of the alimentary canal, such as appendicitis, it may prove best to give the digestive organs entire physiological rest for twenty-four hours at least, but if the patient is in need of nourishment one or two food enemata may be given.

The following schedule of diet for the day may be taken as an example for an ordinary operation under anæsthesia:

7 A. M.—A cup of beef tea, coffee, or cocoa, or a cup of bread and milk.

11 A. M.—Anæsthesia and operation.

3 P. M.—Iced milk and Vichy, beef essence, or peptonoids. If vomiting occurs, give hot water, or half an ounce of brandy with soda.

7 P. M.—Bread and milk, or beef jelly, or cocoa and a biscuit. Nothing more until the next day, when, if there are no special reasons to the contrary from existing disease or complications arising from the operation, the patient's previous customary diet may be gradually resumed.

Diet after Surgical Operations and Injuries

Fractures, wounds, bruises, ulcers, and all surgical injuries naturally heal the sooner the better the condition of the blood. Abundant nourishing diet, properly selected in regard to its ready digestibility, is therefore indicated. Starvation promptly impoverishes the blood and retards all healing processes.

Mild Cases.—In feeding surgical patients who are confined to bed, or who, from the nature of their injuries, are unable to exercise, care should be taken that the channels for removal of waste from the body do not become choked and inert. In the zeal to promote rapid healing by a liberal diet it is quite possible to overcharge the blood with products of nutrition and defeat the object in view by burdening the liver and other organs, and inducing "biliousness."

The patient's appetite should not be the only guide, but the condition of the tongue, the stools, and the urine should be examined to insure the proper assimilation of all the food taken. In the absence of sepsis, fever, and all affections of the alimentary canal there is usually no harm in allowing the full diet of animal and vegetable food to which the patient is normally accustomed, or, if the appetite flags, considerable variety in the dietary may be advantageously permitted.

If there has been no loss of blood and no severe shock, as soon as an ordinary antiseptic operation is over the patient is practically as well as he was before it was performed.

Cheyne says: "After operations performed aseptically there is no reduction of diet even for a few days. A hospital patient remains on full diet, and a private patient may have anything he fancies, provided it is wholesome, and the more nutritious the food the better." In fact, after opening a psoas abscess or a carious joint the appetite soon returns and "hunger becomes the chief trouble."

As a rule, stimulants are unnecessary if the appetite is keen, but otherwise beer or Burgundy or dilute whisky may be prescribed in moderation as an aliment, to be taken with the meals only. Hard drinkers who receive bad injuries, such as severe fractures, frequently develop delirium tremens in the course of a few days, and this may occur even when they have not been indulging in stimulants for some weeks previously. In such cases it may become necessary to allow a certain quantity of alcoholic stimulation at stated intervals between meals, in order to tide them over an emergency which threatens an immediately fatal result, trusting to reduce the quantity as the delirium subsides.

Severe Cases.—If severe pain has preceded an operation, if the operation has been prolonged, or if there has been much shock, even under anæsthesia, the diet must be supervised with great care. Pain is a strong depressant, and after severe shock rest and stimulation is usually more desirable than food. Positive harm results from overfeeding. Black coffee is very serviceable for such cases or whenever there is lack of nerve energy, and it may be appropriate to keep the patient for three or four days upon a diet of milk or pancreatinised milk. Broths, meat extracts, and beaten eggs may be added when the stomach regains its tone. If nausea, anorexia, or disgust for food exists, or if there is much distention of the stomach, it is unwise to urge food upon the patient. It is better to utilise the rectum in such cases, and coffee, pancreatinised milk, egg albumin, and alcohol are to be given in enemata. Opium or other necessary medication may be added.

If extensive loss of blood has occurred, the volume of fluid should be replaced in the body as soon as possible, and liquid food is needed, such as milk, beef broths, peptonoids, and brandy or whisky, if the stomach retains them. Salt-water injections, or in severe cases hypodermic injections of saline solutions, help restore the lost fluid to the blood and improve vascular tone.

Diet after Laparotomy, Ovariotomy, etc.

After all operations involving opening the peritoneal cavity complete rest of the stomach is necessary for at least four or six hours, and not infrequently for two or three days. Food and stimulants may be given by enemata (p. 414). If fed per os for the first three days not over a tablespoonful of pancreatinised milk or milk with lime water or barley water should be allowed once in two or three hours. Later the quantity may be increased and the intervals diminished, and beef tea, beef peptonoids, and egg albumin may be added.

In these cases the duration of anæsthesia has usually been prolonged, and the shock is considerable. The danger from the occurrence of vomiting, malfermentation of food, and flatulent distention of the abdomen is far worse than that of inanition from abstinence. It is well also to precede the operation by a day or two of dieting in order to lessen the bulk of intestinal waste matter. To this end the diet should, when possible, consist chiefly of lean meat and dry toast, vegetables and especially sweets being avoided.

After wounds and operations affecting the stomach or intestines no food at all should be given by the mouth. Nothing but a little cracked ice should be so administered, and all nourishment must be supplied for several days by the rectum. The return to mouth feeding must be made very slowly and cautiously by at first giving not over one or two tablespoonfuls of pancreatinised milk or beef juice at a time.

There is often much thirst following operations involving the peritonæum, which is relieved more by hot fluids than by ice, which sometimes irritates the throat and increases the desire for drink. If there is danger of all fluids exciting emesis, a salt-water enema once in three or four hours will alleviate thirst (p. 410).

Diet in Surgical Inflammations, Sepsis, etc.

The diet in surgical inflammatory conditions was formerly reduced to a minimum, with the idea that the healing process would be more sure if the stimulating influence of food was removed, and that the inflammation, like an infectious fever, should be "starved out." The *diet absolué*, as the French surgeons of the first half of this century termed it, meant virtual starvation, barley water, arrowroot water, or toast water being all that was allowed. With improvement in feeding fevers came a change in the diet of inflammatory conditions, and it was recognised that the waste of tissue material and the expenditure of force in the evolution of heat must be replenished by nutritious food. No one to-day starves pneumonia, nor yet does an intense local inflammation of a joint demand that the patient should have solid meat meals, but there is an appropriate mean to be observed between overfeeding and starvation. After operations inflammation will not be avoided by starving, and the patient's strength must rather be supported by easily assimilable food. In acute inflammatory conditions tissue waste is rapid and appetite and digestive power are lessened.

In severe cases a diet of milk, diluted by one third or one half with Vichy or Seltzer water, may be given, four ounces every hour and a half or six ounces every two hours. Other articles should be added, such as expressed beef juice or beef peptonoids. These substances may at first be given alone, and then added to strong beef, mutton, or chicken broth. Gruels of arrowroot or oatmeal, raw eggs alone, or beaten and added to sherry or brandy, custard, milk puddings, and beef jelly are all recommended.

When improvement occurs, a light convalescent diet may be prescribed, such as that found on p. 441. Acidulated drinks, sour lemonade, oatmeal or barley water, and effervescing waters may be used to relieve thirst.

In mild cases, and in the early stages of many inflammations, alcohol is not required, but if at any time the pulse becomes feeble, the tongue grows dry, or delirium supervenes, stimulants, such as whisky or brandy, should be freely given. Elderly people and those who have been previously reduced by wasting diseases require earlier stimulation in the form both of meat extracts or meat juice and alcohol. From four to six ounces or half a pint of liquor may be prescribed in twenty-four hours, according to its effect on the pulse. In the milder inflammations, especially those of tubercular joints, malt liquors may be of service. A good strong toddy at night may be made to take the place of opium.

Burns, when severe or extensive, require prompt and energetic stimulation. In bad cases a pint and a half of brandy must be given in twenty-four hours.

In chronic surgical diseases, attended by the formation of pus, fresh green vegetables and fresh fruits are often serviceable, both for their antiscorbutic and laxative effect. Lemonade, oranges, baked apples, or stewed prunes are recommended. Fats are also especially needed, and butter, cream, olive oil, or cod-liver oil should be added liberally to the diet when the patient is able to digest foods of this class.

PART IX

RATIONS, DIETARIES

ARMY AND NAVY DIETS

THE food furnished to soldiers and sailors, both in time of peace and war, is more accurately weighed and measured, and its effects are more accurately studied, for economic reasons than is the diet of any other class of men, even including hospital patients. While seeking to furnish wholesome variety it is necessary to keep the quantity of food as uniform as possible, and this may be done by substitution of articles the nutrient power of which is closely related; thus eggs may be occasionally substituted for milk, or peas or beans may be served for a change instead of cereals.

THE UNITED STATES ARMY RATIONS

A "ration" is technically the total quantity of food issued for one man for twenty-four hours in accordance with law, and not, as often supposed, the allowance for one meal. The original principles upon which military rations have been selected are thus summarised by Major Charles E. Woodruff, Surgeon, U. S. A.:

"1. Economy is essential.

"2. The food must be the product of the country at large, neither a specially prepared article nor the output of a few manufacturers.

"3. The articles must be easily preserved in all climates by the most ignorant men.

"4. The articles must be easily transported and capable of the roughest handling during transit.

"5. The ration is intended for the strongest and most robust men in the nation.

"6. It must be approximate to the food used by the nation at large, so that there will be no rapid change of diet on enlistment that would impair the health.

"For these reasons the soldier's ration has always been simple and dry."

Some of these principles, as the author quoted points out, are radically wrong. It is false economy to furnish too cheap or monotonous diet, which only courts disease and swells the pension roll.

After the Revolutionary War, in 1785, the army ration consisted of one pound of beef, one pound of bread, and one gill of rum. This was quite insufficient, and was subsequently increased (Woodruff). During that war, in addition to the above ration, the soldier received one pint of milk, a little molasses, and a few dried vegetables, with a quart of beer in place of rum.

The present United States army ration costs less than fifteen cents. The German soldier is expected to eke out his peace ration by supplies contributed from his home, and the French and English soldier by contributions from his pay, but in the United States the men usually serve so far from home that this system is neither economical nor desirable. Moreover, with the improvements in canning and other methods of food preservation and condensation, it is no longer necessary for the ration to be the product of the surrounding country. The importance of an adjustable army ration is appreciated when it is considered that within the limits of service in the territory owned by the United States may be found a temperature range of 150° F. Diet suitable for Alaska is wholly unfit for Manila.

UNITED STATES ARMY RATIONS

1. For Troops in Garrison (Garrison Ration, 1901)

	STANDARD ARTICLES.		SUBSTITUTIVE ARTICLES.	
	Kinds.	Quantities.	Kinds.	Quantities.
Meat components.	Fresh beef....	20 ounces...	Fresh mutton......	20 ounces.
			Bacon.............	12 ounces.
			Canned meat......	16 ounces.
			Dried fish.........	14 ounces.
			Pickled fish........	18 ounces.
			Canned fish........	16 ounces.
Bread components	Flour........	18 ounces...	Soft bread.........	18 ounces.
			Hard bread........	16 ounces.
			Cornmeal..........	20 ounces.
Vegetable components.........	Beans........	$2\frac{2}{5}$ ounces...	Peas..............	$2\frac{2}{5}$ ounces.
			Rice..............	$1\frac{3}{5}$ ounce.
			Hominy...........	$1\frac{3}{5}$ ounce.
	Potatoes......	16 ounces.	Potatoes...........	$12\frac{4}{5}$ ounces.
			Onions............	$3\frac{1}{5}$ ounces.
			Potatoes...........	$12\frac{4}{5}$ ounces.
			Canned tomatoes...	$3\frac{1}{5}$ ounces.
			Potatoes...........	$11\frac{1}{5}$ ounces.
			Fresh vegetables, not canned......	$4\frac{4}{5}$ ounces.
			Desiccated vegetables	$2\frac{2}{5}$ ounces.
Dried (or evaporated) fruit components.......	Prunes.......	$1\frac{3}{5}$ ounce....	Apples............	$1\frac{3}{5}$ ounce.
			Peaches...........	$1\frac{3}{5}$ ounce.
Coffee and sugar components....	Coffee, green..	$1\frac{3}{5}$ ounce....	Roasted and ground	$1\frac{7}{25}$ ounce.
			Tea, black or green.	$\frac{8}{25}$ ounce.
	Sugar........	$3\frac{1}{5}$ ounces...		
Seasoning components.........	Vinegar......	$\frac{8}{25}$ gill......	Vinegar...........	$\frac{4}{25}$ gill.
			Cucumber pickles..	$\frac{4}{25}$ gill.
	Salt..........	$\frac{16}{25}$ ounce.		
	Pepper, black.	$\frac{1}{25}$ ounce.		
Soap and candle components....	Soap.........	$\frac{16}{25}$ ounce.		
	Candles......	$\frac{6}{25}$ ounce.		

2. For Troops in the Field in Active Campaign (Field Ration)

	Standard Articles.		Substitutive Articles.	
	Kinds.	Quantities.	Kinds.	Quantities.
Meat components.	Fresh beef....	20 ounces...	Fresh mutton......	20 ounces.
			Canned meat......	16 ounces.
			Bacon	12 ounces.
Bread components	Flour	18 ounces...	Soft bread.........	18 ounces.
			Hard bread	16 ounces.
	Baking powder	$\frac{16}{25}$ ounce....	Hops.............	$\frac{1}{80}$ ounce.
			Dried or compressed yeast...........	$\frac{1}{25}$ ounce.
Vegetable components	Beans........	$2\frac{2}{5}$ ounces...	Rice..............	$1\frac{3}{5}$ ounce.
	Potatoes......	16 ounces.	Potatoes..........	$12\frac{4}{5}$ ounces.
			Onions............	$3\frac{1}{5}$ ounces.
			Desiccated potatoes.	$2\frac{2}{5}$ ounces.
			Desiccated potatoes.	$1\frac{23}{25}$ ounce.
			Desiccated onions..	$\frac{12}{25}$ ounce.
			Desiccated potatoes.	$1\frac{23}{25}$ ounce.
			Canned tomatoes...	$3\frac{1}{5}$ ounces.
Fruit component.	Jam...........	$1\frac{2}{5}$ ounce.		
Coffee and sugar components....	Coffee, roasted and ground.	$1\frac{7}{25}$ ounce...	Tea, black or green.	$\frac{8}{25}$ ounce.
	Sugar........	$3\frac{1}{5}$ ounces.		
Seasoning components.........	Vinegar.......	$\frac{8}{25}$ gill......	Vinegar...........	$\frac{4}{25}$ gill.
			Cucumber pickles..	$\frac{4}{25}$ gill.
	Salt..........	$\frac{16}{25}$ ounce.		
	Pepper, black.	$\frac{1}{25}$ ounce.		
Soap and candle components....	Soap.........	$\frac{16}{25}$ ounce.		
	Candles	$\frac{6}{25}$ ounce.		

3. For Troops when Traveling otherwise than by Marching or when for Short Periods they are separated from Cooking Facilities (Travel Ration)

Standard Articles.		Substitutive Articles.	
Kinds.	Quantities per 100 rations.	Kinds.	Quantities per 100 rations.
Soft bread.................	$112\frac{1}{2}$ pounds..	Hard bread.........	100 pounds.
Canned corned beef.........	75 pounds..	Corned beef hash....	75 pounds.
Baked beans...............	25 pounds.		
Canned tomatoes...........	50 pounds.		
Coffee, roasted and ground...	8 pounds.		
Sugar.....................	15 pounds.		

"The above (3) has the following composition (approximately):

		Protein.	Fats.	Carbo-hydrates.	Calories.
Grammes.	Maximum................	150	170	417	3,900
	Minimum................	120	94	380	2,900
Mean		135	132	400	3,400

"This ration is insufficient for active men, being equivalent to the food of men of sedentary habits. The protein is the only ingredient in nearly the proper amount, and this arises from the meats and beans" (Woodruff).

Although considerable latitude is allowed in the use of substitute foods or variants in the diet, in actual practice army officials and cooks commonly follow routine methods. In commenting upon the importance of adapting our army ration to the needs of the tropics, Major Kean says:

"Fish is largely eaten by all tropical races near the source of supply, and is undoubtedly less stimulating and more easily digested than butcher's meats. For this cause, and to secure variety, fresh fish, where obtainable, should be used twice a week, no savings being permitted.

"The issue of the meat components at Columbia Barracks, Cuba, for 185 consecutive days in 1900 was as follows:

Fresh beef	124 days.
Mutton	none.
Bacon	47 days.
Fresh fish	1 day.
Other issues	13 days.

"Which shows well the monotony of the issue, the only important variant being the undesirable bacon. A certainly more desirable issue, and one apparently permissible according to the paper ration, would have been, for example, somewhat as follows:

Fresh beef	100 days.
Fresh mutton	37 days.
Fresh fish	38 days.
Other issues	10 days.

"A saving of two fifths of the fresh meat being authorised. As fresh fish is quite cheap at Havana, the difference in cost would have been immaterial."

For the tropics this ration contains twice too much salt pork and fresh meat and too few fresh vegetables. The white beans especially cause diarrhœa, and the canned tomatoes are liable to ferment. The tropical red beans are less irritating than the domestic white beans. Red beans and hominy are the staple of the Mexican army diet (Seaman).

Major Kean states (U. S. Surgeon General's Report for 1900) that: "A tropical dietary, as compared with one suited to a colder climate, should have less fat and more carbohydrates, less stimulating proteids in the form of meat, a greater variety of diet both of meats and of carbohydrates in the form of fresh vegetables and fruits, and, lastly, a fairly liberal supply of ice." His argument for the substitution of carbohydrates for fats is that the digestion is weakened in hot climates and the liver is inclined to torpidity, while ingested fats are prone to split up into butyric, caproic, and other irritating acids, which the diminished secretion of the liver is unable to neutralise.

Kean's Proposed Tropical Ration

Articles.	Quantities per ration (ounces).	Saving authorized (ounces).
Meat components:		
Fresh beef	20	8
or fresh mutton	20	8
or fresh fish	20	None.
or when these cannot be furnished		
Bacon	12	12
or salt beef	12	12
or dried fish	14	14
or pickled fish	18	18
or canned salmon	16	16
(Mutton and fish to be issued each twice in ten days.)		
Bread components:		
Same as present ration.		
Vegetable components:		
Rice	$2^2/_5$	None.
Frijoles	$2^2/_5$	None.
or macaroni	3	None.
Fresh vegetables in proper variety (purchased in the vicinity of the post when practicable)	16	None.
Ice	32	None.
Coffee, sugar and seasoning components:		
Same as present ration.		

Munson, in an essay which was awarded the prize of the Military Service Institute for 1900, for a tropical ration, says: "It is true that the sugars and starches should be slightly augmented, but their increase is small when compared with the considerable reduction of nitrogenous and fatty matter which is proposed."

It is well known that the history of prolonged wars has presented a far greater death rate from disease than from the wounds of battle, and much of the former is caused by improper or insufficient food.

When leading a comparatively inactive post life the ration may prove too large—i. e., the food furnishes more energy than the body needs, but there is not always enough variety. Any excess of food is then sold to a co-operative store, and the money thus acquired is expended for a few luxuries to stimulate the appetite.

The most concentrated ration which it is practical for soldiers to carry in the field consists of bacon, hard-tack, and coffee. This is a scorbutic diet, and always produces constipation. To obviate this it is now customary to carry desiccated fruits, concentrated by drying, and which are not spoiled by extremes of temperature. Chocolate has been added to the new United States army emergency ration, as it has been in Austria and Russia.

Uncooked Food of Garrison Ration for Ten Days. Weights in Pounds. Daily Average, 440.4 Men (Woodruff)

	Gross weight.	Waste.	Net weight.	Water.	Protein.	Fats.	Carbo-hydrates.	Salts.	Calories.
Bacon	273¾	3¾	270	54.00	21.60	187.65	......	6.75	831,600
Beans	428½	.....	428½	54.05	99.10	8.57	253.80	13.29	691,228
Pork	343¾	31	312¾	37.85	2.82	259.00	....	13.14	1,097,753
Sugar, brown	731	.....	731	21.93	....	....	705.42	3.66	1,312,081
Flour	4,379	126½	4,252½	531.56	467.78	46.78	3,185.12	21.26	6,991,110
Beef	5,025	1,131	3,894	2,196.70	682.97	978.38	....	35.95	5,409,392
Potatoes	5,116	1,386	3,730	2,943.00	78.33	3.73	667.67	37.30	1,398,750
Onions	700	150	550	481.80	7.70	1.65	55.55	3.30	123,750
Oatmeal	44	.....	44	3.34	6.65	3.13	30.01	0.88	81,400
Cornmeal	85	.....	85	12.75	7.82	3.23	60.01	1.19	139,825
Apples, canned	10	.....	10	8.32	0.02	0.04	1.59	0.03	3,150
Apples, dried	183	.....	183	46.85	1.65	3.30	130.85	2.57	259,494
Tapioca (26) and Cornstarch (13)	39	.....	39	0.78	....	....	38.14	0.08	70,980
Butter	58	.....	58	6.09	0.58	49.30	0.29	1.74	209,670
Sirup	165	.....	165	70.60	....	....	90.60	3.80	168,795
Lard	107¼	.....	107¼	12.90	0.65	89.66	....	4.30	383,775
Rice	26	.....	26	3.22	1.92	0.14	20.65	0.14	42,380
Corn, canned	63	.....	63	51.22	1.77	0.70	8.32	0.38	21,735
Tomatoes, can'd.	332	.....	332	318.72	2.66	1.33	8.30	1.00	26,560
Macaroni (51) and vermicelli (1¼)	52¼	.....	52¼	6.88	4.73	0.15	40.32	0.42	73,815
Milk, fresh, lbs.	31	.....	31	25.61	1.58	1.50	2.00	0.31	12,552
Milk, condensed, lbs	31	.....	31	7.75	5.27	3.41	13.64	0.93	49,442
Cheese	10½	½	10	3.50	3.30	2.20	0.50	0.50	16,000
Prunes	35	20	15	10.00	0.75	....	4.00	0.25	3,500
Cabbage and sauerkraut	250	50	200	182.00	4.20	0.60	11.00	2.20	31,000
Ham	32	4	28	11.63	4.68	11.00	....	0.76	54,880
Apricots	20	.....	20	13.50	0.40	....	6.00	0.12	9,200
Barley	5	.....	5	....	0.65	0.14	3.80	0.15	9,000
Peas	4½	.....	4½	0.55	1.20	0.08	2.54	0.12	7,043
Raisins	14	4	10	6.45	0.05	....	3.50	0.08	6,153
Chocolate	3	.....	3	0.48	0.60	1.50	0.30	0.12	7,950
Totals	18,598	2,908¾	15,689¼	7,120.50	1,413.21	1,657.17	5,343.66	154.82	19,446,960

	Pounds.			Grammes.					
Daily average per man	4.22	3.56 85½%	0.66 15½%	733	145	171	550	16	4,416
Counting flour as bread, amount eaten is 4 lbs. per man. Per cent of amount eaten	......	......	.....	45	9	11	34	1	....

The usual army-ration tables are misleading in that they omit to account for the consumption of considerable accessory food, which is purchased by the soldier in addition to the portion he receives as fixed by law. Major Woodruff has taken pains to carefully compute the nutrient value of the entire food eaten by the men of his garrison at Fort Assinniboine, Montana, during a period of ten days. His table, taken from the Journal of the American Medical Association, December 3, 1892, p. 651, is above.

Additional Articles consumed

	Daily per man.	Allowance.	
338 lb. green coffee	1.23 oz.	1.60 oz. or	
8 lb. tea	0.03 oz.	0.32 oz.	
20 gall. vinegar........ }	0.14 gill	0.32 gill	Allowance is large, to allow of making a saving to be used in making sauerkraut and pickles in the fall.
128 lb. salt............ }	0.46 oz.	0.64 oz.	
10 lb. pepper............	0.036 oz.	0.04 oz.	
11 bottles flavouring ext'ts.			
3 lb. mustard.			
24 lb. baking powder.			
6 lb. currants.			
5 gall. pickles.			
4 kegs pickled pigs' feet ..	Though containing much energy, it is omitted because composition is unknown, and the actual amount per man is very small.		

EMERGENCY RATIONS

For scouting parties, troops under forced marching, or under any circumstances which make the supply of the ordinary ration impossible, an emergency ration for temporary service is necessary. The time-honoured food for this purpose consists of bacon, hard-tack, and coffee, sometimes with addition of a little ground peas or beans.

In the autumn of 1900 an emergency ration was tested in Idaho upon a troop of cavalry. The ration contained in an elliptical can eight inches long weighed one pound and contained three cakes of sweet chocolate (four ounces) and three of a meat (four ounces) and grain compound (eight ounces) having a taste not unlike parched corn. The latter can be eaten uncooked, or as porridge or fried mush. Salt and pepper accompanies the cakes. The ration may be eaten dry, as a soup or porridge, or fried. The test proved successful. The details of preparation of this ration, furnished me by Colonel Alfred A. Woodhull, U. S. A., are as follows:

The chocolate component consists of equal weights of pure chocolate and pure sugar molded into cakes of one and one third ounces each. Three of these go into the day's ration.

The bread and meat component consists of: (1) Fresh lean beef free from visible fat and sinew, ground in a meat-grinder and desiccated so as to contain five per cent or less of moisture, the heat never being allowed to cook it in the slightest degree. The dried product is then reduced to powder and carefully sifted through a fine-meshed sieve, the resulting flour being the meat component.

(2) Cooked kiln-dried wheat, the outer bran removed, is parched and then ground to a coarse powder. This yields the bread component. Sixteen parts of the meat, thirty-two parts of the bread, and one part of common salt, all by weight are thoroughly mixed

in such small quantities as to be entirely homogeneous and compressed into four-ounce cakes. Three of these go into the day's ration. The bread and meat may be eaten dry, or be stirred in cold water and eaten; or one cake may be boiled for five minutes in three pints of water and seasoned to taste; or one cake may be boiled for five minutes in one pint of water to make a thick porridge and be eaten hot or cold. When cold it may be sliced, and if fat is available may be fried.

Three fourths of an ounce of fine salt and one gramme of black pepper are in the can for seasoning.

"This ration is calculated to subsist a man for one day, maintaining his full strength and vigour." As it amounts to a pound of water-free food perhaps it will do it if not depended upon too long.

Foreign Army Rations

Soldiers' Daily Peace Ration, in Ounces Avoirdupois

	British (average).	French.	Austrian.	German.
Bread	24.0	35.2	31.0	26.50
Meat (uncooked)	12.0	10.6	9.87	8.81 (larger ration) 3.80 (smaller ration)

It is apparent from this table that the French, Austrian, and German rations all contain more bread and less meat than the English. In addition, the men have potatoes and other vegetables, green or dried, besides sugar, coffee, salt, etc., which are either issued with the ration or purchased with a special allowance of pay, so that the above figures, which apply to only two articles, fall somewhat short of the actual food consumed. For example: The British soldier receives a total of sixty-five ounces of solid food against the French soldier's fifty-one ounces (Parkes); but many of them are undergrown men, being several years under twenty-five, up to which period the formation of the bones is not always complete. The British army ration contains from four to six ounces less meat than the United States ration, and 4.2 ounces more rice.

In England the daily ration of the soldier on home service consists of one pound of bread (twenty-four ounces is given above as the average for foreign service), thirty-seven grammes of sugar, and three quarters of a pound of meat, which is supplemented by an allowance of about fivepence a day to be expended on minor articles of diet, green vegetables, milk, and beverages.

In the French army legumes form an important element of the ration, to some extent replacing animal food, and many experiments have been made with the German army in regard to the introduction of vegetable food, especially pea meal, which is rich in nitrogenous material.

In France and Holland during active service in the field, in manœuvres, or in battle the diet is materially increased. Experiments made in 1897 upon an Austrian regiment in garrison showed an average gain in weight of 6.6 pounds per man in three months upon a steady daily allowance of protein 120 grammes, fat 56 grammes, carbohydrates 500 grammes (J. Schorr).

The larger ration of the German army, issued during the marches or manœuvres, contains about five ounces more meat and several ounces more vegetable food, and in war thirteen ounces of meat are given. Bacon, salt meat, and rice are also supplied. The German army ration for the tropics contains 5.33 ounces of fresh meat, or 4.4 ounces of bacon and seventy-nine ounces of vegetables.

All the chief armies of Continental Europe issue a wine ration in war times. To the French war ration are added nine ounces of wine or two and a quarter ounces of brandy per diem.

Munson advocates the use of a tropical army ration comprising fresh fruit, soft bread, potatoes, rice, tomatoes, dried fruits, sugar, and protein limited to one hundred grammes.

Nation.	Ration.	Protein.	Fats.	Carbohydrates.	Calories.	Remarks.
		Gms.	Gms.	Gms.		
1. England.	1. Home	93	61	244	1,938	This is starvation diet, and the extra food needed for health is purchased and charged against the soldier (about six cents a day), increasing, perhaps doubling, the food value.
	2. Foreign station, or under canvas at home	111	80	244	2,175	
	3. March	120	80	327	2,550	
	4. War — Max.	165	128	425	3,634	Can be greatly changed to suit climate.
	Min.	133	92	425	3,204	
	Sometimes 2 oz. rum	....	....	....	175	
2. Spain	1. Peace — Max.	147	87	588	3,729	Sufficient for such a mild climate and very moderate work.
	Min.	120	62	500	3,421	
	2. War, on march or in the field — Max.	131	94	522	3,327	Varies enormously according to class of rations issued. Very many extra allowances of money for food.
	Min.	113	55	485	2,550	
	Sometimes 1.7 oz. brandy	....	....	....	150	
3. Austria	1. Peace	155	125	504	3,865	This is augmented by four cents per day for vegetables, etc. On the march a limited emergency ration is used. The war ration is so insufficient that commanders of armies or smaller forces may change, supplement, or even double it.
	2. War	165	130	504	3,952	

Nation.	Ration.		Protein.	Fats.	Carbohydrates.	Calories.	Remarks.
			Gms.	Gms.	Gms.		
4. Italy	1. Garrison		111	130	600	4,129	Allowances of one fifth cent per day for condiments; occasional extra money allowances for food. Excepting the protein, it is a very liberal diet for such a mild country.
	2. Camp		115	133	600	4,163	
	3. Marching		125	143	600	4.307	
	Usually wine added.		....	....	....	250	
5. Germany	1. Small rations and portions in garrison and cantonments	Max.	150	40	703	3,947	This is what the government may supply. Usually the soldier feeds himself and is given seven cents a day, or more, to reimburse himself. Food eaten is more than this deficient diet.
		Min.	99	40	502	2,827	
	2. Large rations and portions on march or in manœuvres	Max.	172	62	915	4,961	
		Min.	138	57	644	3,744	
	3. Field	Max.	195	151	703	4,786	
		Min.	78	75	515	3,413	
	Commanding general may add 3½ oz. whisky		....	....	....	268	
6. United States.	1. By law	Max.	183	260	621	5,368	Maxima due to fats if all the bacon is used and no meat. The whole ration is supposed to be supplied and eaten.
		Min.	105	103	500	3,712	
	2. Usually in field (by law).	Max.	106	320	540	5,166	
		Min.	64	240	460	4,722	
		Ave.	85	280	500	5,000	
	3. Food actually eaten in cold climate, moderate work, including all extras from gardens and purchases		155	180	597	4,907	
7. France	War	Max.	183	300	690	5,455	Peace ration not stated. It is purchased as needed and charged against soldier. War ration is subject to great augmentation for increased work or cold climate. The commanding officer can augment ration on the march.
		Min.	146	127	520	4,015	
	Add $2\frac{1}{10}$ oz. brandy.		....	....	....	184	
8. Russia	1. Peace	Max.	233	114	976	5,884	Also allowed money to buy one half to one and one half ounces extra meat, and one to one and one half cents for vegetables, salt, butter, lard, and groceries.
		Min.	165	65	746	4,450	
	Add 3 oz. wine		....	....	....	223	
	2. War	Max.	174	62	805	4.583	Extra meat and spirits may be ordered by the commander in chief.
		Min.	149	50	640	3,307	
	Add 4½ oz. wine		....	....	....	362	

The foregoing comparative table of various national army rations was published by Major Charles E. Woodruff, M. D., U. S. A., in the New York Medical Record (vol. lv, No. 20, 1899).

As stated by Major Woodruff, the United States is the only nation in the world that in time of peace pretends to supply the entire ration. Soldiers living in densely populated European countries supplement their rations by local purchases from a mess fund or, as in Germany, from supplies from his home. In Austria bread alone is furnished as a peace ration, other food being purchased from a money allowance. At remote frontier posts in the United States a variety of local purchases is frequently unobtainable, and hence the attempt to supply the whole ration in kind.

Navy Rations

From Table A, showing the Different U. S. Navy Rations and their Component Parts, as established by Law, with the Substitutes legally allowed for each Article

Allowance for General Use

Rations as composed by Law.	Either of the following—	
	Specified by law.	Substitutes authorised by law.
Ration No. 1.......	1 lb. salt pork. ½ pt. beans or peas.	1¼ lb. fresh meat, or ¾ lb. preserved meat. Vegetables of equal value, or ½ lb. rice.
Ration No. 2.......	1 lb. salt beef. ½ lb. flour. 2 oz. dried fruit.	1¼ lb. fresh meat, or ¾ lb. preserved meat. Vegetables of equal value.
Ration No. 3.......	¾ lb. preserved meat. ½ lb. rice. 2 oz. butter. 1 oz. desiccated mixed vegetables.	No substitute. ½ pt. beans or peas. No substitute. 6 oz. canned vegetables.
Ration No. 4.......	¾ lb. preserved meat. 2 oz. butter. 6 oz. desiccated tomatoes.	No substitute. No substitute. 6 oz. canned tomatoes.

Weekly Allowance

	½ pt. pickles. ½ pt. molasses. ½ pt. vinegar.	

Daily Allowance

	14 oz. biscuit.	1 lb. soft bread. 1 lb. flour. ½ lb. rice.
	½ oz. tea.	2 oz. coffee. 2 oz. cocoa.
	4 oz. sugar.	For coffee and sugar, extract of coffee combined with milk and sugar may be substituted by the Secretary of the Navy, if not more expensive.

The law allows one of the above complete rations to be used on any or each day of the week, or they may each be used in turn as convenient, in case it becomes necessary to vary the order prescribed elsewhere. Estimated average cost per capita per diem, thirty cents.

The following statement is from the New York Medical Record (1898):

"The naval full-diet table is as follows for one day in the week, the number after each article relating to ounces: Breakfast—coffee, 1; bread, 4; butter, 1; milk, 6; sugar, 1; oatmeal, 1; beefsteak, 6. Dinner—rice soup, 8; bread, 4; roast beef or roast or boiled fowl, 8; potatoes, 8; other vegetables, 6; pickles, 1; bread pudding with sauce, 6; or custard frozen, 8; fresh fruit, 6. Supper—tea, $\frac{1}{4}$; bread, 6; butter, 1; milk, 2; sugar, 1; cold roast mutton or cold roast beef, 4; stewed dried fruit or baked fresh fruit or apple sauce, 4. The staples—coffee, bread, butter, milk, sugar, and fresh and dried fruit—are the same for each meal, but there is a daily variety in meats and other articles for breakfast, dinner, and supper. The proportions are about the same, however, especially in the matter of meats, as in the specimen diet table given above. In addition to its use for convalescents, the table is now observed for all naval-hospital employees, and is gradually becoming the standard aboard ship and in the marine corps. Its adoption was the result of most patient and thorough investigation by Surgeon I. D. Gatewood, who consulted all the leading authorities on the subject."

Table showing the Quantities of the Different Articles of the U. S. Navy Ration which are required for One Man for One Year

Biscuit	319⅜	pounds.
Biscuit (with flour)	182	"
Cornmeal	52	"
Oatmeal	52	"
Rye flour or hominy	52	"
Wheat flour	52	"
Salt pork	104	"
Beans	6½	gallons.
Peas	3¼	"
Salt beef	52	pounds.
Rice	26	"
Dried fruit	13	"
Butter	19½	"
Tomatoes	19½	"
Canned meal	78	"
Ham or bacon	39	"
Sausage or salt fish	39	"
Coffee	26	"
Tea	4⅞	"
Cocoa	19½	"
Sugar	91¼	"
Pickles	26	"

Molasses	3½ gallons.
Vinegar	3½ "
Canned vegetables	39 pounds.

The British Navy ration contains one pound of fresh meat, one pound and a half of bread, or one pound and a quarter of sea biscuit.

In comparing navy with army rations it should be remembered that on shipboard a proper cooking range, utensils, and fuel are always obtainable, whereas wholly different conditions obtain with an army in the field.

Table showing the Different Articles of the U. S. Navy Ration, for which Practical Equivalents or Substitutes are permitted, with the Quantity of each allowed for Issue

Articles named in the Law.	Articles considered as included under names given in preceding column.		Quantity allowed per ration.
Bread	Biscuit		14 oz.
	Soft bread		1 lb.
Flour	Cornmeal; Corn (hominy); Oatmeal; Rye; Wheat		As substitute for 1 lb. bread.
Preserved meat	Roast beef; Canned mutton; Chicago corned beef; Brawn; Ham; Bacon; Sausage; Fish: Dried, Smoked, Pickled		12 oz.
Dried fruit	Dried apples. Peaches. Raisins. Currants. Prunes. Figs. Dates.	Or any other kind of dried fruit	2 oz.
Tea	May be substituted for each other		¼ oz.
Cocoa			2 oz.
Fresh meat	Beef. Mutton. Veal. Pork. Poultry.	Or any other kind of fresh meat	1¼ lb.
Vegetables	Fresh (such as can be procured)		1¼ lb.
	Canned (assorted kinds)		6 oz.

DIET IN PRISONS

In prisons, penitentiaries, or reformatories the diet should be adapted to keep the patients in good health through periods of years, while it is maintained at a minimum of expense to the community. A brief review of such established diets is useful in furnishing an idea of quantity and quality of food required to fulfil the necessary conditions.

Voit calculated that for a prisoner not engaged in hard labour the following diet is sufficient to maintain health: Carbohydrates, three hundred grammes; albumin, eighty-five grammes; fat, thirty grammes, or a proportion of about 10, 3.5, and 1.

In some penal institutions the inmates are placed upon a progressive diet—that is, a diet which is regulated according to the duration of their sentence, the degree of labour exacted from them, and their conduct. Such a diet has been recommended by the British Commissioners of Prisons, graded for: (1) Periods of seven days or less. (2) Periods between seven days and one month. (3) Periods between one and four months. (4) Periods exceeding four months.

A somewhat similar system is detailed below—that of the United States Army Prison at Fort Leavenworth.

Diets of the United States Army Prison, Fort Leavenworth, Kansas

GENERAL DIET

Breakfast.—Hash, on Tuesday, Wednesday, Thursday, Saturday and Sunday. Mutton or beef stew, on Monday and Friday. Coffee, one quart each morning.

Dinner.—Pork, one day each week. Corned beef, one day each week. Roast beef and gravy, three days each week. Boiled beef and gravy, two days each week. Vegetable soup, daily except Sunday.

One pint of coffee each Sunday. Pork may be substituted for corned beef or boiled beef one day each week during cold weather.

To the above will be added pickled cucumbers, beets, or tomatoes on alternate days, and such other vegetables as may be available from the prison farm.

Supper.—Tea or coffee, one quart; bread, as much as required. Stewed apples or prunes on alternate days.

No. 1. The following diet, known as "Solitary," is given prisoners confined in cells for punishment, while not performing any labour:

Breakfast.—Bread, eight ounces, water *ad libitum.*

Dinner.—Bread, eight ounces; water *ad libitum.*

This punishment is given only for short periods, varying up to twenty days.

Total farinaceous foods, sixteen ounces.

No. 2. The following diet, known as "Restricted," is given prisoners confined in cells for punishment, while not performing any labour:

Breakfast.—Hash or stew, eight ounces. Bread, seven and a half ounces.

Dinner.—Soup, eight ounces. Bread, seven and a half ounces. Salt *ad libitum.*

Supper.—Bread, eight ounces.

The eight ounces of bread for supper to be given after the twenty days of subsistence on the previous diet.

Total proteid food, eight ounces; total farinaceous food, twenty-three ounces.

No. 3. The following diet is given to prisoners who have undergone punishment:

Breakfast.—Hash or stew, ten ounces. Bread, ten ounces. Coffee and sugar in the usual amounts.

Dinner.—Soup, the usual amount. Beef, eight ounces, or pork, six ounces. Peas or beans, six ounces, or hominy in the usual amount, or potatoes, eight ounces. No other vegetables except such as are contained in the soup.

Supper.—Bread, ten ounces. Tea and sugar in the usual amounts.

To prisoners who have been on "Restricted Diet" for more than ten days and less than twenty days, or on "Solitary Diet" for ten days, the above diet (No. 3) is given for two days.

For those who have been on "Restricted Diet" for twenty days or more, or on "Solitary Diet" for fifteen days, the above diet (No. 3) is given for three days.

The dietary of the New York State Reformatory will be found on pp. 730–732 in tabular form.

The comparison of this Reformatory Diet with other standard rations is presented in the following table of actual nutrient values:

	Nutrients, in grammes.			Potential energy, in calories.
	Protein.	Fats.	Carbo-hydrates.	
Reformatory standard dietary daily ration *	119	61	556	3,334
Actual upper first grade ration	167	75	810	4,696
Actual lower first grade ration	154	69	794	4,524
Actual second grade ration	154	69	776	4,452
Playfair's standard for adults, moderate exercise	119	51	531	3,140
Voit's standard for labouring men at moderate work	118	56	500	3,050
Voit's standard for prisoners in idleness	85	30	300	1,857
Voit's standard for prisoners at work	105	40	500	2,852

* All food supplies are issued according to this standard dietary, except bread, which is unlimited. The average consumption of bread per man is somewhat in excess of one and one half ration per meal, thus accounting for the increase in value of the actual ration over that of the standard dietary, which conforms very nearly in food values to the standards of Voit and Playfair.

At a Conference of the Prison Association of New York, the following bill of fare was recommended for general adoption in prisons. The quantity of food is not specified:

Sunday

Breakfast.—Pea soup, bread and butter.
Dinner.—Baked beans, brown bread, pudding.
Supper.—Bread or crackers, cheese, milk.

Monday

Breakfast.—Oatmeal or boiled rice, with sugar and milk.
Dinner.—Salt fish, vegetables, fruit.
Supper.—Bread and butter, milk.

Tuesday

Breakfast.—Bean porridge, bread.
Dinner.—Roast beef, two or more kinds of vegetables, bread.
Supper.—Bread and milk, molasses.

Wednesday

Breakfast.—Pea soup, bread.
Dinner.—Beef or mutton stew, with vegetables. (Rice may be used in place of potatoes.)
Supper.—Cornmeal mush, molasses.

Thursday

Breakfast.—Bread and butter, milk.
Dinner.—Baked beans, bread, fruit.
Supper.—Bread and butter, cereal, coffee.

Friday

Breakfast.—Pea soup, bread.
Dinner.—Fresh fish, vegetables. (Rice may be used in place of potatoes.)
Supper.—Bread and milk, cheese.

Saturday

Breakfast.—Oatmeal mush, milk, bread.
Dinner.—Corned beef, vegetables.
Supper.—Bread and milk, molasses.

New York State Reformatory Dietary

STANDARD DAILY DIETARY. — TABLE OF FOOD VALUES. (NUTRIENTS.)

*	Sunday.			Monday.			Tuesday.			Wednesd'y.			Thursday.			Friday.			Saturday.			Weekly total.	Refuse, bones, skin, etc.	Water.	Protein.		Fats.		Carbo-hydrates.		Min. mat'r.	Potential energy.
	b	d	s	b	d	s	b	d	s	b	d	s	b	d	s	b	d	s	b	d	s	Oz.	%	%	%	Oz.	%	Oz.	%	Oz.	%	Cal'ies.
Can'd corned beef	1.6						1.6						1.6			1.6						6.40		62.0	30.0	1.92	8.0	0.51	....	......		358
Beef					12			6									6			8		32.00	19.7	44.0	13.8	4.41	21.7	7.94	....	......	0.8	2,608
Mutton											8											8.00	20.0	42.9	37.1	2.97	23.2	1.86	....	......	0.7	834
Pork (fat)														1								1.00	10.4	9.5	2.8	0.03	76.5	0.76	....	......	0.8	205
Kopf's pea soup		2																				2.00			21.0	0.42	17.0	0.34	46.0	0.92		246
Bread	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	168.00		32.7	8.9	14.95	1.9	3.19	55.5	93.24	1.0	13,417
Potatoes	6				12		6	4		6	4		6			6			6	4		60.00	10.0	68.0	1.8	1.08	0.2	0.12	19.1	11.46	0.9	1,489
Onions								½		½	½								½	½		2.50										
Turnips								1			2									2		5.00										
Carrots								1			1½									1½		4.00										
Parsnips								1			1½									1½		4.00	10.0	81.0	2.0	0.39	0.2	0.04	6.0	1.17	0.8	192
Beets								½			½									½		1.50										
Tomatoes																	2½					2.50										
Flour					½						1½						1½			1½		5.00		4.6	11.1	0.55	1.1	0.05	75.6	3.78	0.6	518
Oatmeal								¼														0.25		7.7	15.1	0.04	7.1	0.02	68.1	0.17	2.0	29
Beans				4				½						6								10.50		13.7	23.2	2.44	2.1	0.22	57.4	6.02	3.6	1,042
Barley								¼														0.25		18.0	10.5	0.03	2.5	0.01	67.0	0.17	2.0	24
Rice								¾									1					1.75		12.4	7.4	0.13	0.4	0.01	79.4	1.39	0.4	178
Molasses																						31.00			....	....	....	....	63.0	18.90		2,197
Totals, one week																						344.65				29.36		15.07		137.22		23,337
" one day																			49.24							4.19		2.15		19.60		3,334
Standard daily ration—grammes																							......	....	....	119	....	61	....	556		

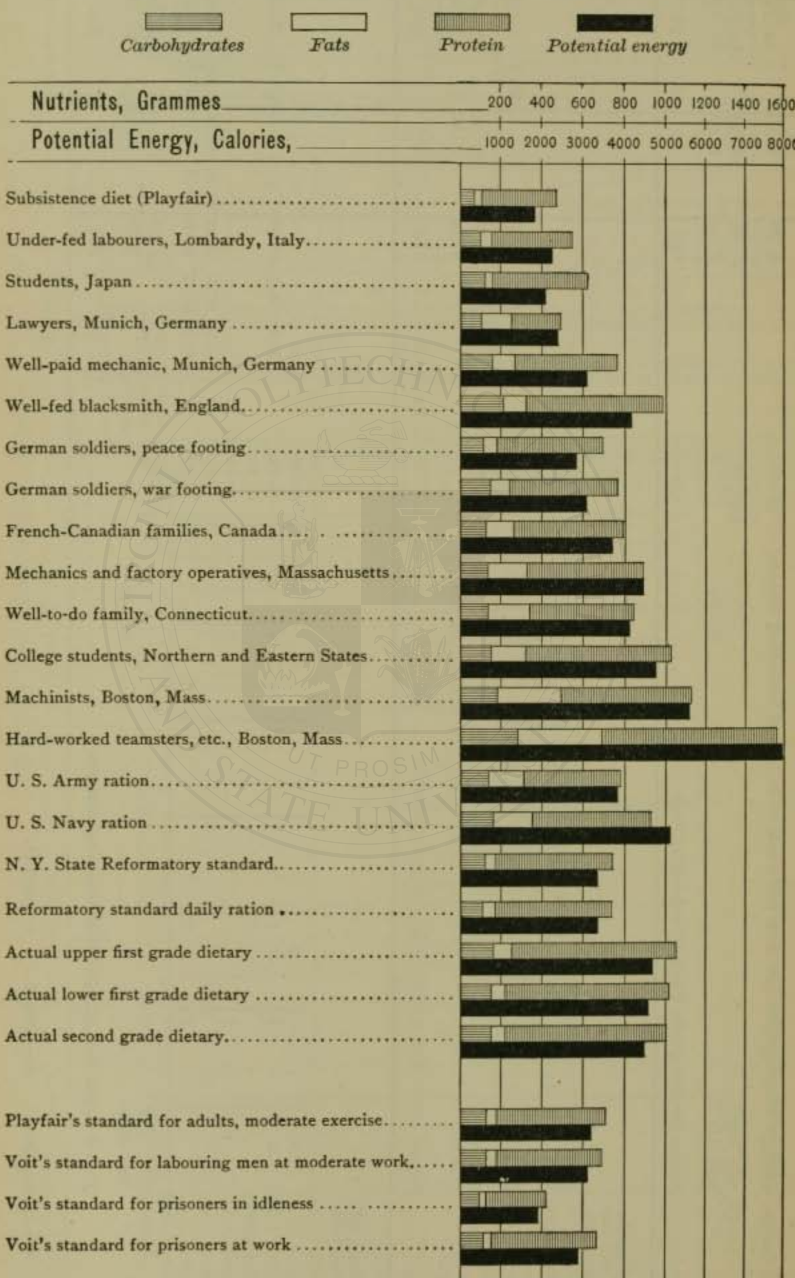
Bread (actual average consumption per man per week in excess of Standard Ration).																						98.00				8.72		1.86		54.39		7,827
Totals, one week																						442.65				38.08		16.93		191.61		31,164
" one day																						63.24				5.44		2.42		27.37		4,452
Actual second grade daily ration—grammes																							......	....	....	154	....	69	....	776		
Additional for upper and lower first grades.																																
Coffee	1/4			1/4	1/4		1/4			1/4	1/4		1/4	1/4		1/4			1/4	1/4		2.75										
Tea			1/8			1/8			1/8			1/8			1/8			1/8			1/8	0.88										
Sugar	1/4		1/4	1/4	1/4	1/4	1/4		1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4		1/4	1/4	1/4	1/4	4.50		2.2	0.3	0.01		.....	96.7	4.35	0.8	507
Totals, one week																						450.78				38.09		16.93		195.96		31,671
" one day																						64.40				5.44		2.42		27.99		4,524
Actual lower first grade daily ration—grammes																							......	....	....	154	....	69	....	794		
Additional, upper first grade.																																
Coffee		.2						.2									.2					0.60										
Sugar		.2	3/8			3/8		.2	3/8			3/8			3/8		.2	3/8			3/8	3.23		2.2	0.3	0.01		.....	96.7	3.12	0.8	363
Dried apples			5/8						5/8						5/8						5/8	2.50										
Currants						3/4						3/4						3/4				2.25										
Butter			3/8									3/8						3/8				1.13		10.0	1.0	0.01	85.0	0.96	0.5	0.01	3.5	254
Cheese						2			2						2						2	8.00		41.3	38.4	3.07	6.8	0.54	8.9	0.71	4.5	583
Totals, one week																						468.49				41.18		18.43		199.80		32,871
" one day																						66.92				5.88		2.63		28.56		4,696
Actual upper first grade daily ration—grammes																							......	....	....	167	....	75	....	810		

* b—breakfast. d—dinner. s—supper.

From the New York State Reformatory Annual Report for 1893

Calculations based on Prof. Atwater's tables, with Reformatory standard diet added.

COMPARISON OF DAILY DIETARIES



THE MILK CURE

An exclusive diet of milk as a cure for certain chronic diseases is advocated by some physicians, and in whose hands it has met with considerable success. Karell, of St. Petersburg, and Weir Mitchell are to be mentioned among those who have extensively used this form of treatment. The treatment as a "cure" does not apply to the temporary exclusive milk diet of typhoid fever and similar acute febrile conditions, but it is believed by the advocates of the milk diet that this form of food not only counteracts certain abnormal conditions and meets definite requirements of the body, but that the milk diet itself possesses a special curative value in some cases. Bauer says emphatically: "It is an indisputable fact that in certain diseases a methodical use of the milk cure gives results such as can be attained by no other treatment."

It is recommended in obstinate cases of chronic intestinal disorders, especially neuralgia, intestinal dyspepsia, and colitis; in chronic congestion, hypertrophy, and fatty degeneration of the liver; in asthma, pulmonary catarrh, and emphysema; in dropsies of renal, cardiac, and hepatic origin; in hysteria and hypochondriasis, in which the predominant symptoms are dyspepsia and malnutrition; and in chronic catarrhal conditions of the whole alimentary canal.

The milk cure is also recommended in cases of neurasthenia, obesity, rheumatism, gout, chronic valvular cardiac diseases, chronic Bright's disease, and endarteritis.

Dosage and Method of giving the Milk.—The milk used is skimmed, and it is important to have it obtained as fresh from the country as possible. It is customary to begin with comparatively small doses—about four ounces, once in two hours throughout the day, with one or two doses at night. Karell gives the milk lukewarm. At the end of a few days the dosage may be increased to six or eight ounces, and the intervals made three-hourly, and finally four-hourly, when twelve tumblerfuls are given daily. Pecholier gave three litres per diem, in two-hourly doses. When the treatment is undertaken it must be carried out with absolute regularity and system, both as regards the quantity of milk consumed and the intervals at which it is given; otherwise, if too large an amount is drunk at one time, or the intervals are too frequent, undigested milk remains in the stomach to mingle with the fresh doses, and abnormal fermentation and dyspeptic symptoms result. It is much better that the milk should be given alone whenever large quantities are to be taken for a long time. If diarrhœa exists, the milk may be boiled or taken hot at any time, if the patient so prefers it, but this is not necessary. If the passages from the bowels are normal in appearance —small and solid—the milk is being well digested and absorbed, and the quantity may be increased. Usually the greatest difficulty with indigestion in this form of treatment occurs during the first week; afterward, as a rule, the alimentary canal becomes accustomed to the diet and digestion proceeds actively and nutrition improves.

Many patients—either from imagination or from past experience with milk drinking—insist that they are unable to take it in any form, but it is rare, indeed, to find any one who cannot digest milk if it is made palatable and properly prepared. For this purpose, suggestions will be found under the heading of the article on the Adaptation of Milk for the Sick (p. 74), to which the reader is referred. Not a few learn to prefer the milk to more highly seasoned food. If the patient chooses—and it is wholly a matter of taste—the milk can be flavoured with very weak tea, weak coffee, or caramel, and a pinch of salt should be added in most cases to each tumblerful. Exceptionally the flavour of a little spice of some sort may be preferred. Some patients do better if the milk is diluted by one third or one half with some alkaline table water, lime water, or Vichy, or it may be scalded with a little boiled water to which five grains of sodium bicarbonate and three or four grains of common salt are added. Milk from first-class thoroughbred cows, such as Alderneys, is often too rich, and it is undesirable to give any milk in this cure which contains much cream. Skimming the milk is therefore necessary in most instances, and in some cases, even after the milk is skimmed, it is better digested if considerably diluted.

In carrying out this treatment much depends upon previously gaining the confidence of the patient and having him thoroughly understand the theory of the cure, so that his willing co-operation may be obtained in a method which is monotonous and wearisome at best. By a little tact and persuasion with care in framing the original rules and supervision over their execution the cure may often be conducted with great benefit in seemingly difficult cases. The one object of the treatment is to enable the digestive organs to rest and recuperate when they are in an exhausted or irritable condition by giving only small quantities of the simplest form of food at first. Later, as digestion improves, larger amounts will be tolerated and the strength and nutrition of the patient will be promoted by increasing the dosage of milk to whatever maximum can be reached without taxing the stomach.

Symptoms accompanying the Treatment.—The frequent occurrence of constipation is a not unfavourable indication that the milk is being well digested and very completely absorbed, leaving but small residue. Diarrhœa or obstinate vomiting, on the other hand, indicate indigestion and malnutrition, and the difficulty should be corrected by temporarily reducing the quantity of milk and prolonging the intervals between the doses to four or even six hours. The constipation is met by the use of a pill of two grains of inspissated oxgall, or by the compound licorice powder (pulvis glycyrrhizæ compositus), or a dose of rhubarb, or half an ounce of castor oil, or thirty to sixty minims of fluid extract of cascara. The addition of coffee to the milk drunk in the earlier hours of the day sometimes renders it more laxative, and, if necessary, prunes or stewed or baked apples may be taken once daily, in the middle of the afternoon.

In addition to the milk, patients should be allowed a reasonable quantity of water or of aërated waters. It is well that some water should be given even though thirst be not complained of. After a fortnight or three weeks some patients complain very much of the absence of solid food, and in such cases—if the digestion is favourable—stale bread, crackers, dry toast, or a little salted Dutch herring may be allowed, or a milk soup thickened with barley or groats. Some patients do well to take one of the prepared starchy foods, such as are in familiar use for infant feeding. As a usual result of the treatment, patients lose weight somewhat during the first ten days or two weeks, but after the quantity of milk begins to be increased they may gain considerable flesh and strength, excepting in the case of very obese persons, who may continue to lose fat after the maximum dosage of milk has been attained. Drowsiness is also a common symptom in the first few days. The urine is increased, and is pale in colour and of low specific gravity. The tongue is covered with a thick white or yellowish coating, and there is usually a disagreeable, mawkish taste in the mouth. The latter condition may be relieved very largely by proper care (compare Treatment of Typhoid Fever, p. 432). The increased quantity of urine is possibly due to the large amount of lactose, which is somewhat diuretic in action; but when given alone I have not found it to possess exceptional power in this direction. According to Weir Mitchell, the uric acid is greatly reduced in the urine and the colour is of a somewhat greenish hue, and indol and skatol also disappear. Weir Mitchell calls attention to the extensive changes in assimilation in the body which these various alterations in excretions indicate.

After about six weeks of this milk diet the substitution of solid food is to be gradually made, reducing the number of milk meals by at first one a day for a day or two, then by two, and so on until all food is taken solid, and Karell suggests that lean, raw scraped beef with stale bread is the best to begin with. The diet should be so graded as to consist largely of milk for several months.

THE WHEY CURE

The whey cure has been extensively practised in the mountainous regions of Germany and Switzerland and at various springs or baths, especially those of the alkaline waters, which latter are frequently mingled with the whey and drunk either warm or cold. The treatment is rigorous, and consists in confining the patient's diet largely to the use of about twenty ounces per diem of fresh milk whey. The principles of the treatment are essentially similar to those of the milk cure, but in whey the casein of the milk has been artificially removed to make cheese by the addition of rennet, the milk-curdling ferment.

Whey is made from the milk of several animals, such as the sheep, goat, mare, and ass, as well as the cow. It consists of milk sugar, albumin, substances resembling peptone, and a smaller quantity of fat with most of the lactic acid. It is whitish, translucent, and opalescent.

When milk has been standing for some time in the air it becomes contaminated with bacteria, which cause spontaneous coagulation, and whey is squeezed out of the contracting clot; but this is sour and not so good as that made by rennet. The percentage composition of whey is as follows:

Water	93.31
Lactose	4.65
Fat	0.24
Proteid	0.82
Lactic acid	0.33
Salt	0.65

The whey cure is used for the treatment of Bright's disease and chronic catarrhal conditions of the alimentary canal. It is particularly recommended for chronic dyspepsia and chronic irritable cough accompanying catarrh of the respiratory mucous membranes.

It is said to improve the secretion in chronic bronchitis, and it increases the strength of the pulse, which is attributed to its potassium salts (May). If more than twenty ounces are ingested daily there is an increased peristaltic movement, with watery evacuations, colic, and dyspepsia.

Whey, like skimmed milk, is diuretic and sudorific. It therefore constitutes a useful beverage in fevers. The class of patients, many of them phthisical, for whom the cure is recommended at Ems, Ischl, Reichenhall, etc., are not fit subjects for a reducing diet, as they have little or no spare strength; they require rather abundant nourishment, owing to the catarrhal processes which affect the respiratory and alimentary passages. However, in such cases digestion and absorption are often greatly impaired, and this condition is found to be benefited by the use for a short period of the alkaline waters and whey. It is not safe to limit the diet exclusively to these fluids, and some nitrogenous food must be given, together with fresh fruit and green vegetables. In Switzerland and Germany the whey cure is often combined with the grape cure.

VARIOUS "CURES"

There are other diet systems or "cures," which deserve passing mention rather as matter of general interest and as illustrations of the effects of strong mental impressions or "mind cure" combined with moderation in previous habits of overeating or gluttony, than because any specific importance is to be attached to the value of one such "cure" more than another.

Many diet "cures" have been devised purely for notoriety, to advertise an otherwise unsuccessful practitioner or a charlatan, and others again are exploited by well-meaning fanatics who have acquired a firm belief in some dietetic system which has first helped themselves, and which they feel that they owe to the world to promulgate for the guidance of others. But they are not always even pretended followers of Æsculapius. Mr. Banting (p. 637), whose name has given rise to a verb meaning to reduce corpulency, was a layman, and so was Mr. Graham, whose name is a household adjective applied to the flour which he introduced, and many famous men, like Shelley and Goldsmith, have sung the praises of vegetarianism.

Not infrequently an element of religious fervour is added to the belief in the efficacy of some new system, and long pilgrimages are made to seek its chief apostle. Such, for example, is the

Kneipp System.—Monseigneur Kneipp was a Bavarian priest whose patients lived chiefly upon a diet of milk, coarse bread of bran and flour, soup, and cooked fruits, with a minimum of meat, eggs, and vegetables. Water was principally drunk, with a little wine or beer, but no spirits or coffee. This is undoubtedly a common-sense regimen for many persons who have long abused their gastronomic powers by eating too much and too rich food, but the ascetic elements were added of wearing very light, loose apparel and walking about barefooted in the grass before the morning dew vanished.

FRUIT CURES

The "fruit cure" has appeared in many forms. At one time it is confined to oranges, English walnuts, and cold water, and, strange to say, some dyspeptics are able to digest it for a short time; or it consists of sweet fruits and meat alone—dates, figs, prunes, bananas, and apples—upon the theory that fruits were the first food of primeval man, and *ergo* they are the natural food of all men—an extreme of atavism, surely! There is also a "lemon cure."

Another fruit cure extends through six weeks. It begins gradually by eating an apple or orange upon rising and again upon retiring. In three or four days the breakfast consists of several baked apples, a small quantity of bread and butter, and a little coffee.

During the forenoon several ripe apples or oranges may be eaten. At dinner fresh animal food is furnished with a potato and roasted apples or apple sauce. Green vegetables are allowed, but no bread or pastry of any kind. Pickles may be eaten. During the afternoon, more fruit, oranges, apples, grapes. Supper, like breakfast, with a little sago in milk, with currants, raisins, or apples. This diet is adapted to obstinate chronic constipation, some cases of obesity, and lithæmia.

THE GRAPE CURE

The grape cure has been advocated for many years as beneficial in certain forms of disease, but, like the majority of vaunted dietetic "cures," it is almost certain that the chief benefit experienced is from the change of scene and the favourable climatic and hygienic surroundings of the patient, and possibly the influence of a stimulated imagination. The "cure" is in vogue during the grape-bearing season of the vineyards in various parts of southern Europe, especially at Meran and Montreux. Grapes, being very largely composed of water, do not possess a very high degree of nutritive power, and it is impossible to maintain life upon their exclusive use; but the grape sugar which they contain, as well as a large amount of potassium and other salts, may have some slight alterative effect and benefit nutrition. Grapes are also laxative. Almost every one is fond of the fruit, and the cure is therefore an agreeable one to take, especially as the diet is not too exclusive, for the eating of large quantities of grapes is made an adjunct to the employment of highly nutritious food.

Vineyard labourers who eat little else but grapes quickly lose weight, and other food must be taken with the grapes if the strength is to be maintained, for a pound of grapes contains a little less than three grammes of proteid.

It is recommended by Lebert that the grapes should be eaten systematically and in quantities commencing with half a pound, and seldom exceeding four pounds per diem, although six or eight pounds are sometimes eaten, a quantity which may excite diarrhœa. Owing to the mildly laxative effect of the fruit, this cure is beneficial in cases of chronic constipation, and especially in engorgement and hyperæmia of the liver accompanied by extensive venous congestion, hemorrhoids, and the formation of various forms of calculi. In gastric catarrh patients are sometimes allowed to eat six pounds of grapes a day. The laxative effect is always greater if the fruit is taken in the intervals between meals, and especially if taken fasting on rising in the morning. At first only half a pound of grapes is to be taken two or three times a day, from half an hour to an hour before meals, the quantity being gradually increased to a pound or more at each dose. Some patients digest the grapes better, however, if they are eaten in the form of dessert than if taken into an empty stomach. The laxative effect gradually increases, and is usually more pronounced after several days. The uric acid and acidity of the urine is lessened.

When patients become tired of the monotony of this single fruit they may be allowed to substitute pears or figs. It is stated that the gums may become somewhat swollen and tender from the acid contained in so much fruit, and to obviate this difficulty the mouth may be cleansed thoroughly after eating with listerine or a solution of sodium bicarbonate, or the mastication of a small quantity of bread will serve to cleanse the teeth.

Abundant other food is allowed with the grapes, but it is important that it should be of an easily digestible character, and certain articles must therefore be forbidden, such as fats, rich sauces, gravies, pickles, condiments, the heavier vegetables, such as potatoes and the legumes, cheese, pastry, cakes, sweets, and beer.

The usual duration of the cure is from a month to six weeks. The average chemical percentage composition of grapes is given by König as:

Water	78.17
Sugar	14.36
Free acid	0.79
Nitrogenous material	0.59
Extractives	1.96
Stones and woody fiber	3.60
Ash	0.53

The latter is chiefly composed of potash salts, some lime and magnesia.

Patients who have undertaken the grape cure without proper supervision easily disorder their digestion and cause gastric catarrh and even jaundice. Knauthe says that the eating of several pounds of grapes daily may at first cause symptoms of flatulent dyspepsia, more or less vertigo, and increased frequency of the pulse, palpitation, diuresis, and malaise. The stools become more frequent and semisolid.

The grape cure is reputed to be useful in chronic bronchitis, the first stage of phthisis, emphysema, in obesity when combined with a restricted diet, in gastro-intestinal catarrh, anæmia, vesical catarrh, gout, hepatic engorgement, malarial cachexia, and chronic cutaneous affections.

In phthisis the grapes should not be given in quantities sufficient to occasion diarrhœa.

MEAT AND HOT-WATER CURE

The meat and hot-water cure, often called in this country by the name of Salisbury, one of its chief advocates, is given to many classes of patients—consumptives, rheumatic subjects, and others. Lean raw beef is ground to a pulp in a machine which is made for the purpose and sold in hardware shops. It is freed from all fibre, seasoned with salt and pepper, rolled into little balls, and cooked just enough to turn the outside from a red to a drab colour. From two to four ounces are eaten at a meal at first; later as much as seven ounces may be taken. In addition, from two to four raw eggs are given with dry toast. No fluid is allowed with meals, but from a half pint to a pint of hot water is given before each meal, and again at bedtime.

This diet reduces corpulency rapidly, and is beneficial in cases of chronic gastric catarrh and dilatation, but it is too rigid for many patients. It is somewhat similar to, but much more strict than, the diets of Carlsbad and Wiesbaden, which consist chiefly of lean meat, eggs, and milk with a minimum of bread, and sometimes fruit.

THE DRY CURE

The " dry cure " is the name given to the treatment which consists in withholding fluid from the diet in increasing degree until the patient takes just as little as is necessary to sustain life. If carried to this extreme, however, thirst becomes intolerable, and patients usually rebel against the rigour of such treatment.

Practically it is found that the minimum of water aside from that contained in food which patients can tolerate is about fifteen ounces per diem, which should be taken between meals. For the relief of thirst in these cases various measures are employed, such as are described on p. 43.

In Germany the dry diet has been tried extensively in some cases, especially those of gastric dilatation and cases of chronic effusion into the joints and in the peritoneal cavity. There are many forms of disease in which it is well to temporarily restrict very much the quantity of fluid consumed, but it is hardly ever justifiable to do so to the degree recommended by enthusiastic advocates of the " dry cure," among whose patients fatal cases of scurvy have occurred as well as cases of fever with a temperature sometimes amounting to 104° F. The conditions in which the quantity of fluid drunk should be especially restricted are gastric dilatation, chronic serous effusions, flatulent dyspepsia due to indulgence in sweets, coffee, tea, etc., some few cases of obesity, and aneurism of the aorta (compare Tufnell's treatment, p. 491).

Schroth's Method

The dry cure of the yeoman John Schroth has achieved some notoriety in Europe, where several "institutes" have been established for its practice. It is a rigorous method which many patients find difficult to endure. The diet is gradually reduced in quantity and variety at first for a few days, and then the actual "cure" is begun, which consists in giving no fluid at all, excepting a small glass of hot wine twice a day for as many days as the patient will endure it. Boiled vegetables are allowed for dinner, and otherwise nothing is given but dry bread. Thirst becomes so extreme that in three or four days the patient is allowed to drink hot wine freely to quench it, after which the quantity of fluid is again cut down to two small glasses a day until the patient is again obliged to receive more.

This treatment has in some cases been carried to the verge of starvation with extreme prostration and fever, and it has little or nothing to recommend it. Even fatal scurvy has followed its use at Kiel. It is based upon the theory that the blood becomes more dense, which favours osmosis between the serum and the surrounding lymph and tissues. As an adjunct to the treatment hot moist packing is employed.

Jürgensen modified the treatment by giving from one third to two thirds of a pound of lean beef with bread as desired, and light red wine. It has been found by this writer and by Bartels that proteid metabolism is undoubtedly increased by the dry diet, for the urine contains nitrogenous waste in as large a proportion as when the patient is upon a full diet—in some cases there is even more than the normal.

Upon slowly resuming the accustomed diet a considerable gain in weight compensates for previous loss, which is attributed in part to restoration of water to the tissues. Bartels noted an increase in urea which was greatest immediately after the treatment. The considerable rise of temperature (104° F.) which accompanies this treatment is explained by the facts that but little water is evaporated from the lungs and skin, and that the body heat is retained by the hot packs.

The treatment has been applied with some success in obstinate cases of syphilis, gastric dilatation, chronic rheumatism, and chronic peritonitis.

DIET FOR ATHLETIC TRAINING

The object of dietetic "training" in athletics is to fit men either for feats of great muscular endurance and strength or for exhibitions of dexterity requiring accurate and quick muscular movements and nerve control. The method of training naturally differs considerably according to the object to be attained. Professional athletes, who are more or less constantly employed in exhibitions of strength or muscular skill, are obliged to adopt very regular habits of life in regard to sleep, bathing, and diet, and abstinence from the excessive use of tobacco and strong drink. In addition, when they enter special contests requiring continued feats of endurance, as in prolonged bicycle races or walking matches, for example, they have to undergo a period of special training for several weeks before the contest. Young men who devote themselves to athletic sports in college usually do so for a comparatively limited period, and are not subjected to such special strain or feats of endurance excepting, perhaps, in boat races, which are of short duration. As a general rule, from six to ten weeks is ample time to cover their course of special dietetic training, although they usually exercise ordinary care in such matters for a longer period before their contests.

The physiological objects to be attained by any system of dietetic training are to reduce the fat and water contained in the tissues of the body, to increase the functional activity of the muscles, to train both muscles and nerves, improve the breathing power or " wind," the heart action and the condition of the skin. This is accomplished by carefully regulated diet, systematic exercises directed to the increase of oxidation processes, and the more perfect elimination of waste matter from the system. Dietetic training prevents the withdrawal of protein from other tissues than the muscles and supplies an excess of protein to make good any loss of this material. The protein is needed to build up muscle protoplasm and repair it.

Rigorous dietetic training should be conducted with great care and supervised only by those who are experienced in such matters, for any system carried to excess may cause too great a reduction in weight, and its object will be defeated by breaking down the individual at the moment of critical contest or laying the foundation for future organic weakness and disease. The heart may become hypertrophied and subsequently fail in accommodation.

It may be observed, however, that much of the ill effect of athletic training may be due not so much to any particular form of exertion or to being trained " too fine " in diet, but to the fact that the system brings to light constitutional weaknesses which were unsuspected until revealed by unwonted effort—in short, the system involves survival of the fittest.

The transition from ordinary diet to that of any training system should be made gradually, and the return to the usual diet after a period of rigid training should be similarly slow. For the first two or three weeks of training athletes usually lose in weight an amount proportionate to their previous condition of robustness, but after several weeks an equilibrium should be reached in which, upon an established diet, the body weight remains practically the same while the muscular strength and vigour and power of endurance increase;

the complexion improves in appearance, the skin becomes clear, the muscles become firmer, and all superfluous fat disappears.

While individual dietaries differ in training for the various forms of contest, most of them include lean meat, chiefly rare or "under-done," either roasted or broiled; the bread should be dry or toasted; a moderate quantity of potatoes and green fresh vegetables and fruits are usually allowed. The class of foods to be especially forbidden are sweets, pastry, *entrées*, rich puddings, sour pickles, and condiments. For beverages, weak tea or coffee may be allowed, although sometimes, where the object of training is the attainment of special skill in feats of delicate balancing, all forms of nerve stimulants, including tea, coffee, and tobacco should be prohibited. Chocolate and cocoa, if not too sweet, may be sometimes allowed, and in some training systems the use of light beer and light wine in moderation is included, but strong alcoholic spirits are absolutely forbidden. As a rule, three meals a day at intervals of about six hours are recommended.

The ancient Greek and Roman athletes used to train very largely upon a dry diet, which at first consisted of fresh cheese, dried figs, and preparations of wheat. Later they ate such meats as pork, beef, and goat flesh.

Parkes gives the amount of fluid which may be allowed as about five pints in winter and six in summer, a little over one fourth of which is contained in the food. Drink should not be taken either shortly before exercise or during meals. If the mouth be well rinsed before drinking, less fluid will be required, and what is taken should be drunk slowly.

The use of tobacco, particularly in the form of cigarette smoking, must be forbidden, and as alcohol in excess lessens the power of sustained muscular exertion, not over two ounces per diem can be allowed.

The following dietaries of training have been kindly furnished me by Dr. Hartwell, who has had much personal experience in such matters:

DIETARY OF THE BOAT CREW AT YALE UNIVERSITY

From March 1st till June 10th (ten weeks and a half), the hours of work are from 4 to 7 P. M., with exercise for an extra half hour or more at such odd times as recitations may permit. During this period the following regulations of the training table are observed:

Breakfast, 7.30 A. M.

Fruit.—Oranges, tamarinds, figs, and dates.

Cereals.—Oatmeal or one of the many preparations of wheat; a rich milk (not cream) and sugar are allowed with this. Toast. No hot breads are allowed.

Meats.—Beefsteak (usually rare), chops, stews, hash. Once or twice a week some salt meat, as bacon or ham, is allowed, and with it usually liver.

Potatoes.—Stewed, browned, and baked.

Eggs.—Served in all styles, except fried (unless with the ham). Eggs appear in some form about four mornings a week.

The meats are varied, steaks or chops alternating with one of the others.

Fluids.—Water, milk, tea on special occasions for some individual man. The water is boiled and poured while hot on the oatmeal. On cooling it has about the consistence of rich milk and a strong flavour of the oatmeal.

Dinner

Soups.—All varieties, including oyster stews and clam broths.

Meats.—Roast beef, mutton, turkey, chicken. Gravies are but little used. Two kinds of meat are always served.

Fish, broiled or boiled, is served twice a week.

Vegetables.—Potatoes (mashed or boiled). Tomatoes, stewed or sometimes raw. Beans, peas, corn (occasionally). Two vegetables besides potatoes are usually served.

Bread.—Toast.

Dessert.—Puddings—rice, bread, tapioca; but little butter is allowed in their preparation.

Fruit.—Same as breakfast, with berries and cantaloupe in season. Baked apples.

Fluid.—Same as breakfast.

Supper (*one hour after rowing*—i. e., *from* 7 *to* 8.15 P. M.)

Cereals.—Same as breakfast.

Meats.—Chops, stews, cold meats from dinner. Rarely, beefsteak.

Potatoes.—Stewed or baked.

Eggs.—All styles, about three times a week, usually not on same day as for breakfast.

Fluids.—Same as breakfast. Bass's ale for men who are getting "fine" and for whole crew after especially hard day's work.

Ale and milk are never taken at same meal.

For three weeks following June 10th the crew is at New London in final preparation for their race. The programme is then somewhat changed.

Breakfast is served at the same hour and consists of the same variety of food as before.

The morning work is from 9.30 or 10 to 11.30 or 12.

Dinner, with same *menu* as before, is served at 12.30 or 1 P. M.

Luncheon.—The afternoon till 4.30 is spent in loafing—often in the water in the steam launch. At that hour a lunch of cold meat, stewed or baked potatoes, milk, and toast is served. The afternoon work—which is the hard work of the day—begins from forty-five to sixty minutes after the lunch and continues for about two hours, more or less, depending on its severity. Forty-five minutes after this work cold oatmeal or other cereal, with toast and milk, is served.

Many of the men are allowed ale every night during the final three weeks, either with the late supper or an hour later—9.30, on retiring.

Quantity of Food and Fluid.—There is no limit set to the quantity of food. The fluids, however, are limited to three glasses at a meal, with but little drink between meals. Of late years this is becoming changed, and in hot weather, when the men are perspiring freely, more fluid is allowed. To counteract the constipating effect which training has upon some men, stewed prunes are served for either breakfast or supper.

The training table of the present day, as given above, is far more liberal than it was five or ten years earlier, and it is aimed to regulate it on a rational basis. What few statistics are at command seem to show that the new is an improvement on the old system, and cases of overtraining are less frequent and less serious now than formerly.

It is the opinion of J. W. White that "an ordinary farmhouse table with its midday dinner and early tea will rarely (with the exception of coffee, hot cakes, pastry, and fried meats) offer anything which should be excluded from a rational training diet as it is at present understood."

DIET OF HARVARD UNIVERSITY CREW

The Harvard University Boat Crew diet while in active training in 1898 was studied for six days by W. O. Atwater and A. P. Bryant. The average weight per man was 162 pounds. A daily loss of from 2 to $3\frac{3}{8}$ pounds per man was produced by rowing and restored before the next day. As much as $4\frac{1}{4}$ pounds is sometimes lost by a man during a four-mile race, and $1\frac{1}{2}$ pound may be lost through worry and excitement immediately preceding the race.

"The diet was simple. Roast and broiled beef and lamb, fricasseed chicken, roast turkey, and broiled fish, made up the meats. Eggs were used plentifully either raw, poached, or boiled in the shell. Large amounts of milk and cream were also consumed. Oatmeal, hominy, and shredded wheat were eaten largely, and corn cakes were occasionally served. Bread was almost always taken in the form of dry toast. Potatoes were served twice a day. These were sometimes baked, sometimes boiled and mashed with a little milk and butter added, and at other times 'creamed.' Boiled rice, prepared with a little cream and sugar, was served instead of potatoes at some meals. Beets, parsnips, green peas, and tomatoes were used to furnish a variety of vegetables. Macaroni was occasionally served. For dessert, apple tapioca pudding, custard pudding, or other pudding containing a large proportion of milk and eggs was used. The members of the crew were allowed beer once a day. No pastry was allowed, and the puddings were, as above stated, composed largely of eggs and milk. A small amount of coffee jelly was served, and at one meal during the study ice cream. No fresh fruit was served, with the exception of oranges for breakfast. Stewed prunes, rhubarb, or apples were also eaten, prunes most abundantly. No beverages were allowed other than water, milk, and beer. Breakfast was served at 8, lunch at 1, and dinner at 6 o'clock."

These experimenters found that the average nutrients consumed per man per diem amounted to 145 grammes protein, 170 grammes fat, and 375 grammes carbohydrates, aggregating 3,705 calories. Just before racing each man received one ounce of beef extract with eight ounces of dry toast.

A subsequent study of the Harvard University Boat Crew was made in 1899 by E. A. Darling, who reports as follows:

"*Diet.*—The diet allowed was a very generous one, consisting of a hearty breakfast at 7.30, lunch at 1, and dinner after the evening row. For breakfast the fare consisted of fruit, oatmeal, or shredded wheat, eggs, some form of meat, bread and butter, potato, and milk. At noon there was cold meat, potato, bread and butter, marmalade, preserved fruit, and milk. Dinner comprised soup, occasionally fish, roast beef or some other hot meat, several vegetables, bread and butter, and a simple dessert. No tea or coffee was allowed, but ale or claret was permitted at dinner, also water in small amounts, as desired. During the last week before the race each man received a dish of calf's-foot jelly with sherry wine after the morning row, and a light lunch of oatmeal, milk, and bread was served at 4 o'clock in the afternoon."

Another study of the Harvard Freshman Crew during training was made in 1898 by Atwater and Bryant:

"The men arose at about 7 o'clock. Before this time no noise was allowed in the kitchen or elsewhere. After a short run, breakfast was served at 7.30 o'clock and was quite a hearty meal, consisting principally of oranges, a breakfast cereal, hot meat or fish, and potatoes. During the morning there was usually a practice row on the river, followed by a light lunch at about 11.30 to 12 o'clock. The principal meal of the day was taken early in the afternoon. In the late afternoon the crew had another season of hard work on the river, after which another hearty meal was served. Leisure time was spent in study or recreation."

Sugar in large quantity may be added with advantage to the diet of athletes and soldiers on the march. It may be given with other food, such as cereals, tea and coffee, etc., as is customary with the Cornell University Crew; or it may be given separately either as plain confectionery or in the form of cakes of chocolate. In a recent study of the training diet of boat clubs in Holland as much as one third of a pound of sugar per man per diem was found to be consumed with very marked benefit.

Summary of Results of Dietary Studies of University Boat Crews and other Dietary Studies, by W. O. Atwater and A. P. Bryant, 1900

(Nutrients in food actually eaten per man per day)

	Protein.	Fats.	Carbo-hydrates.	Fuel value.
DIETARY STUDIES OF UNIVERSITY BOAT CREWS	*Grms.*	*Grms.*	*Grms.*	*Calories.*
Harvard University crew at Cambridge	162	175	449	4,130
Harvard Freshman crew at Cambridge	153	223	468	4,620
Yale University crew at New Haven	145	170	375	3,705
Harvard University crew at Gales Ferry	160	170	448	4,075
Harvard Freshman crew at Gales Ferry	135	152	416	3,675
Yale University crew at Gales Ferry	171	171	434	4,070
Captain of Harvard Freshman crew	155	181	487	4,315
Average	155	177	440	4,c85
SUMMARISED RESULTS OF OTHER DIETARY STUDIES				
Football team, college students, Connecticut	181	292	557	5,740
Football team, college students, California	270	416	710	7,885
Professional athlete, Sandow	244	151	502	4,460
Prize fighter, England	278	78	83	2,205
Average of 15 college clubs	107	148	459	3,690
Average of 14 mechanics' families	103	150	402	3,465
Average of 10 farmers' families	97	130	467	3,515
Average of 24 mechanics' and farmers' families	100	141	429	3,480
Average of 14 professional men's families	104	125	423	3,325
DIETARY STANDARDS				
Man with moderate muscular work, Voit	118	56	5co	3,055
Man with moderate muscular work, Playfair	119	51	531	3,140
Man with moderate muscular work, Atwater	125	...	...	3,500
Man with hard muscular work, Voit	145	100	450	3,370
Man with hard muscular work, Playfair	156	71	568	3,630
Man with hard muscular work, Atwater	150	...	...	4,500
Man with severe muscular work, Playfair	185	71	568	3,750
Man with severe muscular work, Atwater	175	...	...	5,700

DIET OF YALE FOOTBALL TEAM

"The diet of the football team is practically the same as for the crew except for lunch, which is eaten at 1 P. M., the practice taking place from 2.30 to 3.45 or 4 P. M. This one-o'clock meal consists of cold meat, one chop or eggs, hot broth or bouillon, and toast. Milk and oatmeal-water are drunk. Apple sauce is sometimes allowed" (Hartwell).

DIET OF PUGILISTS, JOCKEYS, AND BICYCLE RACERS

Chambers gives the following example of a diet used by pugilists:

7 A. M. Light breakfast: oatmeal with little or no milk and sugar; one to three eggs, poached or raw; a cup of tea with little or no milk or sugar; a slice or two of toast. The eggs may be varied by a rare or well-broiled chop.

12 NOON. Dinner (following a half hour of rest): roast beef or mutton and vegetables; cup custard and plum pudding. A heavy dinner may be eaten, unless it is desired to reduce the weight. Old, mixed, or Bass's ale is allowed, but only a little water should be drunk, for it favours obesity. If thirst is annoying, a pebble may be carried in the mouth to increase the flow of saliva.

An hour or two of rest should be taken after dining.

6 P. M. Light supper: toast, a mutton chop or an egg, a vegetable, and a cup of tea.

Percy studied the diet of a prize fighter twenty-two years of age, 5 feet 6 inches in height and weighing 119 pounds. "He breakfasted at 9 A. M., and ate one pound of mutton, weighed before cooking. He dined at 1 P. M., and ate the same quantity of mutton, with the addition of about two ounces of bread. And again at supper, at 8 P. M., he had the same quantity of mutton. At each meal he drank half a pint of ale, but no other liquid at any other time of the day. Nor did he eat any other vegetable matter whatever besides the small quantity of bread mentioned. He walked seventeen miles per day."

Such a diet would not be indorsed by most trainers, nor would it fit a man for sustained effort.

A noted New York prize fighter says that in training he is accustomed to eat almost any plain substantial food that he likes, relying largely upon beef, mutton, bread, and potatoes, but avoiding pastry and sweets. He drinks fluid freely until within a week of the contest, when he reduces the water ingested to a minimum.

Bicycle racers entering six days' contests undergo the severest kind of muscular strain and require a diet rich in protein and energy. They work from eighteen and a half to twenty-one hours out of the twenty-four, and have a minimum of sleep. They take most of their food in fluid or semisolid form, in part to save time and in part because it is easily digestible. Water is not drunk during the race. A dietetic study of bicycle racers was made in 1898 in New York by W. O. Atwater and H. C. Sherman. The most remarkable contestants were C. W. Miller, who rode 2007.4 miles in six days, and F. Albert, who rode 1822.6 miles. Miller lost four pounds the first day, but subsequently maintained his average weight. His average daily food consumption in grammes was: Protein, 169; carbohydrates, 585; fat, 181; having a total fuel value of 4,770 calories. His food was of very simple character, and pastry and pork, as well as alcohol and tobacco, were excluded during a month of training.

Albert, on the other hand, limited his diet chiefly by the exclusion of veal and fat meats. He smoked tobacco in moderation but did not use alcohol. He lost three pounds and a half in weight on the first two days of the contest, but subsequently regained them. His average daily food consumption in grammes was: Protein, 179; carbohydrates, 859; fat, 198; having a total fuel value of 6,079 calories. The protein metabolised by these two contestants was found to be about twice as much as that metabolised by the average mechanic, and they did more than two days' work in one. Each contestant lost "body protein equivalent to two or three pounds of lean flesh, and that no injury resulted therefrom would seem to indicate that these men had stores of protein which could be metabolised to aid in meeting the demands put upon the body by the severe exertion, without robbing any of the working parts, and at the same time relieving the system of a part of the labor of digestion. Possibly the ability to carry such a store of available protein is one of the factors which make for physical endurance" (Atwater and Sherman).

The dietetic training of jockeys is merely for the purpose of reducing weight, and more depends on their eating a small quantity of food than upon its restriction in variety. They should make their fare chiefly bread and meat, and abstain from much fluid.

Chambers points out that men who have brief holidays in the country often fail to get the maximum good of their outdoor life, because they are not in proper condition for it. If a shooting or walking trip is to be undertaken for a week or two, it is well to abstain for a fortnight beforehand from eating elaborate dinners, and to leave off sweets and pastry and live on a drier diet than usual.

In general the athlete in training, when not trying to reduce his weight, develops more energy from food and consumes more protein than the ordinary working man. In the case of the crews studied by Atwater this excess of energy equalled 400 calories, or 10 per cent, and the protein consumption was increased by 45 per cent. This excess of protein is demanded by the increased nervous tension which is lacking in the slow, methodical, muscular exertion of the day labourer (Zuntz).

DIET AND OCCUPATION

There are some occupations which are more or less closely connected with dietetics. Workers in lead, plumbers, painters, polishers, pottery glaziers, *et al.*, should be taught to be very careful to cleanse the clothing, hands, and especially their finger nails, before

The following Table, compiled by A. P. Bryant for the Yearbook of the U. S. Department of Agriculture for 1898, presents a Comparison of the Average Food Consumption of People of Different Occupations or in Different Conditions of Life

(Per man per day)

Families Studied.		Cost.	Protein.	Fats.	Carbohydrates.	Fuel value.
		Cents.	*Grms.*	*Grms.*	*Grms.*	*Cals.*
Average of 10 farmers' families in Vermont, Connecticut, and New York	Food purchased.	..	101	136	483	3,655
	Food eaten	..	97	130	467	3,515
Average of 14 mechanics' families in Connecticut, New Jersey, Tennessee, and Indiana	Food purchased.	..	110	161	425	3,690
	Food eaten	19	103	150	402	3,465
Average of 14 professional men's families in Connecticut, Pennsylvania, Indiana, and Illinois	Food purchased.	..	108	132	429	3,435
	Food eaten	28	104	125	423	3,325
Average of 15 college clubs in Maine, Connecticut, Tennessee, and Missouri	Food purchased.	..	130	187	519	4,390
	Food eaten	..	107	148	459	3,690
Average of above 53 studies	Food purchased.	..	113	156	463	3,810
	Food eaten	..	103	138	436	3,500
Average of 12 labourers' families in New York city	Food purchased.	..	103	119	356	2,950
	Food eaten	19	101	116	344	2,905
Average of 11 poor families in New York city	Food purchased.	..	96	98	414	3,005
	Food eaten	15	93	95	407	2,915
Average of 2 labourers' families, very poor, in Pittsburg, Pa.	Food purchased.	..	81	98	311	2,525
	Food eaten	11	80	95	308	2,485
Average of 2 labourers' families, more comfortable circumstances, in Pittsburg, Pa.	Food purchased.	..	121	148	534	4,055
	Food eaten	19	120	147	534	4,045
Average of 12 negro families in Alabama	Food purchased.	9	67	134	453	3,375
Average of 4 Italian families in Chicago, Ill.	Food purchased.	16	103	111	391	3,060
Average of 5 French Canadian families in Chicago, Ill.	Food purchased.	22	118	158	345	3,365
Average of 4 families of Russian Jews in Chicago, Ill.	Food purchased.	19	120	101	406	3,095
Average of 8 Bohemian families in Chicago, Ill.	Food purchased.	12	115	101	360	2,885

eating. The soft crumb of bread getting under the nails easily becomes contaminated with lead salts, which by this means are conveyed to the stomach, where the white-lead carbonate, which is insoluble in water, is dissolved by the gastric juice into a more dangerous chloride. Workers in dyestuffs, artificial flowers, green wall papers, and other materials in which arsenic is used, should be similarly careful, and should never be permitted to bring their food into the workrooms.

Some occupations—those of foundrymen, stokers, and porcelain manufacturers—necessitate exposure to extremely high temperatures. Profuse sweating results, and thirst. The thirst is quenched by subsequently drinking enormous quantities of fluid, which should be water or oatmeal water, not too cold, rather than beer or other alcoholic beverages. Their lives at best are apt to be shortened by the suddenness and severity of the changes to which their kidneys and circulation are subjected, and a resort to alcohol is soon fatal.

Tea tasters acquire more or less poisoning, although they do not swallow the beverage, for a good deal is absorbed by the mucous membrane of the mouth. The symptoms are insomnia, nightmare, headache, "nervousness," tremors, dyspepsia, and constipation. Even smelling the tea infusions constantly is poisonous to some sensitive persons (Chambers). To mitigate the danger they should eat abundantly before exposing themselves to the noxious effects of their occupation.

Among other diseases occasioned by the handling of food products may be mentioned the grocer's itch, from handling low grades of sugar (now much less common than formerly, owing to better methods of refining), and the bronchial diseases produced by the inhalation of flour and grain dust in grist mills and grain elevators.

There are, in addition, many occupations which directly interfere with the proper digestion of food, such as those of tailors and shoemakers, whose cramped positions compress the abdominal viscera and impede full respiratory action. Their discomfort from dyspepsia and flatulency teaches them to avoid eating vegetables and sweets.

All occupations conducted in close, ill-ventilated apartments are injurious by depriving the individual of sufficient oxygen to consume the food products in the system.

DIET FOR BRAIN WORKERS

Persons who are constantly employed in mental labour, and consequently lead sedentary lives, usually find from experience, sooner or later, that they must pay attention to their diet in order to maintain the best condition of health. Energy diverted for mental work is apt to be at the expense of digestive activity, consequently it is important that the meals should be of such a character as not to unduly tax the stomach and intestines. As a rule, meat should be eaten but once a day, and then only in moderation, and persons who are not of strong physique do well to replace meat for a time by other varieties of animal food which require less time and energy for their digestion. Milk, eggs, fish, and abundant fresh fruit, with light, porous, and dry bread, should constitute their staple dietary.

Brain workers may suffer from lithæmia, which is undoubtedly often due to other causes than dietetic errors, such as anxiety, worry, and overwork. Patients of this class do better with a good, full, nourishing diet than by any attempt at restriction, provided their food is thoroughly well cooked and is light and digestible. They should avoid saccharine, fatty, and purely starchy dishes, but they need meat, and may have a moderate variety of fruits and fresh green vegetables.

The brain contains nearly three times as much fat as may be found in the muscles, and in nerves an even larger percentage is present. For this reason carbohydrates and fats are of value for brain workers who are not lithæmic, and the latter food may be supplied in the form of cream, butter, or fat well-cooked bacon.

It is believed by some writers that the fact that fat is good food for brain workers depends upon the ease with which it develops energy with less complex metabolism than starches, and the nervous energy of many Americans is sometimes attributed to the greater consumption of fat in this country as compared with Continental Europe and England.

The popular idea that fish has some specific action as a brain food on account of the phosphorus which is present in some species in considerable amount, and which is also an ingredient of nerve tissue, is not founded upon fact. Fresh fish is very wholesome, and by replacing meat in the *menu* less labour is required of the digestive organs, and some forms of fish contain abundant fat or oil, but aside from this, fish cannot be said to be especially a brain food. It has been pointed out elsewhere (p. 127) that the tribes of man who live very largely upon fish are by no means noted for their intellectual development.

For brain workers who desire to keep in good health the alternative is either to take at least two hours of rest after a noon dinner or else to eat a light meal at noon and dine later in the day. This fact should be recognised in the arrangement of meals for college students. It is far better during the active hours of brain work to supply only such food as is necessary for prompt force production without calling upon the digestive organs for the expenditure of much energy in elaborating food which is only needed for storage.

Breakfast should consist of fresh fruit, a cereal with cream, a poached egg, a bit of broiled (not fried) fish, or a rasher of bacon, with tea or coffee.

Luncheon may comprise such articles as a roast potato with butter and cream, or beans and bacon, one or two light sandwiches made with a slice of game or a relish of some sort, cheese, lettuce or salad, and a baked apple and cream.

Dinner should be a hearty meal with soup, a roast or joint, vegetables, and a light farinaceous pudding. If evening work must be done, there should be an interval of at least an hour for rest and recreation. A generous meal is easier digested after work is done, and makes the best preparation for the next day's toil.

A Work Ration for a Professional or Literary Man
(Mrs. E. H. Richards)

	Ounces.	Protein.	Fats.	Carbo-hydrates.	Calories.
		Grammes.	*Grammes.*	*Grammes.*	
Bread	16	32.0	3.0	258.0	1,216.6
Meat	16	50.0	30.0	.....	481.0
Butter	1	....	25.0	.....	230.0
Sugar	4	....	....	110.0	451.0
Milk	8	18.0	18.0	22.0	329.6
Oysters	4	7.0	1.0	.....	37.8
Soup	4	4.0	3.0	.....	44.0
Potatoes	6	3.0	....	38.0	168.1
Eggs	3	10.0	9.0	.....	123.8
Oatmeal	2	1.0	0.5	4.0	25.1
Cream	1	1.5	6.5	1.0	70.1
Fruit	8	0.5	....	50.0	207.1
Additional liquid—tea, coffee, or water	30	....	....	.....	......
Total	..	127.0	96.0	483.0	3,384.2

Overeating should be studiously avoided. Loading the system with incompletely assimilated food products impairs intellectual activity and exhausts the nervous system. If some special task requires long hours of work and absorbing concentration, it may be better to eat but little at a time, and take one or two extra lunches during the day. When such labour proves fatiguing, alcohol may be temporarily employed, but only with the meals, and not as a stimulant between. The quantity may be regulated somewhat by the appetite, but it should never be large. If a glass or two of claret or Burgundy or of malt liquor with lunch or dinner improves the appetite for solid food and aids its digestion, it is beneficial, for, as Chambers wrote, "it stays the weariness of the system and allows the nerve force to be diverted to the digestion of the meal" but to labour on and "continue to take this anæsthetic between meals is inconsistent"; and "when any extraordinary mental toil is temporarily imposed, extreme temperance or even total abstinence should be the rule, for mental activity makes the brain bear less alcohol than rest and relaxation."

The varieties of beverages named are all better than port, sherry, or the stronger liquors.

It is a mistake to suppose that violent muscular exercise is an offset to mental strain. Very moderate exercise combined with abundant fresh air and with mental diversion and relaxation are more beneficial, and do not add one kind of material exhaustion to another already present.

Tobacco and coffee, like alcohol, are stimulants which are useful in such cases only in proportion to the moderation in which they are employed. Tea may be allowed in the earlier part of the day if it does not cause wakefulness.

Following is the dietary at the Lake Erie College, at Painesville, Ohio, for women students:

DAILY MENU

Wednesday, January 17, 1900.

Dinner.—Corned beef, mashed potatoes, turnips, bread, butter, rice pudding.

Thursday, January 18.

Breakfast.—Baked apples, hominy grits, creamed dried beef, bread, butter, milk, coffee.

Luncheon.—Cheese, pudding, raspberry jam, bread, butter, milk, tea.

Dinner.—Roast beef, potatoes, parsnips, bread, butter, chocolate pudding.

Friday, January 19.

Breakfast.—Oranges, wheat breakfast food, corned-beef hash, corn rolls, butter, milk, coffee.

Luncheon.—Oyster stew, wafers, bananas, bread, butter, tea.

Dinner.—Pot roast, potatoes, beets, bread, butter, brown betty, lemon sauce.

Saturday, January 20.

Breakfast.—Wheat breakfast food, bacon, baked potatoes, bread, butter, milk, coffee.

Luncheon.—Beef in gravy, pickles, sauce, milk, bread, butter, tea.

Dinner.—Lamb chops, potatoes, canned peas, bread, butter, cherry tapioca, cream.

Sunday, January 21.

Breakfast.—Oranges, wheat breakfast food, fried mush, maple sirup, bread, butter, milk, coffee.

Luncheon.—At evening on Sunday. Stewed apricots, cake, milk, tea, bread, butter.

Dinner.—Stewed chicken, mashed potatoes, cranberries, bread, butter, cottage pudding, hard sauce.

Monday, January 22.

Breakfast.—Bananas, wheat breakfast food, rolls, codfish balls, bread, butter, milk, coffee.

Luncheon.—Beet salad, raspberry jam, milk, bread, butter, tea.

Dinner.—Hamburg steak, browned potatoes, squash, bread pudding.

Tuesday, January 23.

Breakfast.—Hominy grits, minced lamb, milk, bread, butter, coffee.

Luncheon.—Pea soup, crackers, bananas, tea, bread, butter.

Dinner.—Roast pork, baked sweet potatoes, cole-slaw, bread, butter, dates.

Wednesday, January 24.

Breakfast.—Bananas, hominy grits, bacon, potato cakes, bread, butter, milk, coffee.

Luncheon.—Baked beans, brown bread, pickles, milk, bread, butter, tea.

Dinner.—Roast beef, boiled potatoes, spinach, bread, butter, boiled rice, maple sirup.

Thursday, January 25.

Breakfast.—Oranges, wheat breakfast food, meat hash, French toast, bread, butter, milk, coffee.

Luncheon.—Cheese, gingerbread, bread, butter, cocoa.

Dinner.—Beefsteak, mashed potatoes, Lima beans, bread, butter, baked potatoes.

Friday, January 26.

Breakfast.—Cream of wheat breakfast food, creamed beef, rolls, bread, butter, milk, coffee.

Luncheon.—Pea soup, croutons, apple butter, bread, butter, tea.

Dinner.—Baked ham, catsup, stewed tomatoes, potatoes, bread, butter, fruit custard.

Saturday, January 27.

Breakfast.—Oranges, wheat breakfast food, beef in gravy, bread, butter, milk, coffee.

Luncheon.—Boiled rice, stewed prunes, milk, bread, butter, tea.

DIET IN COMMERCIAL LIFE

The responsibilities and anxieties of active business life are apt at times to react unfavourably upon digestion, producing dyspepsia, headache, constipation, and biliousness. As a rule, there are few patients less willing to listen to advice in regard to diet and habits of life than the overworked business man engaged in the strife of active competition and with large financial interests at stake. He expects a dinner pill or laxative or the latest fashionable "tonic" to counteract the persistent violation of the simplest dietetic and hygienic laws, and, obtaining temporary relief, goes on overtaxing his alimentary canal, liver, and nervous system, laying the foundation of more serious ills, such as lithæmia, arterio-sclerosis, or possibly gout, gravel, or cirrhosis. The prevalence of chronic Bright's disease and neurasthenia in this country is by some clinicians of large experience attributed to such causes. Imperfectly oxidised waste materials in the circulation may irritate kidneys and vascular system alike, and long-continued excitation eventually results in structural changes.

While prescribing remedies for individual symptoms the physician should not neglect to give wholesome counsel concerning diet, and such advice, however little heeded by itself, will sometimes be regarded as an essential part of other remedial measures, and accepted accordingly. The too hasty consumption of food, the neglect of securing proper action of the bowels, and carrying the concerns and worries of the counting-house to the table, combined with loss of sleep and of outdoor exercise, are the principal difficulties which this class of patients must contend against. Three good meals a day should be eaten. The breakfast should be substantial, comprising meat or eggs or fish with some cereal and fresh fruit; and dinner should be the last meal of the day, eaten preferably late—at half past six or seven o'clock—allowing an interval before the meal for recreation or diversion.

The lunch should be the lightest meal of the day, for the reason that it is difficult for many to take it always at a fixed hour, and still more difficult to allow sufficient time for due mastication and digestion. Sydney Smith once said, referring to the bad habit of hasty eating, that " many a man digs his grave with his teeth." It is not necessary, nor is it advisable, to eat meat three times a day, and many of these patients who are made dyspeptic by eating meat and vegetables together find that they have less flatulence and discomfort after meals if they take these classes of foods independently, eating meat and no vegetables or sugars at one meal, and vegetables without meat at another. The reason for this should be explained to them—namely, that carbohydrates, digested only by alkaline saliva and pancreatic fluid, may interfere with the acid digestion of animal food in the stomach. The luncheon should consist, therefore, of simple farinaceous food with one or two plainly cooked vegetables or a salad and a relish of some sort.

Alcoholic stimulants of any kind are not required, except to counteract exceptional fatigue, and, as a rule, these patients are better without their habitual use. If allowed, they should be drunk at dinner only. Malt liquors taken at luncheon are apt to cause drowsiness and dulness in the afternoon.

As adjuncts to the dietetic treatment other measures should not be neglected. Cold bathing with vigorous rubbing is desirable on rising, and an occasional Russian or Turkish bath may be serviceable if there is a tendency to heavily loaded urine and biliousness. Exercise in the open air is very important. Golfing is of value, but too much walking is fatiguing. Bicycling is much better. It furnishes more active exercise and diverts the mind; but horseback riding is preferable, even if it can be indulged in but once a week.

The bowels should be kept active, and fresh fruit and abundant draughts of pure water are the best means for this purpose.

DIET AND TRAVEL

In travelling one is often placed in circumstances in which it is difficult or impossible to obtain wholesome food, and must either be content with badly cooked or positively repugnant food, or go without. Under such conditions it is a decided advantage to have a varied taste, so that something may be found which will not disgust.

It is difficult to give any but the most general directions for circumstances which are so various. It is a common fault to eat too much when travelling, and the lack of exercise combined with an excess of food results in indigestion, constipation, and biliousness. Sea voyages sometimes benefit invalids and dyspeptics more than the healthy, for the latter, if not seasick at first, often overeat, and suffer in consequence.

The " stand-up lunch counters " of American railway stations freighted with doughnuts, tough ham, and pie are a constant invitation to dyspepsia with the hurried eating of such indigestible articles as they afford, but which the more general introduction of dining cars is fortunately replacing, at least for those whose means allow them to consult the best interests of their digestive organs.

In warm climates olive oil may be often obtained and made to replace rancid butter upon baked potatoes. Much garlic may cause diarrhœa and colic in those unaccustomed to its use, but mustard will counteract its effect. Lemon juice also forms a wholesome relish and aids in checking diarrhœa. It is well to avoid raw or imperfectly cooked ham and sausage of every sort, for fear of parasitic infection. If the food is inevitably greasy its digestion may be promoted by the use of condiments, such as vinegar, Cayenne, or lemon juice. All milk as well as water drunk should be previously boiled.

Fresh fruits, crackers, bread, cold meats, soft-cooked eggs, and milk will be found to comprise the most digestible articles for a railway journey, and invalids or travellers who have wandered far from good food supplies do well to carry some of the concentrated preparations which with the aid of a little hot water may be made into a nutritious beverage, such, for example, as malted milk and cereals, beef meal or beef jelly, chocolate, condensed coffee, meat extracts, etc., besides which there is an almost inexhaustible variety of canned foods, meats, vegetables, and fruits from which the traveller or explorer may replenish his table. For infants sterilised milk may be carried which will keep fresh for ten days, or canned milk may be provided for a longer period.

Lime tablets are prepared which may be conveniently used in travelling when fresh lime water is likely to be required for dilution of milk or for use in seasickness.

DIET IN PREGNANCY

It is not customary to adopt any definite system of diet for pregnancy unless complications arise. If serious vomiting occurs in the early months, this should be treated in the manner described on p. 552. If albuminuria is discovered, meat and other nitrogenous food must be restricted, in accordance with the directions given under albuminuria (p. 504). If the patient becomes very anæmic, without albuminuria, meat, eggs, and milk should be eaten in abundance (p. 494).

The "longings" of pregnant women for various indigestible articles, such as pickles, chalk, etc., are largely mythical, and occur, if at all, only as an accompaniment of a general hysterical condition, not as a peculiarity of the period of pregnancy. Pregnant women, however, should live simply and avoid foods which are likely to produce dyspepsia, heartburn, and colic, such as sweets, pastry, fried food, rich sauces, spiced dishes, and heating drinks. They often suffer from constipation, in which case fruits and coarse cereals, such as oatmeal or wheaten grits, may be of service (p. 582). The stomach, especially at night, should not be overloaded.

The idea formerly prevalent that pregnant women need to eat food containing abundant phosphates and lime salts, to furnish the embryo with material for making bones, as a hen eats lime to make egg shells, is no longer accepted. The salts in question are sufficiently contained in an ordinary mixed diet, such as any pregnant woman may eat, if plainly cooked.

Another theory, equally ingenious and directly opposed to the one above mentioned, is only interesting historically, for efforts to aid Nature in a process which she is abundantly competent to regulate unaided are now regarded as futile. This theory was that the agonies of labour would be less severe if the pregnant woman lived upon a diet of fruits and meats, avoiding bread and fresh vegetables during gestation, on the ground that the lime salts which they contain would favour early ossification of the infant's bones, and thus make the labour proportionately difficult.

It will be observed that the first theory favours the child, and the second the mother, but practically it has been found that diet has little or no influence either way, so long as it is digestible, nourishing, and sufficient to keep the mother in good general condition.

DIET FOR PUERPERAL WOMEN

Within the past thirty years a revolution has been experienced in the dietetic treatment of puerperal women, and they are no longer, as formerly, kept for ten days or a fortnight upon a diet of toast water, "slops," etc., with the idea that semistarvation would keep down puerperal fever and "milk fever." This change is largely due to methods of antiseptic midwifery, but the reaction started even earlier, and in 1876 Fordyce Barker, who was one of the first to forsake the old routine, wrote of the puerperal state: "I have never seen the slightest evil result from good, ample, judicious alimentation," and "I have had patients eat a good piece of tenderloin steak the day after labour with a relish, and with happy results."

A pregnant woman may eat her ordinary diet up to the commencement of labour.

If the labour is greatly protracted, the first stage lasting, as it exceptionally does, for more than a few hours, it will not do to let her strength become further exhausted from lack of food, and she must be urged to take stimulating hot broths, gruels, or similar easily digested food. Under the circumstances she is naturally nervous and may decline all food, so she should be given only that which is quickly swallowed without effort. In ordinary cases, however, no food is necessary or desirable during labour.

Immediately after delivery the woman, exhausted by muscular effort and agonising pain, and possibly also under the influence still of an anæsthetic, needs rest rather than food, and as she is more thirsty than hungry, she may drink freely of water or Vichy.

On the other hand, many puerperal complications, including mania, are favoured by exhaustion and inanition, and good feeding must not be delayed too long. The nursing woman, moreover, needs a more liberal diet than other patients. Her milk contains a large percentage of proteid and fat, and she also loses proteid substance to a greater or less extent through the lochia. A low diet means poor breast milk, for it diminishes both its fats and proteids.

Spiegelberg says: "It is a bad practice to allow healthy lying-in women to fast long; they need to be well fed, and if the appetite is good they may be encouraged to eat." If they are well nourished they both sleep and feel better. "Four or five hours after confinement the patient may be given a cup of hot bouillon or chicken or mutton broth. She usually does not care for meat before the second or third day, but she may have it then. Meanwhile she is allowed broths of any kind, thickened with egg or rice, milk, tea, light farinaceous gruels or puddings, soft-cooked eggs, toast, milk toast, custards." Schröder gives meat and vegetables within a day or two after the conclusion of labour. Lusk recommended a light fluid or semisolid diet for the first three days. Then, after the bowels have moved once or twice and the appetite returns, steak, chops, a piece of fowl or a bird, eggs, and cooked fruits are given.

Playfair adopted the following system: If the woman is confined in the early morning hours, at 9 A. M. she is given a cup of tea and a piece of toast; at 1 P. M. a light lunch of some form of predigested meat preparation; at 5 P. M. tea or beef tea, and at 7 P. M. a

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small bit of chicken with bread and butter or milk toast. Tea again at 9 P. M. He discountenanced a continued use of gruels, "slops," and stimulants. During the next day or two if the patient is hungry, he allowed sweetbread, chicken, fish, eggs, and milk.

On the whole, the patient's own appetite is a better guide for feeding than are any rules as to the exact time which has elapsed since parturition. She should not be urged to take food, unless greatly exhausted, and the stomach must not be overloaded; but if hungry after the establishment of the milk secretion and after free action of the bowels, she may be allowed a reasonable quantity and variety, though while still in bed she needs less than if up and about. The occurrence of fever is a contraindication for giving much proteid food except milk, but extreme exhaustion without febrile reaction demands it.

SELECTION OF A WET NURSE

The selection of a wet nurse should be based upon the following data:

Her own general health and digestion must be good, and her bowels not habitually constipated. All evidence of syphilis, scrofula, tuberculosis, or other disease must be rigidly excluded. A primipara is to be preferred to a multipara as having milk somewhat richer in fat.

Her best age is between twenty-two and thirty years, and she should be of good temperament and have cleanly habits. Her period of lactation should not be too widely different from the age of the infant to be nursed.

The breasts should be firm, and the nipples fairly prominent and free from fissures. Breasts which are always oozing spontaneously are by no means always the best, for their milk is soon exhausted.

The nurse's own child, if living, should be examined, for if it has been nursing at the breast its condition is an even better index of suitableness of the mother's milk than her own appearance.

The child should be in good flesh and firm, without evidence of gastric catarrh, fever, or indigestion, and of good development for its age.

The question whether it is possible for a wet nurse to transmit her own mental and physical characteristics to the child at her breast has given rise to much discussion, but there is no more reason why she should transmit an evil temper through the food she gives than that a cow should transmit a bland one. An ill-tempered, irascible wet nurse may sometimes give milk which disagrees with the child's stomach, but beyond that there is nothing in the belief that she can affect it mentally or morally by this agency.

The milk which can be expressed from the breast should have the following properties: Reaction alkaline, color an opaque blue-white, specific gravity 1.031, taste sweetish. Examined microscopically, the fat corpuscles should abundantly fill the field and be of nearly equal size.

Human breast milk on an average has a specific gravity of 1.031 at 70° F., but it varies between 1.017 and 1.036 (Holt). The fat varies less than the sugar and proteids.

If the specific gravity of the milk is high, and at the same time the percentage of fat is considerable, the gravity must be due to a larger quantity of proteids than usual, because fat tends to lower it. If the fat percentage is small and the specific gravity of the milk is low, the proteids must also be reduced. Holt furnishes the following convenient table for determining the richness of human milk in fats and proteids, which gives results that are sufficient for practical purposes in examining the milk of a wet nurse:

	Specific gravity 70° F.	Cream—24 hours.	Proteids—(calculated).
Normal average....	1.031	7%	1.5%
Healthy variations..	1.028—1.029	8%—12%	Normal (rich milk).
" " ..	1.032—1.033	5%—6%	" (fair milk).
Unhealthy " ..	Below 1.028	High (above 10%).	" or slightly below.
" " ..	" "	Normal (5%—10%).	Low.
" " ..	" "	Low (below 5%).	Very low (very poor milk).
" " ..	Above 1.033	High.	Very high (very rich milk).
" " ..	" "	Normal.	High.
" " ..	" "	Low.	Normal (or nearly so).

To calculate the actual fat from the cream multiply by three fifths.

In examining the composition of the milk of a wet nurse it is only fair to the nurse to remember that, like cow's milk, her own contains less fat when the milk is first drawn than after the breast has been nursed for a few moments.

The quantity of the milk may be best estimated by weighing the infant immediately before and after suckling, when the gain should be between three and six ounces.

DIET OF A NURSING MOTHER OR WET NURSE

The diet of the nursing mother or wet nurse must be regulated, to prevent noxious substances from passing into the breast milk and to keep her in good health, so that she does not suffer from constipation, indigestion, or anæmia. Her weight should not alter, and if she has menstruated once or twice the milk changes and may disagree.

If milk does not make her constipated or bilious she may drink it abundantly. She may take gruels and meat broths, and she should eat simple nourishing food, meat, eggs, vegetables, and fruits. The latter, even if sour, do not react unfavourably upon the child, provided the mother's digestion is good, and they serve to keep the child's bowels active. The mother should forego the drinking of much tea and coffee. Beer and wine also should not be drunk unless they are especially prescribed as a tonic. Wet nurses often demand beer, ale, or porter with their meals if they have been accustomed to it; but the popular idea that such beverages are especially beneficial is fallacious. Malt liquor sometimes causes the secretion of more milk, because more fluid is drunk, but the milk is no better for it. A reasonable quantity of fluids should be drunk, however, or the secretion of milk will suffer. The fluid may be in the form of plain or effervescing water, milk, soups, etc.

The mother or wet nurse should avoid all fatigue, worry, and emotional excitement of any kind, which may inhibit her digestive functions, and should take daily outdoor exercise.

On the whole, the best indication for the dietetic treatment of the wet nurse is the study of the condition of the child's digestion, bowels, and nutrition. A too meagre diet for the nurse is soon evident in lack of nutrition and development of the infant.

Drugs in Human Milk.—Not many drugs pass unchanged into the milk which are likely to poison the child through its food, but there are some which should be carefully avoided on this account. Such are belladonna, opium, morphine, and other alkaloids; iodine and its preparations; mercury and its salts; salicylic acid (see p. 57).

When, for any reason, it becomes necessary to discontinue the nursing and to stop further secretion of milk, the diet should at once be made as dry as possible, and a minimum quantity only of fluid is allowed.

THE FOOD OF INFANTS

Size of the Infant's Stomach.—With regard to infant nursing, it is never sufficient to give general directions about an infant's food. The physician should supervise the exact mode of its preparation, and order both the quantity to be given and the intervals at which it is to be given.

Mothers seldom know what is best for their infants in these matters.

It is therefore well to explain to them fully the facts as to the proper hours for feeding and the amount of food required, and also to give them some idea of the size of the infant stomach, for many have a vague idea that the word "stomach" includes almost the entire abdominal cavity.

Rotch gives the following table of capacities of infant stomachs:

1.	Premature 8 months' infant	8	cubic centimetres.
2.	Infant 5 days old	25–30	" "
3.	Infant 4 weeks old	75	" "
4.	Infant 8 " "	96	" "
5.	Infant 16 " "	107	" "
6.	Infant 20 " "	108	" "

It is advisable to show the mother or nurse an empty bottle representing the capacity of the infant's stomach, in order to impress upon her the danger of overloading it.

Overfeeding.—It is sometimes said that overfeeding kills more babies than starvation, and certainly it is responsible for a large proportion of the ailments of early infancy, such as gastric catarrh and diarrhœa. This is especially true in summer, when the fretfulness of the child, which is often mistaken for hunger, may be due to thirst, the external temperature, too warm clothing, or indigestion. At such times Holt advises reducing the bulk of each meal by one quarter and giving the infant more water to drink, for, as he says, infants, like adults, require less food in excessively hot weather.

It is difficult to impress mothers with the fact that milk should never be given to soothe a baby's fretfulness merely, and "unmethodical and improper feeding is quite as bad as feeding with improper aliments" (Adams).

The new-born infant secretes ptyalin only from the parotid glands. After the second month the amylolytic ferments are secreted from other glands, namely, the submaxillary and the pancreas. Not until the sixth month, however, or the period of teething, are these ferments strong enough to enable the infant to digest much starch.

Methods of Feeding

Infants may be given their food in one of five ways: I. By mother's milk. II. By milk from a wet nurse. III. By bottle feeding. IV. By mixed feeding—i. e., when the mother's or nurse's milk is supplemented by bottle feeding. V. By gavage.

There is no room for doubt that infants brought up on breast milk are stronger and better able to remain in good health and resist disease than those who are hand fed, for no infant food has ever been devised which is as satisfactory as good mother's milk.

This method is unquestionably better for the infant in all cases where it is feasible than any method of artificial feeding. In lands without cow's milk, such as Japan or the arctic regions, infants are singularly free from digestive disorders. Artificial feeding, if carelessly performed, is full of dangers to the infant. Statistics might be cited indefinitely, showing the relative high mortality rate among artificially fed infants. For example: In Munich, the mortality rate has been 15 for breast-fed infants, against 85 for those artificially fed; and in England, 42 per cent of the infant mortality is due to digestive disorders, largely among the artificially fed.

I and II—FEEDING BY THE MOTHER OR WET NURSE

Starr advises putting the infant to the breast as early as six or eight hours after labour is completed, which is good for both mother and child. For the mother it improves the nipple, stimulates the true milk secretion, and reflexly the uterine contractions; for the infant it is also desirable, for it insures the ingestion of colostrum.

Colostrum constitutes the secretion of the first three days. This secretion is mildly laxative, and it cleanses the child's alimentary canal of the waste matter called meconium, which is found within it at birth.

Colostrum contains an excess of albumin, so that boiling coagulates it. It also has large corpuscles, which may be seen with the microscope throughout the first week of lactation, gradually lessening in number. They then rapidly disappear, and none should be present after a fortnight. If found later, the milk is certain to disagree and a change of nurse is necessitated.

Intervals for Feeding.—Infants during the first three days should be nursed only four or five times a day. Water may be given, but no bottle food, which only upsets the stomach and lessens the ability to suck. After this period once every two hours is the proper interval for suckling for the first six weeks or two months. The child should be nursed at this interval between 5 A. M. and 11 P. M., with one feeding only in the middle of the night. If absolute regularity is always observed in the hours for nursing, the child's digestive organs keep in much better condition, it sleeps better, and is much less likely to be overfed. During the first four or five months of life an infant should be fed once during the night; after that it need not be fed between 10 P. M. and 7 A. M. When a year old, if strong and well, it need not be fed between 7 P. M. and 7 A. M. If fed or nursed oftener than this, the child receives too much food, and digestion and rest are both disturbed.

Sometimes an infant will demand milk at night and not take it in the daytime as well as it should, but with a little firmness and by starving it for a few hours until it is really hungry, it can often be trained to suckle in the manner which experience has proved is best for both itself and its mother.

From fifteen to twenty minutes is sufficient time to keep the child at the breast, and it will often doze off to sleep after nursing.

As the child grows older the intervals between the hours of nursing are to be prolonged, in accordance with the tables given below (pp. 766, 767), and the child may be allowed to remain a few moments longer at the breast.

The infant while sucking should always be held in a comfortable position with the nipple within easy reach.

After a three-hour interval for feeding has been reached, it may be maintained in many cases until lactation is completed, but after reaching six months of age some infants do better with a three and a half or four hours' interval.

Infants born with a cleft lip or palate cannot be properly nursed at the breast, for they are unable to make the necessary vacuum in the mouth to draw the milk. They may be unable to take the bottle successfully, and must then be fed by gavage or with a spoon.

III—FEEDING BY THE BOTTLE

When it becomes necessary to employ artificial feeding there are two principles upon which it may be conducted. The first and most extensively practised is to endeavour to obtain a food by modifying cow's milk, which corresponds as nearly as possible to the composition of average human milk. The second is to adapt the prepared milk to the needs of each particular infant, as suggested by the state of its digestive organs and existing nutrition and development. The first method seeks to bring the child up to the standard of the milk, the second to bring the milk to the standard of the child. This system of "prescription writing" as applied to milk, in cases of severe illness and great impairment of digestion, is more rational than the older method, but it presupposes much experience and care on the part of the physician.

Due regard must be had, of course, for the circumstances of those for whom an especially modified diet is ordered. For the very poor, milk is a serious item of expense, and cream and sugar may be out of the question. Condensed milk is usually cheaper in large cities than fresh cow's milk, for less care and expense is involved in its transportation, and it is accordingly much used by the poor. Moreover, in hot weather it keeps without ice, but for reasons given elsewhere (p. 95) it is never to be preferred when good fresh cow's milk is obtainable. It is deficient in protein, and this may be corrected by adding meat broth, beef juice, or egg albumin. It is also deficient in fat, and cod-liver oil may be added.

Cow's milk contains approximately half the quantity of sugar present in human milk.

Leeds says that the curd derivable from human milk is only one fifth as much as that of cow's milk, and there are other striking differences in regard to the quantity of casein precipitable by acid, as compared with the non-coagulable ingredients of both forms of milk.

For this reason cow's milk must be diluted for very young infants with two parts of water, in order to bring the casein nearer to the right proportion; but the addition of water reduces the percentage of fat and of sugar.

Escherich has shown that the infant fed upon diluted cow's milk has to take much more fluid than when nursed by breast milk to get the same quantity of nutriment, with consequent distention and possible enfeeblement of the stomach.

The disproportion of fat may be counterbalanced by using "top milk"—i. e., the upper layer which forms after the milk has stood for about eight hours, and which contains most of the cream. Milk sugar is then to be added in the proportion of one heaping teaspoonful to four ounces of the diluted milk. If cane sugar is used, which is less desirable, as it is more apt to ferment, only one teaspoonful to every six ounces is necessary.

From a quart of ordinary milk six ounces of top milk may be skimmed, seven ounces from rich, and five from poor milk. In lieu of top milk a mixture of equal parts of cream and of ordinary milk should be used (Holt).

When the milk causes dyspepsia, and large curds are vomited, it is well to substitute barley water for plain water in the same proportion.

If pearl barley is used it should be boiled a long time—for six or eight hours—the water being replaced as it evaporates. The proportion usually employed is two tablespoonfuls of barley to the quart of water. After careful straining through a linen cloth, a pinch of salt is added, and when cool the fluid is ready for use. Instead of pearl barley, one of the barley flours may be employed. This answers the purpose as well, and has the advantage of requiring much less time, boiling for half an hour being sufficient.

Holt gives the following formulæ for an infant two months old receiving twenty-four ounces a day:

Top milk	8 ounces.
Barley water	16 "
Milk sugar	6 heaping teaspoonfuls, or
Cane sugar	4 " "

The quantity is to be slightly increased, but the proportion may remain the same until the seventh or eighth month, when the mixture should be changed to—

Top milk	19 ounces.
Barley water	19 "
Milk sugar	9 teaspoonfuls, or
Cane sugar	5 "

In answer to the question, "Can a child one year old take plain cow's milk?" Holt says: "Many children can, but the majority do better when the milk is modified by the addition of cream and water, or by the use of diluted top milk. After standing six hours six ounces should be taken off from the top of the milk bottle and ten ounces more should then be poured off and the two mixed. This may be diluted with an equal quantity of water or barley water."

It is generally conceded that fresh raw cow's milk derived from a healthy cow, and carefully kept from germ contamination, is a more wholesome food for babies than milk which is either boiled, sterilised, Pasteurised, or peptonised. But in cities always, and everywhere in summer, it is difficult or impossible to obtain such milk, and one or other of the means of disinfection becomes imperative.

The heat required for sterilisation in some manner destroys the vital properties of nuclein of the milk (Starr). (See page 85.)

Peptonised milk is used much less for infant feeding than formerly, for it has been found that they do not thrive if continuously fed upon it.

Care of the Milk.—In order to keep milk fresh and pure for infant use in hot weather it should be at once artificially cooled, and if intended for city consumption, during transportation both car and delivery wagon should be supplied with ice, so that the milk temperature never rises above 50° F. The milk when received at the dealer's should also be kept in refrigerators, for it is exceedingly important that it should not become lukewarm even temporarily. It is an undoubted advantage to have the whole system of milk supply under proper inspection and licensing. The cows when stabled should be kept in clean, well-ventilated quarters, and should always have the udders washed before milking. Every receptacle used for holding the milk should be thoroughly scoured with boiling water each day, but after first rinsing with cold water. If this process is reversed, particles of scalded milk may cling to the pail or can and give rise to subsequent fermentation. Milk should never be allowed to stand about in uncovered vessels, especially in a bathroom, near an open sewer pipe or drain, or in a damp cellar.

When given to the infant the milk, as well as all infant food, should be moderately warmed to approximate its body temperature (99° F.).

When the milk temporarily disagrees it becomes necessary to substitute for it some other form of food. Useful formulæ for this purpose are given by Starr as follows:

Substitutes for Milk in Infant Feeding (Starr)

Veal broth (½ lb. of meat to the pint) .... f℥ jss.
Barley water .... f℥ jss.
Mix.

Whey,
Barley water, } .... each, one and a half ounce.
Milk sugar .... half a drachm.
Give one portion at two months.

Raw beef juice (one teaspoonful every two hours) will "be retained when everything else is rejected."

Both barley water and lime water are sometimes added when temporary looseness of the bowels occurs.

In using lime water (carbonate of lime) as a diluent of cow's milk in infant feeding, it should be remembered that in the latter the phosphate of lime is four times greater in quantity than in human milk (Leeds), and it is of questionable utility to continue the practice beyond the requirements of a temporary fit of indigestion.

Many persons suppose that the milk from a single cow is to be preferred to the mixed milk of several animals, and formerly some dairies used to supply such milk in separate bottles. It has been proved, however, that there is less variation in the quality of mixed milk, and the infant is not so apt to become dyspeptic while taking it.

The milk of fancy breeds of cows, such as that of thoroughbred Alderneys or Durhams, is often too rich both for infants and invalids.

IV—MIXED FEEDING

There is no harm whatever in partly feeding infants with the bottle who are at the same time being nursed. If the mother is suffering from want of sleep she will be of more value to her infant if allowed to sleep at night while her child is hand-fed once or twice. When the breast milk is insufficient or poor in quality the child must be fed by hand several times a day in addition to nursing. A hungry, ill-nourished child cries continuously in a fretful manner and nurses irregularly, either taking the breast too long and eagerly or stopping too soon if it cannot obtain the milk without much effort. The sleep is fitful, the abdomen is tender and usually distended with gas. There may be vomiting, and the stools are malodorous and contain milk curds. Sometimes such babies may be given the bottle for the greater part of their food for a few days, until the mother's milk is found to agree with them better, and thus the necessity for absolute weaning may be postponed.

Infants who are brought up to take the bottle once or twice at night, being nursed at the breast in the daytime, are usually more easily weaned when the period for entire hand-feeding arrives.

When a mother who has abundant milk supply is obliged to be temporarily absent from her infant beyond the period when a meal is due, she may beforehand express into a clean glass a little milk which may be kept and fed to the child with a teaspoon while the mother is away.

V—GAVAGE

When infants have irritable stomachs, gastric catarrh, or when they persistently refuse food or are too feeble and marasmic to take sufficient food, they are fed by the method of "gavage," which consists in pouring liquid nourishment into the stomach through a glass funnel attached to a catheter. A soft-rubber catheter (No. 7) may be used. The child is wrapped in a sheet to restrain the arms, and then laid on its back upon a table. The catheter is passed through the mouth for a distance of about 8 inches, and warm milk or broth and, if necessary, medicines may be poured in.

Weaning

The period for weaning varies considerably, according to the health and vigour of both mother and infant. As a rule, it should be between the tenth and eighteenth month, ordinarily not before the tenth or twelfth month has been passed. Many infants are nursed for fifteen months, but after, if not before the eighteenth month the mother's milk deteriorates, and the child's needs will be better met by bottle feeding. There can be no fixed rule about this, however, and much depends upon the nationality and social position of the mother. The poor, for reasons of economy, sometimes nurse their children longer than is good for them, and many foreigners in this country seem able to nurse their infants longer than native Americans.

The eruption of the eight incisor teeth, which should be complete by the end of the first year, is often regarded as an indication for weaning. At this time the digestive organs become stronger, the saliva becomes more abundant, and the appearance of the anterior molar teeth is a sign that the child is gradually preparing for solid food.

Usually, even though the anterior molar teeth are cut, the child, if weaned, should still be fed chiefly upon milk until the eighteenth month. It is best not to wean a child during very hot weather, but when this is imperative milk only should be given, otherwise a small quantity of beef juice, egg, etc., may be allowed by degrees.

An infant may be weaned at any time, and occasion may require its being done suddenly, but ordinarily the process should occupy at least one or two months. When the child is nine or ten months of age the bottle may be given once a day in place of the breast; later two or three times, and so on, until at the end of a year the weaning is completed. This, however, is a very general rule, subject to modifications necessitated by the ill health of mother or child, or by hot weather, etc.

The circumstances which necessitate earlier weaning than the period after the twelfth month may be due to the condition of the infant, who may have malformation of the mouth or be congenitally too feeble to suckle, or rendered so by some disease, such as rickets or hereditary syphilis, or the condition of the mother may be at fault, either from constitutional disease, such as tuberculosis or syphilis, from local disease, abscess, or malformation of the nipples, from insufficient or poor milk, or from the recurrence of menstruation or pregnancy.

If an infant be nursed after the mother's milk has grown poor in quality it may acquire rickets and digestive disorders.

The following directions for weaning an infant from the bottle and for feeding during the second year are concisely given by Holt in his admirable *brochure* on The Care and Feeding of Infants. They summarise concisely a very large experience:

"At ten months the bottle or breast milk may be supplemented by a little beef juice or a portion of a soft-boiled egg. If the bottle is given, arrowroot or farina may be added to one feeding each day. . . .

"A child should always be weaned as early as eighteen or twenty months, but it can be easily done at twelve or fifteen months. . . . During the second year a healthy child never requires more than five, and some do better with four, meals during the latter half of the year. . . .

"If five meals are given, the best hours are 7 A. M., 10 A. M., 1 P. M., 4 P. M., 7 P. M., with nothing whatever during the night. It is better to make the 10 A. M. and 4 P. M. meals rather smaller than the others."

Starr gives the following mixture in commencing weaning at the tenth month:

Weaning Mixture at Ten Months (Starr)

Cream	f℥ ss.
Milk	f℥ iv.
Sugar of milk	℥ j.
Water	f℥ jss.

If disorder of digestion occurs, return temporarily to the breast.

Holt presents the following table, based on the measurement of forty infant stomachs and the weighing of infants immediately before and after nursing. The table gives the averages computed from such data, but the robust will require a little more, and the feeble will take less food. The measurements are in ounces:

AGE.	Quantity suckled at one feeding.	Number of feedings.	Total daily amount.
2 weeks	2	8	16
1 month	3	8	24
2 months	4	7	28
4 months	5	6	30
6 months	5½–6	6	33–36
9 months	7–7½	5	35–38
12 months	8–9	5	40–45

After the twelfth month three pints is the limit of digestive capacity for food for the stomach for one day. If the child seems to need more nourishment, the strength of the food, but not its bulk, may be increased.

Quantity of Food required in the First Year of Infancy (Rotch)

	At each feeding.	Number of daily feedings.	Total daily amount.
During the 1st week	1 oz.	10	10 oz.
At the 3d week	1½ "	10	15 "
At the 6th week	2 "	8	16 "
At the 3d month	3 "	8	24 "
At the 4th month	4 "	7	28 "
At the 6th month	6 "	6	30 "
At the 10th or 12th month	8 "	5	40 "

Holt's "Schedule for Feeding an Average Child in Health" for the First Year

AGE.	Number of meals.	Interval by day between meals.	Night feedings, 10 P. M. to 6 A. M.	Quantity for each meal.	Quantity for 24 hours.
1 week	10	2 hours.	2	1 oz.	10 oz.
2 to 3 weeks	10	2 "	2	1½ "	15 "
4 weeks	9	2 "	1	2¼ "	20 "
6 "	8	2½ "	1	3 "	24 "
3 months	7	3 "	1	4 "	28 "
5 "	6	3 "	..	5½ "	33 "
6 "	6	3 "	..	6 "	36 "
9 "	5	3 "	..	7½ "	37½ "
12 "	5	3 "	..	8 "	40 "

NOTE.—A large child may be given a few ounces more in the 24 hours than the quantity above specified, a small child a little less. A large child may pass from one formula to the next a little more rapidly than at the time specified, but a small child, or one with feeble digestion, will have to proceed more slowly. The hours for feeding should in all cases be observed with regularity.

Chrystie's Table for Infant Feeding

AGE.	Interval.	Number of feedings in 24 hours.	Amount of food at each feeding.	Total amount in 24 hours.
1st week	2 hours.	10	1 oz.	10 oz.
2d to 4th week	2 "	9	1½ "	13½ "
2d to 3d month	3 "	6	3 "	18 "
3d to 4th month	3 "	6	4 "	24 "
4th to 5th month	3 "	6	4–4½ "	24–27 "
6th month	3 "	6	5 "	30 "
8th month	3 "	6	6 "	36 "
10th month	3 "	5	8 "	40 "

The foregoing tables differ only in a few unimportant details—less, in fact, than the digestive powers of infants differ from each other.

Dr. Louis Starr's Table of the Ingredients, Hours, and Intervals of Feeding, and Total Quantity of Food from Birth to the End of the Seventh Month

AGE.	Cream.	Whey.	Milk.	Water.	Milk sugar.	Salt.	A non-starchy infant's food.	Hours of feeding.	Intervals of feeding.	Total quantity.	Remarks.
During 1st week......	f ʒ ij.	f ʒ iij.	......	f ʒ iij.	Gr. xx.	......	....	5 A. M. to 11 P. M.; occasionally once or twice at night.	2 hours.	f ℥ xij.	Water must be hot.
From 2d to 6th week..	f ʒ ij.	....	f ℥ ss.	f ℥ j.	Gr. xx.	A pinch.	....	5 A. M. to 11 P. M.	2 hours.	f ℥ xvij.	
From 6th week to end of 2d month.	f ℥ ss.	....	f ʒ x.	f ʒ x.	ʒ ss.	A pinch.	....	5 A. M. to 11 P. M.	2 hours.	f ℥ xxx.	
From 3d month to 6th month.	f ℥ ss.	....	f ℥ ijss.	f ℥ j.	ʒ j.	A pinch.	....	5 A. M. to 10.30 P. M.	2½ hours.	f ℥ xxxij.	
During the 6th month:											
Other bottle, morning.... and	f ℥ ss.	....	f ℥ ivss.	f ℥ j.	......	......	ʒ j.	7 A. M. to 10 P. M.	3 hours.	f ℥ xxxvj.	Water must be hot to dissolve food.
midday.....	f ℥ ss.	....	f ℥ ivss.	f ℥ j.	ʒ j.	......	....				
During 7th month.....	Same.	....	Same.	Same.	Same.	......	ʒ ij.	Same.	Same.	Same.	Same.
From 8th to end of 9th month.	f ℥ ss.	....	f ℥ vjss.	f ℥ j.	ʒ j at 7 A. M. and 10 P. M. only.	......	ʒ j at 10.30 A. M., and 2 and 6 P. M. only.	7, 10.30 A. M., and 2, 6, 10 P. M.	3½ and 4 hours.	f ℥ xl.	
For 10th and 11th months.	f ℥ ss.	....	f ℥ viijss.	f ℥ j.	......	......	℥ ss. of a Liebig food, or barley jelly ʒ ij, at 7 A. M. and 6 P. M. only.	Same.	Same.	....	Second meal 10.30 A. M., and fifth meal 10 P. M., a breakfastcupful of warm milk, ℥ viij. Third meal 2 P. M., yolk of egg, lightly boiled with stale bread crumbs; or beef tea, ℥ vj, on alternate days.

Artificial Infant Foods

Very young infants fed upon "proprietary" or "prepared" baby foods, to the greater or less exclusion of mother's or good cow's milk, soon become rhachitic or scorbutic. Wiederhofer says that "the numerous infant foods, although much bepuffed, are of no value whatever." This is certainly true of all non-malted amylaceous foods. The common fault of nearly all such preparations is that they contain too much sugar or starch and too little fat—which latter is very difficult to preserve without becoming rancid. For example: Prof. Leeds says that Mellin's food has only 0.15 part fat in 144.74, and Nestlé's food only 1.91 part in 139.69, but human milk has 3.90 per cent and cow's has 3.66 per cent.

Two extreme conditions are seen in such infants—those who are emaciated and marasmic, and those who are stout and apparently robust, but whose strength and power of resistance to disease is very deceptive. As described by Holt: "When children are fed upon foods lacking in fat, the teeth come late, the bones are soft, the muscles flabby," whereas "children fed upon foods containing too much sugar are frequently very fat, but their flesh is very soft, they walk late, and they perspire readily about the head and neck." They present a variety of rhachitic deformities, and are subject to catarrhal and other diseases. Such foods should never be fed to young infants unless under a physician's direction. For the further discussion of this topic the reader is referred to the section upon Prepared Farinaceous Foods, p. 151.

Another objection to feeding infants with starchy food, even when partially converted by diastase into dextrin and maltose, is that the final products are unlike the carbohydrate of normal milk (lactose), and it is doubtful whether they are as readily assimilated and as useful in the obscure metabolic processes of infant growth.

Predigested proteid foods, such as somatose and various forms of meat extracts, albumoses, etc., are sometimes used to re-enforce the milk of very young infants by addition to it. This is a mistake, for the cow's milk is already too rich in proteids. If temporary indigestion requires their use, they should be substituted for milk, and not given with the idea of re-enforcing it.

Infant Stools.—The stools of the infant should be observed from time to time in order to ascertain whether the milk is being properly digested.

The stools of an infant fed exclusively on milk should number two (or only one) a day, and be of uniform soft consistence, smooth, of inoffensive odour, and of a gamboge-yellow colour. If meat juice or meat broth of any kind is given, the stools usually become darker. If too much is given they become acid, malodorous, very dark brown, and diarrhœal.

Abnormal appearances of the stools will be found described in connection with the dietetic treatment of infantile diarrhœa (p. 565). When farinaceous or any amylaceous food is being given, it is well to test the stools with a few drops of tincture of iodine which imparts a purple colour to any particles of undigested starch which they may contain.

Nursing Bottles.—Ever since the influence of bacteria upon the fermentation of milk has been established the necessity for observing carefully the most minute details for cleansing all the infant's feeding utensils has been apparent.

The necessity for use of the bottle for feeding is always to be regretted on account of the difficulty of keeping the milk from bacterial infection. Adams says: "One of the greatest nuisances in infantile life is the popular feeding bottle. It probably causes more intestinal diseases in the infant under two years of age than any other article."

The use of nursing bottles with long rubber tubing is to be unhesitatingly condemned, although it saves trouble in holding the bottle. It is impossible to keep the tubing sterile. The bottle should be of pure glass, white, of half-pint capacity, with a wide mouth and a sloping neck, and never with a shoulder, which prevents cleaning every part of the interior with a sterilised cotton swab.

A measure of ounces should be blown in the side, and it should be fitted with a short black rubber nipple, which can be removed and turned inside out for thorough cleansing. This short nipple has the further advantage that the child is less apt to be left by the nurse alone with the bottle. The latter is a slovenly way to feed an infant, and should be discountenanced, for the child gets its milk with periods of delay and irregularity. The bottle may slip out of reach, or after it is empty the child keeps on sucking or draws in air, and obtains the milk at uneven temperatures, or sometimes the child goes to sleep with the nipple in its mouth, and, awaking, it finishes the bottle. "The sucking power of the child is to a great extent produced by the muscles at the posterior portion of the mouth; if this action is carried on to too great an extent it has a tendency to contract the width of the mouth and cause protrusion of the teeth" (Cryer). For these reasons the nurse should always continue holding the bottle in a comfortable position for the child until it has taken its portion. This usually requires a few minutes less time than is occupied in nursing at the breast. The usual time is not above ten minutes (Dencke). Any residue in the bottle should be at once thrown away, and not warmed over for a second feeding.

For washing the milk bottles a solution of sodium bicarbonate or salicylate, a teaspoonful to the pint, should be first used, after which they must be thoroughly scalded in boiling water. If fitted with a plug of sterilised baked absorbent cotton they will remain sterile until ready for use.

When from six to eight teeth have appeared the bottle can usually be discarded.

Care of the Infant's Mouth.—Cryer says that mothers or nurses in caring for the infant " will give attention to dirty hands or face and bathe the body daily, but how few keep the mouth as clean! The teeth should be gently and thoroughly brushed with a small soft tooth brush as soon as they make their appearance. . . . Fermentation of residual portions of milk remaining in the mouth of the infant after feeding is a prolific source of gastric curd, intestinal irritation, giving rise to colic and diarrhœa. The mouth of the child should therefore be kept carefully cleansed, and before each feeding be washed out with a solution of boric acid in distilled water applied on a soft linen rag."

Weighing of Infants.—The systematic weighing of infants at least once a week is a very useful indication of the progress in nutrition and growth which they are making, and it should not be neglected.

Budin reported some interesting experiments with three classes of infants—namely, (1) suckled, (2) partly suckled, partly artificially fed, (3) artificially fed. During the first fortnight of life he found that the gain in weight was considerably more rapid with suckled infants, but during the first year of life the infant will gain as much weight if fed upon cow's milk as if suckled. Roughly speaking, the infant's weight should be doubled in the first five months of life and trebled in the first year.

Premature Infants.—The feeding of premature infants demands unusual care. Their bodies are small; their vitality is low; their digestion is feeble, and their rate of heat loss is rapid. They are sometimes advantageously reared in incubators. They are often too weak to suckle or even to take the bottle unless they are very carefully hand-fed so as to obtain the milk without effort. It may be best to feed them by gavage. This method takes less time than any other. A small, feeble, puny infant at nine months of age may not take as much as ten ounces of milk a day, and yet keep alive. Such a baby must be fed at shorter intervals than the rule allows for well-developed infants at the same age, and a two-hour interval will often be best. Newborn premature infants may at first require feeding every hour, not over a drachm or two of milk being given at a time.

FOOD FOR YOUNG CHILDREN

The infant, although weaned, should receive all its food from the bottle until at least the twelfth month, and then very gradually a few other articles than milk or beef juice may be added.

Children often do best, however, upon a milk diet up to the end of the second year.

"Towards the end of the second year all the milk teeth have cut through, and the digestive functions have greatly increased in power. The lower maxilla becomes stronger, the muscles of mastication more powerful, the cavity of the mouth larger, the lips more fleshy, the œsophagus wider; the salivary glands are better developed, and secrete a larger quantity of saliva; the shape of the stomach changes, and its walls grow thicker, the intestinal canal longer and more capacious; in short, all the digestive organs are more adapted to an animal diet. At this period milk alone could not satisfy the child. It may be dispensed morning and evening, but during the day more substantial food is of absolute necessity" (Ammon).

Should illness of any kind occur after a child has been put upon solid diet, it should at once be given only fluid food again, and this does not mean tea and toast water, but milk or meat broths.

It sometimes happens that a growing child acquires a distaste for plain water and for plain milk, and needs encouragement to take fluid enough for physiological requirements or the elimination of waste. In such cases the following named articles afford considerable variety for selection, and not only supply necessary fluid, but small quantities of nutriment as well: toast water, thin farinaceous gruels, such as arrowroot gruel, etc.; egg-albumen water flavoured with cinnamon or vanilla; "cambric tea" (i. e., a cup of hot water with sugar, a little milk, and a mere trace of tea to impart flavour); whey, buttermilk, koumiss, and matzol; malted milk; broths of beef, mutton, or chicken; various meat extracts in hot water; orangeade or pineappleade; unfermented grape juice; somatose in peppermint tea (Starr); ginger ale and sarsaparilla.

Young children of four or five years of age or more, commonly crave sugar, but do not care for fatty foods. They are apt also to like vegetable acids, and are therefore fond of fruits. These acids are wholesome, and the fruit is laxative and healthful when ripe.

It may seem superfluous to separately name the chief prohibited substances which must be kept from young children, but experience proves the contrary, and when common sense is lacking in those who are entrusted with their care, a written list of these foods should be given them. If the child's food is too coarse, too much energy is diverted in the attempt to digest it, and this is at the expense of normal growth and development. Young children should be kept out of the pantry and kitchen, where their attention is attracted by forms of food which they cannot have.

It is estimated by Edward Smith that in proportion to its weight, the growing child requires about three times as much carbonaceous food as the adult and six times as much animal food.

Foods Forbidden to all Young Children

The following articles are particularly indigestible for children, and should not be allowed them under four years of age, and some of them should not be given at any period of childhood: Fried food of all kinds, game, salt food, the flesh of swine in all forms, pickles, salads, condiments, except salt, "stews," the "dressing" of fowl, sauces, visceral foods (such as liver, kidneys, tripe, etc.), all raw vegetables, potatoes (except baked), tomatoes in any form; the coarser vegetables, such as beets, turnips, cabbage, etc.; fancy bread, cake, and pastry; griddle cakes, canned food of all kinds; fancy confectionery, sweets, and preserves; cheese, rich soups, jellies, dried or unripe and overripe fruits (bananas, so often given to young children, are very bad for them), nuts, fruits with large seeds, such as grapes, the skin of all poultry, fruits, or vegetables.

All food should be plainly and thoroughly cooked. No greasy or highly seasoned dishes are permissible, and as a rule twice-cooked meats are indigestible.

Tea, coffee, and alcohol in every form must be withheld. The two former beverages interfere with digestion and make the child nervous, and the latter lays the foundation for a permanent alcohol habit. Soda water with sirups should not be given. Too much water should not be allowed with meals, and what is given should not be ice cold.

Children, as they grow up, should continue to observe regularity in the hours for taking meals, and the habit of perpetually nibbling at cake, crackers, and confectionery between meals should not be tolerated. It is best for young children not to be put to sleep immediately after their most substantial meal of the day. As they require a nap in the early afternoon, many advise giving this meal at 4 P. M.

The following is a useful summary (taken in part from Holt) of

General Rules for Feeding Young Children

1. Allow time for meals.

2. See that the food is thoroughly masticated.

3. Do not allow nibbling between meals.

4. Do not tempt the child with the sight of rich and indigestible food.

5. Do not force the child to eat against its will, but examine the mouth, which may be sore from erupting teeth; and examine the food, which may not be properly cooked or flavoured.

If good food is refused from peevishness merely, remove it and do not offer it again before the next meal time.

6. In acute illness reduce and dilute the food at once.

7. In very hot weather give about one fourth or one third less food, and offer more water.

The young infant depends wholly upon animal food, and derives the necessary carbon largely from the sugar of milk. The older child lives in part only upon animal food, and begins to derive additional carbon from bread and other cereal foods.

Quantity of Food Required.—Experiments have been made by Ueffelmann, Hasse, and others, to determine the necessary percentage of albuminous food required per diem per kilogramme of body weight, by growing children, with the following result:

	Albumin.	Average weight of child.
At 2 years	4 grammes.	12.5 kilogrammes.
At 3 to 5 years	3.5 "	15 "
At 8 to 11 years	2.5 "	24 "

Thus it is seen the percentage of albuminous food required diminishes as the child gains in weight, and more carbohydrate food is used to replace it.

The daily average quantity of food required by each child in an aggregate of twenty-eight healthy children between the ages of two and three years is reported by Starr to be as follows: Bread, 7.5 ounces; butter, 0.98 ounce; meat (beef), 4.6 ounces; potatoes, 3.9 ounces; milk, 32.6 fluid ounces. The daily average for each child in an aggregate of twelve children between the ages of three and six years was: Milk, 48.6 fluid ounces; beef, 12.1 ounces; rice, 13 ounces; bread, 10.3 ounces; butter, 1.08 ounce. The daily average for each child in an aggregate of twenty-four children between the ages of four and ten years was: Roast beef, 12.46 ounces; bread, 10.23 ounces; potatoes, 10.03 ounces; butter, 0.99 ounce; milk, 38.5 fluid ounces.

Dietaries for Young Children

The following diets are recommended by Starr as types for use from the period of weaning up to three and a half years or more:

Diet from the Twelfth to the Eighteenth Month (Starr)

7 A. M., stale bread soaked in a breakfast cup of new milk.

10 A. M., milk, six ounces, and soda biscuit, or a thin slice of buttered bread.

2 P. M., beef tea, six ounces, bread, and a tablespoonful of rice and milk pudding.

6 P. M., same as first meal.

10 P. M., a tablespoonful of Mellin's food in eight ounces of milk.

In alternation a lightly boiled egg with bread crumbs and six ounces of milk may be given at 7 A. M., and at 2 P. M. a mashed baked potato moistened with four tablespoonfuls of beef tea, two tablespoonfuls of junket.

The following is the sample diet given by Holt for a child eighteen months old:

First Meal.—A tablespoonful of some cereal with salt and one tablespoonful of cream, one half pint of milk.

Second Meal.—One half pint of milk.

Third Meal.—One tablespoonful of scraped meat, two small pieces of dried bread, half a pint of milk.

Fourth Meal.—Milk.

Fifth Meal.—Milk with farina or arrowroot.

Instead of scraped meat (p. 113), beef juice (p. 116) or a soft cooked egg may be substituted occasionally. Of the beef juice from one to three tablespoonfuls may be given at a time.

"The quantity of milk allowed at a single feeding for a child during the second year should be from eight to ten ounces during the first half and from ten to twelve ounces during the latter half of the year" (Holt).

Diet from the Eighteenth to the Thirtieth Month (Starr)

7 A. M., new milk, eight ounces; the yolk of an egg lightly boiled; two thin slices of bread and butter, or else milk, and two tablespoonfuls of well-cooked oatmeal or wheaten grits, with sugar and cream.

11 A. M., milk, six ounces, with a soda biscuit or bread and butter.

2 P. M., one tablespoonful of rare mutton pounded to a paste, bread and butter, or mashed potatoes moistened with good dish gravy, a saucer of junket; or else a breakfastcupful of beef tea or mutton or chicken broth, a thin slice of stale bread, a saucer of rice and milk pudding.

6.30 P. M., a breakfastcupful of milk with bread and butter, or soft milk toast.

Diet from Two and a Half to Three and a Half Years of Age (i. e., *for Children who have cut their Milk Teeth*) (Starr)

7 A. M., one or two tumblers of milk, a saucer of thoroughly cooked oatmeal or wheaten grits, a slice of bread and butter.

11 A. M. (if hungry), a tumbler of milk or a teacupful of beef tea with a biscuit.

2 P. M., a slice of underdone roast beef or mutton, or a bit of roast chicken or turkey, minced as fine as possible, a mashed baked potato moistened with dish gravy, a slice of bread and butter, a saucer of junket or rice and milk pudding.

7 P. M., a tumblerful of milk and a slice or two of soft milk toast.

Diet from Three and a Half Years up (Starr)

Breakfast.—Every day: Milk, porridge and cream, bread and butter.

One dish only each day: Fresh fish, eggs lightly boiled, eggs poached, eggs scrambled, eggs (plain omelet), chicken hash, stewed kidney, stewed liver.

Sound fruits may be allowed before and after the meal, according to taste, as oranges without pulp, grapes (seeds not to be swallowed), peaches, thoroughly ripe pears, and cantaloupes.

Dinner.—Every day: Clear soup, meat roasted or broiled and cut into small pieces, bread and butter.

Two dishes each day: Potatoes baked, potatoes mashed, spinach, stewed celery, cauliflower, hominy, macaroni (plain), peas, string beans (young), green corn (grated).

Junket, rice-and-milk or other light pudding, and occasionally ice cream, may be allowed for dessert.

Supper.—Every day: Milk, milk toast or bread and butter, stewed fruit.

From the third to the fifth year the child has twenty teeth, and often three meals a day suffice, although from the third to the fourth year four may be given. After three years of age it is not possible to lay down definite rules for the quantity of food allowed. In health, the appetite may be taken as a fair guide, and the child will not eat too much if taught to eat very slowly and thoroughly chew each mouthful.

When the second set of teeth begin to replace the deciduous or milk teeth, which gradually decay, digestion is sometimes interfered with temporarily from lack of ability to masticate thoroughly, and food should be subdivided before it is offered to the child.

The following rules for meats and vegetables for young children are given by Holt:

"**Meats.**—After eighteen months, if most of the teeth are present, once daily, finely bruised or scraped rare roast beef, roast lamb, broiled mutton chop or beefsteak, white meat of chicken or turkey, fresh fish boiled or broiled—bones the only objection.

"**Vegetables.**—Potatoes (not till after second year) roasted, peas, asparagus tops, spinach, string beans, boiled onions, stewed celery; all should be very well cooked, in season, and fresh."

Fruits are very wholesome food for young children from three or four years onward, provided they are properly selected and not allowed in excess, which is almost the only source of trouble from them. They serve to keep the blood in good condition, favor digestion, and prevent constipation. After the fifteenth month two to six teaspoonfuls of orange juice may be given, and a little later the soft pulp of two or three stewed prunes, or a half-baked or stewed apple.

A child three or four years of age may have a piece of ripe pear, peach, or plum, or strawberries in season. Cherries and bananas should be forbidden. Grape juice is allowed without the skin or seeds. During very hot weather great caution should be observed in giving fruit of any kind to infants.

Bread, rice, oatmeal, and other cereal foods should always enter largely into the dietary of healthy children after they are able to digest them. Their fats should be derived chiefly from butter and cream. The best fruits for them are oranges, cooked apples, and stewed prunes.

Children between three and four years of age should be fed when in health four times a day—at 7 A. M., 10.30 A. M., 1.30 P. M., and 6 P. M. The following is

Holt's "Sample Diet for a Child Four Years Old"

First Meal.—Half an orange, one and a half tablespoonfuls of oatmeal or hominy, well salted, with two tablespoonfuls of cream, but no sugar, and one glass of milk.

Second Meal.—A glass of milk or cup of broth and one slice of stale bread.

Third Meal.—Meat—either steak, chop, or chicken—one green vegetable (e. g., spinach), one starchy vegetable (e. g., potato), water to drink, stewed prunes for dessert.

Fourth Meal.—Bread and milk or milk toast.

Desserts for Children

" After two and a half years—plain custard, ice cream (not oftener than once a week), rice pudding (no raisins), baked apple, stewed prunes " (Holt).

The following rules for feeding young children are given by Adams:

When the child has its first sixteen teeth it is to be given more varied food than before, such as stale bread and butter, crackers, mashed potato and gravy, scraped beef sandwiches with salt or sugar, a piece of rare beef, or a chicken bone to suck. He gives during the period of sixteen teeth:

6 A. M., a cup of milk, cream biscuit, or slice of buttered bread; 8 A. M., stale bread broken and soaked in a tumblerful of rich milk; 12 M., slice of buttered bread, half a pint of weak beef tea, or mutton or chicken broth; 4 P. M., tumblerful of milk with cracker or a slice of buttered bread; 8 P. M., a tumblerful of milk with bread or crackers.

At the end of the period of sixteen teeth:

6 A. M., bread or crackers with half a pint of milk; 8 A. M., a tablespoonful of oatmeal, cracked wheat, or cornmeal mush with milk and a couple of slices of buttered bread; 12 M., bread and butter, milk, and a soft-boiled egg; 4 P. M., a piece of rare roast beef to suck, mashed boiled potatoes, moistened with dish gravy, bread and milk, and a small portion of rice, jelly, or farina; 8 P. M., milk and bread or crackers.

Adams usually prefers, however, to give milk and oatmeal water or barley water through the second summer.

If the child vomits sour food, a little alkali should be added to the food (sodium bicarbonate, etc.). Diarrhœa may be excited by a too solid diet.

He prescribes for a child with all the milk teeth, and able to walk, up to the third year:

8 A. M., well-cooked oatmeal, wheaten grits, or cornmeal mush, with a liberal supply of milk, cold bread and butter, a piece of finely cut, tender beefsteak or a soft-boiled egg; 12 M., bowl of chicken or oyster soup, or weak beef tea, milk with bread or crackers, and butter; 4 P. M., roast beef, mutton, chicken, or turkey, fresh white fish, mashed white potato moistened with gravy, bread and butter, and rice and milk; 8 P. M., milk with bread or crackers.

Bread and milk or butter may be given between the first and second meal or before the first, also ripe fruit later.

For a child from the third to the fifth year Adams gives:

Breakfast.—Cornmeal mush, oatmeal, wheaten grits, hominy, plenty of cream; potatoes, baked or stewed; eggs, poached, soft-boiled, omelet; fish, fresh broiled; meats: beef hash, broiled steak, stewed liver and kidneys, lamb chops, chicken fricassee; tomatoes, sliced; bread (cold); light Graham, entire wheat, corn muffins (plain), and occasionally Graham, corn, and rice cakes; fresh, ripe fruit.

Luncheon.—Soups: oyster, clam, bean, chicken, *consommé*; vegetables: potatoes, baked or stewed, sliced tomatoes; beefsteak, lamb chop, cold roast lamb; cold rolls, soda crackers; fruits in season; rice and milk.

Dinner.—Soups: *consommé*, oyster, cream of barley, potato; fish: baked, broiled, or boiled; roast beef, chicken, lamb; stewed potatoes, rice, cauliflower, macaroni, peas, tomatoes, beans; bread, well-cooked wheat. Dessert: rice and milk, light pudding, ice cream, fruits, and berries.

Teething and Food

Much illness and digestive disturbance in infancy and early childhood is popularly ascribed to "teething," and the gums do occasionally become swollen and inflamed during dentition, but the evils of this process are exaggerated in the lay mind and wrong feeding is much more often accountable for the disturbance. In regard to this matter Adams says, "My experience has taught me that whenever the child has become ill during this physiological process, some other cause than the mere cutting of the teeth can be found to account for the illness."

Sleep and Feeding

The relation of sleep to infant feeding is very well summarised by Adams as follows: "A young infant has nothing to do but eat and sleep. As soon as he is fed he will take a nap and will probably sleep for an hour and a half. After the first year the naps become shorter and less frequent. During the second year a nap in the morning after breakfast, one in the afternoon about one or two o'clock for an hour or an hour and a half are usually sufficient, and these naps should be insisted upon for the rest of his mind and body, and to enhance his growth and health. As the child attains the third year, he can usually drop the morning nap. The afternoon one should be insisted upon very soon after the child has its noonday meal, in winter as well as in summer."

DIET FOR SCHOOL CHILDREN

Too much attention cannot be given by teachers to the diet of the pupils under their care in boarding schools, and they should exercise some supervision in regard to the matter in day schools as well, for the subject is often ill understood by parents.

The age for training most school children is from the tenth to the seventeenth or eighteenth year. During the entire time both mind and body are undergoing development, which in many instances is exceedingly rapid, and in the midst of this period the condition of puberty is attained, which in itself requires additional care and watchfulness, especially in girls.

With the present system of kindergarten training the attendance at school of most children begins much younger than the age mentioned. Throughout the whole school period the growth of the body is continued until almost completed. The individual organs and structures increase in actual size, and there are unusual demands, therefore, upon the functions of absorption and assimilation. The food must be abundant and of the proper character to furnish new tissue and to yield energy in the form of heat and muscular activity. The former condition is met by a proper allowance of animal food in the diet, and the latter by sufficient hydrocarbonaceous material. The food should also contain salts of lime, to meet the requirements of formation of the bones and teeth. While the material or structural development of the body progresses, there is also a marked development in the functions of the various organs; the muscles are trained to act with vigor and with proper co-ordination, and the nervous system is constantly receiving and storing new impressions and regulating their transmission and the proper relations of inhibitory and reflex actions. The metabolic processes of the body are extremely active and the digestive secretions are vigorous. To maintain the proper standard, therefore, of growth and development requires care in the selection of the right quantity and quality of "fuel" or food for the body, and the lack of such care too often lays the foundation for future disease, or results in an enfeebled constitution with greatly diminished resisting power of coping with emergencies which may arise.

Many children inherit feeble constitutions or diatheses, such as the tuberculous, which must be combated throughout the whole period of childhood. Such children are better kept at home, where they can be under constant observation and proper dietetic treatment, or country schools can be found for them where such matters are made the subject of special consideration.

Many cases of anæmia and chlorosis, which are so commonly seen in young girls during or shortly after the attainment of the condition of puberty, are directly traceable to malnutrition from faulty diet. Girls take much less exercise than boys, as a rule, and are more apt to become constipated. This difficulty may be enhanced by a lack of sufficient fresh vegetables or fruit in their diet, and if prolonged it is enough in itself to cause anæmia. The latter may also be brought about by insufficient good animal food. It should be the imperative duty of every head master of a school for children to realise the responsibilities of rightly developing the physical constitutions of those entrusted to his care, and to make a thorough study of the questions of dietetics involved. He should remember that the mind keeps on developing long after the body, and that the period under discussion is one in which the constitution of the individual is established for the remainder of life, and success in digestion and assimilation is of greater importance than success in mental attainments.

Variety.—An important consideration in school diet is to prevent monotony, which becomes so common from economic reasons, or more often from carelessness. It is much easier to yield to routine and force of habit or to leave the matter to the indiscretions of an unintelligent cook. But a little study and thought expended upon this subject can always result in furnishing variety in a wholesome diet without material increase of expense.

Hours for Meals

The hours for study and for meals should be so regulated that sufficient time should be allowed before each meal for children to wash and prepare themselves comfortably without going to the table excited by hurry, and they should be required to remain at the table throughout a fixed time, never being allowed to hastily swallow their food in order to complete an unfinished task or game. An interval of half an hour or more should intervene for recreation after meals, in order that digestion may be well under way before any mental exertion is required. Constant nibbling at food between meals should be forbidden; it destroys the appetite, increases the saliva, and interferes with gastric digestion. The number of meals for children should be adapted to the age of the pupils. For young children from ten to twelve or thirteen years of age it may be necessary to furnish food somewhat oftener than for older ones.

If children live at a distance from their school, or if they are weak and easily fatigued and inclined to sleep over in the morning, their hours for study should be so adjusted that they are never obliged to hurry their eating in order to be on time for school work. The teachers should consider themselves quite as responsible for regulating this matter as are the parents.

Children should never be hurried off to school in the morning with an insufficient and rapidly eaten breakfast. Their appetites are often poor at this hour from the effects of an ill-ventilated sleeping apartment, and if they are subsequently kept at school for five hours without luncheon they are very ill prepared for mental work. Or they ride to school without exercise after a hasty breakfast, take a hurried cold lunch at noon, and perhaps a warmed-over late dinner, and at six or seven o'clock a fourth meal, after which they are expected to study and go to bed.

The fact is being more and more realised by teachers and the public in general that the breaking down of health at school is quite as often, if not oftener, due to impoverished nutrition as to overwork.

A fact which is sometimes overlooked in the dietetic treatment of growing children is that their digestive processes are so active that the stomach is emptied somewhat sooner than in the case of adults, and their meals being promptly absorbed, it is natural for them to become hungry if the intervals between the hours of eating are prolonged. In some schools, children are given their last meal of the day at six o'clock in the evening, and they may not breakfast until seven or half past seven or even later, leaving an interval of over thirteen hours during which they have no food at all. The evening meal is usually made light, on the ground that they can sleep better, and it is, therefore, sooner digested. Robust children can perhaps thrive on this treatment, but those less strong are injured by it. For some school children of from ten to fourteen years of age it will be much better to give the evening meal later, at, say, half past seven o'clock, and the breakfast at seven, and if they awaken hungry during the night there is no harm in their having a glass of milk and a cracker.

Very delicate children whose appetites are poor and who do not do proper justice to their regular meals should be given an extra allowance of hot broth or hot milk or an occasional cup of chocolate with bread and butter and rusk between meals.

These general rules are applicable to those children who, during one or two years, seem to develop with extraordinary suddenness and rapidity, growing sometimes two inches or more in six months and attaining a height quite disproportionate to their frames. The demands of this rapid growth must be met by proper nutrition or serious subsequent impairment of vitality may result. Such children should have their meals made tempting by good cooking and pleasant variety as well as an agreeable appearance of the food.

Meat which is carved in unsightly masses and vegetables which are sodden and tasteless will be refused, and an ill attempt is made to supply the deficiency in proper food by eating indigestible candy, nuts, etc. Children often have no natural liking for meat, and prefer puddings, pastry, or sweets when they can obtain them, and it is the more important that meat should be made attractive to them at the age when they need it.

It is unnecessary to discuss further questions which after all must be controlled by tact and circumstances of individual cases, and the line must be drawn with care between making a child too fastidious on the one hand in regard to the nature of its food, and on the other impairing its constitution by monotony of diet and ill-cooked viands. Children at school should be especially required to eat slowly, for the habit of fast eating is almost contagious, and as it is much easier to acquire than to overcome, the foundation of dyspepsia and lifelong discomfort may be laid in this way in childhood.

A Sample Diet

If early rising is insisted upon, a child should never be set at any task before breakfast, especially in winter, and if it is not expedient to serve a full breakfast at half past six or seven the child should be given a bowl of hot milk and bread, or a cup of cocoa with a roll, or other light food: breakfast may be served later after the first exercises of the morning, and should be a substantial meal with animal food in the form of either fish, or eggs, or cold meat of some sort, with porridge of wheaten grits, or hominy with milk or cream and abundant sugar, also bread and butter, with some sweets in the form of jam, or marmalade, or stewed fruit. Dinner, which should always be served near the middle of the day, should comprise meat, potatoes, with one or two green vegetables, and some form of sweet pudding. The supper it is generally admitted should comprise only easily digestible articles of food, and such substances as pastry, cheese, and meats are better omitted. It should consist of either a porridge with milk or cream, or a light farinaceous pudding of rice, tapioca, sago, and the like, with bread and butter, and some simple form of preserve, or stewed apples or prunes, or very light plain cake, or a good bowl of nutritious broth with bread or crackers may be substituted for the porridge or pudding. It will sometimes be found best to serve this meal at seven o'clock or half past seven, and if hungry the child may be given a slice of bread and butter and a cup of weak tea or coffee, mostly hot milk, at half past five or six o'clock.

Sample Diet from a Well-known Boys' School in New England

Breakfast, 7.30 A. M.—Oatmeal. Bread and butter. Stew or hashed meat, or beefsteak or chops. Twice a week, griddle cakes with sirup.

Dinner, 1 P. M.—Soup. Fish once or twice a week. Meat, either roast beef, beefsteak, mutton, or chicken. Potatoes and green vegetables in season. Pudding, or pie, or plain cake, and lemonade. Fruit.

Supper, 7 P. M.—Cold meat, or hashed meat, or fish balls. Potatoes. Bread and butter. Cake. Preserved fruits.

Time allowed for Meals.—Breakfast and supper, each half an hour; dinner, three quarters of an hour. Intervals of rest or recreation for the younger boys (thirteen to fourteen years), after breakfast, half an hour; before dinner, three quarters of an hour; after dinner, two hours and a half; before and after supper, fifteen minutes.

On Sundays, breakfast an hour and dinner half an hour later than on week-days, and supper five hours after dinner.

Some of the more important articles of school diet require special mention.

Bread, as a rule, should be made of whole meal, but must not be too coarse. The advantage of this bread for children consists in its containing a larger proportion of salts, which they need, than is found in refined white flour, and butter should be freely served with it, to supply the deficiency of fats which exist in wheat. Children need fat, but they do not digest meat fat well, as a rule, and are very apt to dislike it. They will often take suet pudding, however, when hot mutton fat disagrees.

Milk should be freely supplied not only in the form of puddings and porridges, but as an occasional beverage, and children should be made to understand that when hungry they can obtain a glass of milk, or a bowl of crackers or bread and milk, for the asking.

Chambers says: " The best luncheon that a growing young man can have is a dish of roast potatoes well buttered and peppered and a draught of milk."

Fresh Fish, eggs, and bacon are all wholesome and serviceable foods for children, and

Meat, as a rule, may be given twice a day, but not oftener. It may sometimes be advisable to give it but once a day when fish or eggs are supplied; it should, however, always be given at least once daily, and better twice to rapidly growing children. Large, strong boys require a great deal of meat, and its use should not be stinted. The larger boys may eat from seven to nine or even twelve ounces of cooked meat as a ration, although many children may not require so much, the smaller boys doing well with from five to six ounces and the older boys with from seven to eight ounces daily.

During midwinter, when fresh vegetables are almost unobtainable in severe climates, vigorous boys sometimes have too much meat given them, and Yeo calls attention to the fact that eczema may be produced in them by a too exclusive animal diet.

Sweets.—The greater number of children have a natural craving for sweets. The important rôle of sugars in furnishing energy for the body has been discussed (p. 13), and the energy developed in active childhood necessitates the consumption of a larger proportion of sugar than is required by adults. The craving of children for confections, candy, etc., furnishes a true indication of the actual requirements of Nature, and it must be admitted that a certain amount of wholesome candy, like plain molasses candy, not only does most children no harm, but may serve them as an excellent food. The main difficulty with such forms of sugar, however, is that children are not furnished with a proper porportion of sugar with their meals, and the meals themselves are not so regulated as to prevent their becoming very hungry between times; consequently, if they can obtain candy, which satisfies them for the time, they eat too much, with the result of producing more or less dyspepsia and diminishing the normal appetite. If pains be taken to give such children a slice of bread and butter with a little honey or jam between meals and a proper proportion of saccharine food with their meals, they are much less likely to obtain candy surreptitiously and gorge themselves with it. Simple forms of well-cooked pastry and of cakes with stoned raisins should be furnished as dessert occasionally. It is better to give such food from time to time with the meals under proper supervision than to have children indulge themselves in it.

Alcohol in every form should be absolutely excluded. If given during early youth it is particularly prone to develop a taste which may become uncontrollable in later years. The only exceptions to this rule are some sickly and anæmic children who are especially under the physician's care.

Habit.—Many children acquire a habit of dislike or even disgust for certain articles of food, which become so fixed in later life that they find it very inconvenient, especially when placed in circumstances, as in travelling, where one cannot always obtain the accustomed diet, and giving in to such habit is often a serious obstacle to normal development. There are children who acquire a dislike for meat and who persistently refuse to take it, until they become anæmic and feeble, and there are others who refuse fresh vegetables, which they need. It is a great misfortune for a child to be indulged in such likes or dislikes. With a little tact and persuasion the repugnance can usually be overcome before the habit becomes rooted, and these questions are very largely a matter of proper education. How often is the physician baffled in the treatment of a severe disease like typhoid fever, which requires the use of a milk diet, by the patient's insisting that he has never been able to drink milk since childhood! If there be any taste which is natural to all men it is that for milk, upon which all must live during early infancy; and while it is better after a certain period of growth to restrict the quantity of milk in the diet, there is no reason at all why children should not retain a normal fondness for it. There are, no doubt, cases in which it seriously disagrees (see p. 73), but they are exceptional as compared with the number of persons who can digest milk, when properly prepared, with perfect ease, but whose antipathy for it prevents them from taking it in the emergencies which may befall them in acute disease.

Children who object to vegetables can sometimes learn to eat them when cooked in an unusually attractive manner or served in soup.

Overeating should be guarded against, for habits of gluttony may be acquired in youth, especially between puberty and full development, which are never overcome, and which may lead to visceral distention and hypertrophy, obesity and other troubles, which develop in adult life. The habit of slow eating should be insisted upon.

Exercise.—As a general rule, active muscular exercise in children disturbs their digestive processes far less than mental effort when taken immediately after meals, and every adult is familiar with the romping which children can undertake straightway after dinner, often, though not always, with impunity, whereas a proportionate amount of exercise on the part of an adult might produce a severe dyspeptic attack. It is well to allow children to play but moderately immediately after eating, and to require no mental work of them at such time.

For some reason the diet in girls' schools is often much less carefully regulated than in corresponding schools for boys. This applies not only in the United States, but it has been found the common experience in England and France; it is the more unfortunate, since girls from their greater delicacy of constitution, especially at the period of puberty, require more careful nurture. Differences in habits and exercise and outdoor recreation, no doubt in part, are responsible for the comparative lack of proper development in some girls' schools as compared with boys', but this should be recognised and regulated with as much care as the diet.

During the establishment of puberty it is best for children to avoid stimulating and highly seasoned food, and eating late at night, which is apt to excite the sexual organs reflexly and cause lascivious dreams. Alcohol should be wholly forbidden. Its use by young girls is said to bring menstruation earlier. Some articles of diet have a reputed aphrodisiac effect, but this is very slight; such are oysters, eggs, peppers, and champagne.

HOSPITAL DIETARIES

Statistics of the most economical quantity and quality of food for men in health, and under different conditions of activity, have been very accurately and practically determined, but such data for invalids are in most cases unobtainable, and obviously so, for the condition of individual cases and the severity of diseases are constantly varying, and no definite rules for the exact quantity of food needed could be formulated which would be of general application. For this reason in many hospitals no attempt is made to classify the diet beyond the very elementary subdivisions, consisting, first, of milk diet—i. e., milk alone, or of milk with a little bread, and light farinaceous food; secondly, the "full diet," which is commonly known either by that name or as "house diet" or "ordinary diet." Where no further general classification of the diet is attempted, it is customary to have a supplementary list of foods, usually called "articles of special diet," from which the visiting physician or surgeon is to select appropriate food for individual cases. The expression "low diet," indicating that for the very sick patients, is an unfortunate one, as it may have a depressing sound. In other institutions, where more care is bestowed upon diet, it is found both convenient and practical to subdivide the diet under several additional headings; the diet under each heading to contain only specially selected and classified foods. This arrangement is to be highly commended, as it not only saves much time and confusion, but is economical to the institution in preventing waste, instead of sending a large number of full diets from the kitchen to the ward, where the lighter or more easily digestible articles are selected for the sicker patients by possibly inexperienced nurses, much of the food being returned uneaten. If the diet is assorted in the kitchen and sent to the ward in a properly classified condition—that is, so many rations of each specified class—there is very much less waste and confusion.

Under this system, the subdivisions which it is found practical and advantageous to adopt are the following:

I. **Milk Diet**, consisting of from two and a half to three quarts of milk per diem, and nothing else.

II. **Convalescent Diet**, or half diet, or light diet, as it is variously called, intended for patients convalescing from acute disease, or for patients who are unable to digest the full house diet. In the average medical ward the majority of patients live usually upon this diet, which is not adapted for the special requirements of any particular disease, but is simply light, nutritious, and easy of digestion, and is therefore serviceable in a very large number of cases which do not need more careful selection of food.

III. **Farinaceous Diet**, from which animal food, with perhaps the exception of milk and butter, is excluded. This diet is not of very general use, but is temporarily serviceable in some forms of disease, such as chronic Bright's disease and acute gout.

IV. **Nitrogenous Diet**, or animal food, which is somewhat more used than the preceding diet, and from which sugars and almost all forms of starchy food excepting a little dried bread, toast, or Graham bread, are excluded. This diet is particularly serviceable in cases of flatulent dyspepsia, chronic gastric catarrh, and dilatation of the stomach, in which the starches and sugars invariably undergo acid fermentation, with eructations and flatulence. It also serves for diabetics, with slight modification.

V. **House or Full Diet** should be the most economical diet for the hospital upon which patients who have nearly completed their convalescence may be placed, as well as those patients, including certain medical cases and a large number of minor surgical cases, whose digestive organs are in normal condition. It usually includes the coarser articles of food, sometimes corned beef and cabbage, potatoes, codfish, etc., and it is very often the general diet for the servants and attendants in hospitals as well as patients.

VI. **Articles of Special Diet.**—Under this list are included luxuries and delicacies, such as oysters, jellies, custards, etc., and extra allowances of eggs, chicken, cream, and fruits, which may be desirable to furnish in a few individual cases.

With a system arranged upon this plan, as will be seen by the accompanying sample tables, used in some of the representative hospitals, the ordering of the diet is simplified for the visiting physician or surgeon, and is less likely to be relegated by him to subordinates than it is if he is obliged to spend the time required for selecting a separate *menu* for each patient in the ward. The limitations of each separate diet should be distinctly understood by all the attendants and nurses, and a printed diet list of articles included under the headings "nitrogenous diet," "farinaceous diet," etc., should be conspicuously posted in the ward dining or service rooms. The daily variations within the limits of these diets should be regulated by the superintendent of the hospital or an assistant, whose special duty it is to provide the food for the institution, and select such articles as will give reasonable variety, due allowance being made for variations in regard to price and season of the year.

In many large hospitals not only is the arrangement of the diet imperfect, but the details of preparing and serving food are so inefficiently supervised that there is great loss from waste and imperfect cooking, and the additional expense of employing one or two specially trained persons to superintend these matters would be more than counterbalanced by the saving in the waste and in the benefit to the patients.

Overfeeding.—Too much food is often given hospital patients by overzealous nurses, who are anxious to hasten convalescence. This is particularly true in the treatment of simple surgical cases where there is no special digestive disorder. A man accustomed to doing eight hours of active physical labour when put to bed for six weeks or more with his leg immobilised for a fracture, does not need to be constantly stuffed with large quantities of food, and yet such patients, if the matter is not carefully directed, will be often found to receive full house diet, which in itself is ample for the working attendants of the hospital, and in addition to be given two or three quarts of milk a day as a beverage. The natural result is constipation, indigestion, with a heavily coated tongue and more or less biliousness, which in turn is counteracted by a compound cathartic pill or a dose of calomel. I have known of night nurses going through wards with pitchers of milk, and pouring out tumblerfuls for any patients who were at all thirsty, quite irrespective of any supervision. In a large hospital, where the monthly consumption of milk is from ten thousand to fifteen thousand gallons, it may be easily seen that its indiscriminate use as a beverage is an item of very considerable and unnecessary expense to the institution, besides being an actual detriment to many of the patients.

Another undesirable tendency among American hospital dietaries is to include too much meat. The ordinary hospital *menu* compared, for instance, with that of the agricultural labourer, shows this fact very strikingly. Not over four ounces of cooked meat (without bone) need be allowed in the meal for men.

Fish Diet.—In some hospitals in addition to the subdivisions of the diet above given, a "fish diet" may be ordered, which is very useful and should be generally adopted. In the London Fever Hospital this diet consists of a ration of bread ten ounces and fish eight ounces (the uncooked measure), such as haddock, cod, or sole, or some similar fish, potatoes eight ounces, cocoa one ounce, with half an ounce of sugar and a sixth of a pint of milk. This is a serviceable and economical form of diet for a considerable class of patients for whom large quantities of meat are not only unnecessary but injurious.

Broth Diet.—In children's hospitals a diet is sometimes classified as the "broth diet," i. e., mutton broth flavoured with vegetables, and bread and butter, with milk; or a "beef-tea diet," in which the beef tea replaces the broth; and in the lighter diet of children, gruels, bread and molasses, and simple articles of farinaceous food such as farina, cornstarch, rice, etc., should play an important rôle. Sometimes such diet goes under the name of "soft food."

In some of the English hospitals, as in the London Fever Hospital, beer is allowed with the full diet, and in this hospital also a discrimination is made in ordering the diet according to sex, females being given from two to four ounces less bread and two to three ounces less meat than males. This discrimination is not usually made in American hospitals.

Sample Hospital Dietaries

DIETARY OF THE NEW YORK HOSPITAL

"All patients shall be furnished the regular house diet, unless otherwise specially directed by the attending physician or surgeon. As a substitute for the house diet, there may be furnished, on the order of the attending physician or surgeon only, either of the following:

"1. Restricted diet.

"2. Milk diet.

"The attending physician or surgeon shall specify, on the occasion of his first visit to a patient, which diet shall be furnished. This duty may not be delegated to the house physician or house surgeon, except that, on the admission of a patient to a ward, it shall be the duty of either to give instruction on the subject to the nurse in charge, and such instruction shall be followed until the first visit of the attending physician or surgeon.

"The wards shall be supplied with blanks, called diet lists. The head nurse shall carry one of these with her regularly when accompanying the attending physician or surgeon on his visits, and shall note down carefully all his instructions as to diet; he shall sign these lists before leaving the ward.

"Milk diet, or restricted diet, may not be ordered in addition to the regular house diet, but only as a substitute therefor, but the attending physician or surgeon may order items of special diet in particular cases.

" Lists defining the different classes of diet shall be furnished each attending physician and surgeon.

" Cards, appropriately inscribed, shall be placed at the head of each bed, which shall designate the class of diet, and also the amount of stimulant, which is furnished each patient.

" A diet kitchen is established, under the direction and control of the directress of nurses, wherein articles of special diet shall be prepared and served as ordered.

" *Daily House Diet*

" *Breakfast.*—Oatmeal or hominy; tea or coffee, with milk and sugar; bread and butter.

" *Dinner.*—Potatoes; bread and butter; one or more of the following vegetables: turnips, sweet potatoes, beets, spinach, squash.

" *Supper.*—Tea with milk and sugar; bread and butter; stewed or fresh fruit.

" *In addition on Sunday.*—Breakfast: eggs. Dinner: roast beef, cornstarch pudding. *Monday.*—Breakfast: baked potatoes. Dinner: stock soup, stewed beef or mutton, rice pudding. *Tuesday.*—Breakfast: mutton chops. Dinner: pea soup, roast mutton, bread pudding. *Wednesday.*—Breakfast: fried or stewed potatoes. Dinner: roast beef, cornstarch pudding. *Thursday.*—Breakfast: eggs. Dinner: stock soup, stewed beef or mutton, tapioca pudding. *Friday.*—Breakfast: salt mackerel or codfish. Dinner: bean soup, baked fish, beans, rice pudding. *Saturday.*—Breakfast: beefsteak, Dinner: corned beef, cabbage, bread pudding.

" *Restricted Diet*

" *Breakfast.*—Tea or coffee (with milk and sugar), farinaceous food (with milk), eggs.

" *Dinner.*—Soup; either of the following: raw oysters, roast beef, steak, chicken with vegetables, pudding (bread, rice, tapioca, or cornstarch).

" *Supper.*—Tea (with milk and sugar), bread (with butter), fruit (fresh or dried).

" *Milk Diet*

" Six pints of milk daily.

" *Articles of Special Diet*

" Milk, eggs, beef tea, oysters, cornstarch, chops, steak, chicken, chicken soup, rice, broth, farina, ice cream, as ordered by the attending physician or surgeon.

" Salt fish, jellies, custards, gruels."

At the New York Hospital a carefully graduated diet list, made out in ounces per capita, was formerly in use, but it was found both unnecessary and unpractical. Separate tables are laid for the patients, nurses, and servants; but the amount of food is estimated in a general way, the terms being based rather upon the cost price per capita than upon the number of ounces, and it is proportioned by the housekeeper and her assistants with due regard to economy.

DIETARY OF THE PRESBYTERIAN HOSPITAL, NEW YORK, 1901

Although the diet is very satisfactory and ample at the Presbyterian Hospital, New York, the food allowance per capita for patients is not separately estimated, and the house diet, convalescent diet, and diet for the servants on pages 796–797 are all originally prepared in bulk, and subsequently subdivided by the cooks and nurses under the order of the visiting physicians and surgeons, but without regard as to accurate measurement of quantity in ounces.

The diet sheet on page 798 is in daily use in the wards at the Presbyterian Hospital, New York city. It will be observed that it is properly classified according to quality as well as quantity. It was introduced several years ago after a careful comparison with diets of other institutions, and it has proved very practical. It is the most liberal and best-classified diet of any hospital with which I am familiar.

DIETARY IN BELLEVUE, GOUVERNEUR, FORDHAM, AND HARLEM HOSPITALS, NEW YORK, 1901

Monday

Breakfast.—Coffee, one pint, with half an ounce of milk and half an ounce of sugar; bread, five and one third ounces, and a quarter of an ounce of butter; oatmeal, one ounce; crackers, one ounce; milk, one quart.

Dinner.—Roast beef, eight ounces; rice, one ounce; soup, one pint; potatoes, eight ounces; vegetables, four ounces; bread.

Supper.—Tea, one pint, with half an ounce of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; one ounce of stewed apples.

Tuesday

Breakfast.—Coffee, one pint, with half an ounce of milk and half an ounce of sugar; bread, five and one third ounces, and a quarter of an ounce of butter; hominy, one ounce; crackers, one ounce; milk, one quart.

Dinner.—Mutton stew, eight ounces; potatoes, eight ounces; vegetables, four ounces; bread, five and one third ounces; bread pudding, two and a half ounces.

House Diet.	Convalescent Diet.	Nitrogenous Diet.
BREAKFAST.	BREAKFAST.	BREAKFAST.
Tea or coffee (milk and sugar). Bread and butter— White bread, or Graham bread, or Corn bread, or Rolls, or Toast. Porridge— Oatmeal, or Wheaten grits, or Indian meal, or Hominy, or Farina, or Samp. Meats— Hash, or Eggs, or Salt fish, or Fresh fish, or Stew.	Tea or coffee (milk and sugar). Bread and butter— White bread, or Graham bread, or Corn bread, or Rolls, or Toast. Porridge— Hominy, or Farina. Meats— Eggs, or Fresh fish, or Stew (plain).	Tea or coffee (milk Bread and butter— Graham bread. Meats— Eggs, or Fresh fish, or Stew *without* vegetables, or Meat hash *without* potatoes.
DINNER.	DINNER.	DINNER.
Soup— Stock, or Mutton broth, with barley or vegetable, or Chowder. Dry bread. Meats— Beef (roast or boiled), or Mutton (roast or boiled), or Corned beef, or Fresh fish, or Irish stew. Vegetables— Potatoes, baked, boiled, or mashed, and Tomatoes, or Baked beans, or French beans, or Turnips, or Beets, or Rice, or Macaroni, or Samp. Pudding— Rice, or Bread, or Tapioca, or Farina, or Corn starch, or Custard.	Soup— Stock, or Chicken, or Mutton broth, with barley or vegetable. Dry bread. Meats— Beef (roast or boiled), or Chicken, or Fish (fresh). Vegetables— Potatoes (baked), or Rice, or Macaroni, or Samp. Pudding— Rice or Bread, or Tapioca, or Farina, or Corn starch, or Custard.	Soup— Stock, or Chowder. Graham bread. Meats— Beef (roast or boiled), or Mutton (roast or boiled), or Fresh fish, or Irish stew. Vegetables— Spinach, or Lettuce, or Celery, or String beans. Pudding— Custard.
SUPPER.	SUPPER.	SUPPER.
Tea (sugar and milk). Bread and butter, or Toast and butter. Fruit— Apples, stewed or baked, or Prunes, or Pears.	Tea (milk and sugar). Bread and milk, or Milk toast, or Bread and butter, or Toast and butter. Fruit— Apples, stewed or baked, or Prunes, or Pears.	Tea (milk). Graham bread and butter, or Bread and milk. Eggs, or Cold meat.

Farinaceous Diet.	Milk Diet.	Extras.
BREAKFAST. Tea or coffee (milk and sugar). Bread and butter— White bread, or Graham bread, or Corn bread, or Rolls, or Toast. Porridge— Hominy, or Farina, or Indian meal.	BREAKFAST. One quart of milk.	ORDERED ONLY BY THE ATTENDING PHYSICIAN OR SURGEON. Mutton chops. Beefsteak. Scraped beef. Beef tea (made with hydrochloric acid). Chicken (broiled, fricasseed, or roast). Chicken broth. Eggs. Milk. Oysters. Clam broth. Gruels. Crackers. Gingerbread. Custard. Milk toast.
DINNER. Soup— Vegetable, or Macaroni, or Barley broth. Dry bread. Vegetables— Baked potatoes and Tomatoes, or French beans, or Rice, or Macaroni, or Samp. Pudding— Rice, or Bread, or Tapioca, or Farina, or Cornstarch.	DINNER. One quart of milk.	
SUPPER. Tea (milk and sugar). Bread and milk, or Milk toast, or Hominy, or Boiled rice, or Farina. Fruit— Apples stewed or baked, or Prunes, or Pears.	SUPPER. One quart of milk.	

THE PRESBYTERIAN HOSPITAL

______________ *Division.*

DIET SHEET

Ward No. ______________ *New York,* ______________ *189*

NAMES OF PATIENTS.																				
House diet...........																				
Convalescent diet.....																				
Nitrogenous diet......																				
Farinaceous diet......																				
Milk diet.............																				
Extra diet............																				

No. of Patients on House Diet ______ No. of Patients on Farinaceous Diet ______

" " Convalescent Diet ______ " " Milk Diet ______

" " Nitrogenous diet ______ " " Extra Diet ______

Total No. of Patients in Ward ______

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Attending Physician; Surgeon.

____
House Physician; Surgeon.

Supper.—Tea, one pint, with half an ounce of milk and half an ounce of sugar; bread, five and one third ounces; butter, a quarter of an ounce.

Wednesday

Breakfast.—Coffee, one pint, with half an ounce of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; rice, one ounce; crackers, one ounce; milk, one quart.

Dinner.—Roast beef, eight ounces; barley soup, one pint; potatoes, eight ounces; bread, five and one third ounces.

Supper.—Tea, one pint, with half an ounce of milk and half an ounce of sugar; bread, five and one third ounces, and a quarter of an ounce of butter; stewed prunes, one ounce.

Thursday

Breakfast.—Coffee, one pint, with half a pint of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; oatmeal, one ounce; crackers, one ounce; milk, one quart.

Dinner.—Beef stew, eight ounces; potatoes, eight ounces; vegetables, four ounces; bread, five and one third ounces.

Supper.—Tea, one pint, with half a pint of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; one ounce of stewed apples.

Friday

Breakfast.—Coffee, one pint, with half an ounce of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; two eggs; crackers, one ounce; milk, one quart.

Dinner.—Baked fish, eight ounces; potatoes, eight ounces; vegetables, four ounces; bread, five and one third ounces; rice pudding, two and a half ounces.

Supper.—Tea, one pint, with half a pint of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter.

Saturday

Breakfast.—Coffee, one pint, with a quarter of a pint of milk and a quarter of an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; hominy, one ounce; crackers, one ounce; milk, one quart.

Dinner.—Mutton stew, eight ounces; potatoes, nine ounces; vegetables, four ounces; bread, five and one third ounces.

Supper.—Tea, one pint, with milk half a pint, and half an ounce of sugar; bread, five and one third ounces; butter, a quarter of an ounce; stewed prunes, one ounce.

Sunday

Breakfast.—Coffee, one pint, with half a pint of milk and half an ounce of sugar; five and one third ounces of bread and a quarter of an ounce of butter; crackers, one ounce; milk, one quart; two eggs.

Dinner.—Corned beef, eight ounces; bean soup, one pint; potatoes, eight ounces; bread, five and one third ounces; cornstarch pudding, two and a half ounces.

Supper.—Tea, one pint, with half a pint of milk and half an ounce of sugar; bread, five and one third ounces, and butter, a quarter of an ounce.

Milk Diet

To be prescribed by attending physicians or surgeons.

Articles of Special Diet

Beefsteak, half a pound; beef tea, one pint; chicken, half a pound; chicken soup, one pint; rice and milk, one pint; two eggs; milk, one quart.

DIETARY OF THE ROOSEVELT HOSPITAL, NEW YORK

The ward diet of the Roosevelt Hospital, New York city, is classified as follows:

Full Diet

Daily.—Meat, dressed, eight ounces; potatoes, eight ounces; bread, twelve ounces; butter, one ounce; sugar, two ounces and a half; milk, half a pint; coffee, half an ounce; tea, an eighth of an ounce. On Sundays, Tuesdays, and Thursdays, other vegetables in addition to potatoes, two ounces; bread, rice, or tapioca pudding. On Mondays and Wednesdays, soup, one pint. On Fridays, fish.

Breakfast.—Coffee with sugar and milk, bread and butter, porridge of oatmeal, wheaten grits, or samp.

Dinner.—Sunday: Roast beef, potatoes, tomatoes, or other vegetable, bread, and bread pudding. Monday: Soup, boiled mutton, potatoes, and bread. Tuesday: Corned beef, twelve ounces; cabbage or turnips, potatoes, and bread. Wednesday: Soup, roast beef, potatoes, and bread. Thursday: Soup, boiled beef, potatoes, onions, tapioca, sago, or farina pudding, and bread. Friday: Fish, boiled or roast beef, potatoes, bread, boiled rice sweetened with sugar and milk, and raisins. Saturday: Stew of mutton, potatoes, and bread.

Supper.—Tea with sugar and milk, bread and butter, baked apples, or stewed pears, or prunes, or green or dried apple sauce, and, on Sundays, gingerbread varied, alternate weeks, with currant buns,

Half Diet

Daily.—Meat, dressed, four ounces; potatoes, four ounces; bread, six ounces; of other articles, the same as in full diet.

Milk Diet

Daily.—Milk, two pints; bread, twelve ounces; rice or samp, two ounces; butter, one ounce.

Extras

In addition to the above, the following extras may be ordered by the visiting physicians and surgeons: Beefsteak, chicken soup, gruel, beef tea, oysters or clams, cornstarch, mutton chops, milk, rice, chicken, eggs.

DIETARY OF THE JOHNS HOPKINS HOSPITAL, BALTIMORE

At the Johns Hopkins Hospital the Free Ward Diet is liberal, but no attempt is made to classify the food qualitatively as served to the wards. A sample Sunday *menu* given there is the following. It is expensive, owing to the excess of animal food:

Breakfast.—Corned-beef hash, oatmeal, toast, eggs, bread and butter, coffee or tea, and milk.

Dinner.—Soup, roast beef, potatoes, rice, turnips, toast, pudding and milk, bread and butter.

Supper.—Cold roast beef or pressed corned beef, bread and butter, coffee or tea, and milk.

DIETARY FOR LIVERPOOL INFIRMARY

Sample Diet suggested for the Liverpool Infirmary and other English Hospitals

	Sick.	Normal.	Convalescence.
Breakfast, 8.30 A.M.	$\frac{1}{3}$ pt. milk. 3 oz. bread or oatmeal.	$\frac{3}{4}$ pt. of new milk. 6 oz. bread. 2 oz. oatmeal.	1 pt. new milk. 8 oz. bread. 3 oz. oatmeal.
	If cocoa or coffee is given with sugar, omit the oatmeal and give $\frac{1}{2}$ pt. of milk.		
Dinner, 1.30 P.M.	$\frac{1}{3}$ pt. of milk, made into pudding with rice, sago, etc. $\frac{1}{2}$ pt. beef tea. 4 oz. bread.	Meat, 4 oz. (men). " 3 oz. (women). Bread, 6 oz. Potato, 8 oz. Cheese, $\frac{1}{2}$ oz.	Meat, 4 oz. " 3 oz. Bread, 8 oz. Potato, 8 oz. Cheese, 1 oz.
	Same for all as the breakfast, but with addition of a cereal.		
Supper, 6.30 to 7 P.M.		$\frac{3}{4}$ pt. broth with boiled meat. Salt *ad libitum*.	
Bed at 8 P.M.	Malt liquor as exceptional treat.		
		Total bread, 18 oz.	Total bread, 24 oz.

DIETARY OF THE COOK COUNTY HOSPITAL, CHICAGO

In the Cook County Hospital, of Chicago, the official diets are four—viz., ward diet, light diet, special diet, milk diet.

Extras may be ordered, such as chickens, chops, beefsteak, eggs, cream, crackers, lemons, or additional butter, milk, sugar, sirup, and vinegar.

Here again no special attempt is made to classify foods qualitatively.

The following is a sample midsummer diet, from a smaller hospital, having about seventy beds, in which attention is economically given to variety in food cookery which would be impossible in a larger institution without incurring needless expense:

WARD DIETARY OF THE NEW YORK INFIRMARY FOR WOMEN AND CHILDREN, 1901

Sunday

Breakfast.—Full Diets: Hominy with milk, fish balls or creamed fish, brown bread or biscuit, coffee with milk and sugar, fresh fruit. Half Diets: Hominy with milk, toast, coffee, fresh fruit.

Dinner.—Full Diets: Soup, bread, roast beef, sweet or white potatoes, spinach or egg plant, pudding. Half Diets: Clam broth, toast, chicken or beef jelly, rice, or ice cream.

Supper.—Full Diets: Pressed beef or cream salmon, bread and butter, cocoa. Half Diets: Indian meal porridge and milk, toast, cocoa, fruit.

Monday

Breakfast.—Full Diets: Oatmeal and milk, bread and butter, poached eggs on toast, coffee with milk and sugar. Half Diets: Oatmeal, eggs on toast, coffee, fresh fruit.

Dinner.—Full Diets: Soup, bread, roast lamb, spaghetti, tomatoes or lima beans, rice pudding or prune pudding or cottage pudding. Half Diets: Chicken broth, toast, spaghetti, rice pudding or cottage pudding.

Supper.—Full Diets: Baked potatoes and bacon or creamed beef or toast, bread and butter, tea, fruit. Half Diets: Hominy and milk, bread and butter or toast, tea, fruit.

Tuesday

Breakfast.—Full Diets: Wheat flakes and milk, beef mince or hash, bread and butter, coffee. Half Diets: Wheat flakes, buttered toast, coffee, fresh fruit.

Dinner.—Full Diets: Soup, bread, steak, cresses, potatoes, beans or carrots or beets, boiled or baked custard or ice cream. Half Diets: Mutton broth, rice, toast, custard or ice cream.

Supper.—Full Diets: Brown bread and butter, cream cheese or boiled eggs or sliced beef, fruit, cocoa. Half Diets: Oatmeal jelly and milk, toast, fruit, cocoa.

Wednesday

Breakfast.—Full Diets: Hominy with milk, lamb mince or lamb with cream sauce, bread, butter, coffee. Half Diets: Hominy with milk, buttered toast, boiled eggs, coffee, fresh fruit.

Dinner.—Full Diets: Soup, bread, chicken, potatoes or rice, peas, tapioca or fruit pudding or custard. Half Diets: Broth, rice, toast, tapioca.

Supper.—Full Diets: Spaghetti and tomato or sliced tomatoes or baked corn, bread and butter, tea, fruit. Half Diets: Wheat flakes and milk, toast, tea, fruit.

Thursday

Breakfast.—Full Diets: Oatmeal and milk, fresh fish, bread and butter, coffee. Half Diets: Oatmeal and milk, toast, coffee, fresh fruit.

Dinner.—Full Diets: Soup, bread, braised beef, macaroni, spinach or string beans, wine jelly or fruit jelly. Half Diets: Chicken broth, macaroni, toast, wine jelly.

Supper.—Full Diets: Beef stew or cream toast or pea soup, bread and butter, cake, fruit, cocoa. Half Diets: Cream toast, cocoa, fruit.

Friday

Breakfast.—Full Diets: Wheat flakes and milk, scrambled eggs on toast, bread and butter. Half Diets: Wheat flakes and milk, eggs, toast, coffee, fresh fruit.

Dinner.—Full Diets: Soup, bread, fish, potatoes, tomatoes or peas, bread pudding or Indian pudding or ice cream. Half Diets: Lamb broth, rice, bread pudding or ice cream.

Supper.—Full Diets: Chowder or boiled eggs, bread and butter, tea, fruit. Half Diets: Oatmeal jelly, toast, tea, fruit.

Saturday

Breakfast.—Full Diets: Indian meal porridge and maple sirup or milk, beef ragout, bread and butter, coffee. Half Diets: Indian porridge, toast, coffee.

Dinner.—Full Diets: Soup, bread, steak, potatoes, cauliflower or squash. Half Diets: Chicken broth, toast, rice, rennet custard, blanc mange.

Supper.—Full Diets: Lamb stew or baked beans, bread and butter, tea, fruit. Half Diets: Wheat flakes and milk, toast, tea, fruit.

Food which may be ordered by resident or attending physicians when daily diet is not adequate or suitable:

Beefsteak, chops, chicken, beef jelly, chicken jelly, scraped beef balls, raw beef sandwiches, clam broth, crackers, extra eggs and milk, gruels, oatmeal jelly, wine or fruit jelly, cold beef extract made with hydrochloric acid.

Average Daily Dietary for Adult Women Patients, 1901, not including Milk, Eggs, or Beef Tea for Special Cases

Flour, meal, rice, or beans, uncooked	½	ounce.
Bread	8	ounces.
Butter and fat	2½	"
Sugar	2	"
Breakfast cereals, uncooked	1	ounce.
Meat or fish, dressed but uncooked	8	ounces.
Potatoes, dressed but uncooked	5 to 6	"
Fresh or canned vegetables, cooked	4 to 5	"
Stewed or fresh fruit, prepared or cooked	3 to 4	"
Soup	½ pint or 8	"
Milk	1 " " 16	"
Coffee	½ " " 8	"
Tea or cocoa	½ " " 8	"
Eggs, one every other day	½	ounce.

NEW YORK STATE HOSPITAL—PROPOSED DIETARY

Austin Flint recommends the following dietary and food supply for the New York State Hospital:

"The table is intended for patients not upon extra diet and attendants only, and I have suggested that 25 per cent in the rations of meat, flour, and potatoes be added for workers."

Daily Ration

Meat, with bone, including salted meats, fresh and salted fish, and poultry	12	ounces.
Flour, to be used in making bread and in cooking (may in part be substituted by cornmeal and macaroni)	12	"
Potatoes	12	"
Milk	16	"
One egg	2	"
Sugar	2	"
Butter	2	"
Cheese	1	ounce.
Rice, hominy, or oatmeal	1½	"
Beans or peas (dried)	1½	"
Coffee (in the berry and roasted)	⅚	"
Tea (black)	⅛	"

Supplies for One Hundred Persons for Thirty Days

Meat, with bone, including salted meat, fresh and salted fish, and poultry, total	2,250	pounds.
Flour (may be in part substituted by cornmeal and macaroni)	2,250	"
Potatoes	2,250	"
Milk	1,500	quarts.
Eggs	250	dozen.
Sugar	490	pounds.
Butter	430	"
Cheese	215	"
Rice	108	"
Hominy	108	"
Oatmeal	108	"
Coffee	180	"
Tea	26	"

" Flour should be interchangeable, on this basis, with potatoes, rice, hominy, and oatmeal. Butter and cheese may be interchangeable in the proportion of one pound of butter to two pounds of cheese; and eggs and milk, in the proportion of two eggs to one pint of milk. There are occasions when eggs may be substituted with advantage for meat. This may be done on the basis of eight eggs for one pound of meat. When fruits, fresh and dried, are used in abundance, a reduction may be made in eggs, butter, cheese, and milk."

DIETARY OF THE UTICA STATE HOSPITAL FOR THE INSANE

Monday

Breakfast.—Cold corned beef, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Roast beef, boiled potatoes, gravy, boiled rice, bread and butter, tea.

Supper.—Roll, bread, sirup, butter, tea.

Tuesday

Breakfast.—Cold roast beef, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Vegetable soup, boiled mutton, boiled potatoes, bread and butter, and tea.

Supper.—Molasses cookies, bread and butter, tea.

Wednesday

Breakfast.—Roast mutton, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Roast veal, boiled potatoes, Indian pudding, gravy, bread and butter, tea.

Supper.—Stewed prunes, bread and butter, tea.

Thursday

Breakfast.—Cold roast veal, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Baked salt pork, baked beans, boiled potatoes, bread and butter, tea.

Supper.—Cheese, roll, bread, sirup, butter, tea.

Friday

Breakfast.—Codfish, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Fresh fish, boiled potatoes, dried raspberry pie, bread and butter, tea.

Supper.—Sugar cookies, bread and butter, tea.

Saturday

Breakfast.—Cold roast beef, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Corned beef, boiled cabbage, boiled potatoes, bread and butter, tea.

Supper.—Corn and wheat bread, cheese, butter, tea.

Sunday

Breakfast.—Boiled eggs, oatmeal, boiled potatoes, bread and butter, tea or coffee.

Dinner.—Cold boiled ham, boiled potatoes, pickled beets, canned corn, bread and butter, tea.

Supper.—Ginger cookies, bread and butter, tea.

Fresh vegetables and fruits in their season.

Extra diet may be ordered as follows: Milk toast, dry toast, egg on toast, beef tea, beefsteak, chops, ham, scrambled eggs, fried and boiled eggs, baked custard, cornstarch, rice and milk, gruel, sauce, hot milk, and chocolate. For each patient the daily allowance is:

Butter	$1\frac{1}{2}$ oz.
Sugar	$1\frac{1}{2}$ "
Potatoes	$11\frac{2}{3}$ "
Coffee	$\frac{3}{10}$ "
Tea	$\frac{1}{4}$ "
Flour	$11\frac{1}{4}$ "
Fresh beef	10 "

Fresh vegetables in season and in varying amount.

Extra Diet

Acute mania.	Milk toast (for breakfast)	Three times a day.
	Beef tea (Cybils's extract)	
	Gruel (at night).	
	Milk (about three quarts daily).	
Melancholia.	Breakfast—Egg on toast (no coffee).	
	Dinner—Steak (rare) or chops, fresh vegetables.	
	Supper—Gruel, sauce (apple), custard or boiled egg.	
Melancholia, refusing food fed by tube twice daily.	Milk, one quart.	
	Three eggs.	
	Cod-liver oil.	
	Whisky.	
	Sugar.	
	Salt.	
	Pancreatin, three grains.	
	Pepsin, three grains.	
	Sodium bicarbonate, fifteen grains.	

This amount given twice a day is varied once a week by chicken or mutton broth.

"Two of the patients fed by tube with this combination for over a year remained in good condition" (Steele).

Full Dietaries for Children at Various English Hospitals (Chambers)

Age.	Bread.	Butter.	Milk.	Meat.	Vegetables.	Pudding.	Hospital.
Under 7.	Unlimited.	1 oz.	¼ pt.	2 oz.	4 oz.	Unlimited.	St. George's.
Under 7.	12 oz.	?	½ pt.	2 oz.	3 oz.	Twice a week.	London.
Under 8.	5½ oz.	About ⅜ oz.	½ pt.	2 oz.	4 oz.	¼ pint.	Children's Hospital, Great Ormond Street, and Evelina Hospitals.
Under 8.	8 oz.	About 1 oz.	?	2 oz.	4 oz.	....	Leeds Infirmary.
Above 8.	8 oz.	About 1 oz.	¾ pt.	3 oz. broth, ⅓ pt.	6 oz.	Gruel, ⅓ pint.	Children's, Great Ormond Street, and Evelina Hospitals.
Under 9.	6 oz.	?	1 pt.	2 oz.	6 oz.	½ pint gruel or broth.	Birmingham General Hospital.
Under 9.	7 oz.	½ oz.	1 pt.	4 oz.	4 oz.	To order.	St. Bartholomew's.
Under 10.	12 oz.	¾ oz.	1 pt.	2 oz.	4 oz.	6 oz.	St. Thomas's.
Under 10.	6 oz.	?	1½ pt.	2 eggs.	?	8 oz.	King's College.

Diet of Northeastern Hospital for Children, London

	Milk diet.	Fish diet.	Full diet.
Breakfast, 7 A. M....	Milk, ½ pt.; bread, 2 oz., with butter.	Milk or cocoa, ½ pt.; bread, 2½ oz., with butter.	Milk or cocoa, ½ pt.; bread, 2½ oz., with butter.
Dinner, 12 M........	Milk, ½ pt.; rice or other milk pudding.	Fish, boiled, 2½ oz.; potatoes, mashed, 3 oz.; bread, 1 oz.; milk pudding.	Roast, boil'd, or minc'd mutton, or roast or minced beef, 2½ oz.; mashed potatoes, 4 oz., to alternate with green vegetables; bread, 1 oz.; milk pudding.
Tea, 3.30 P. M......	Milk, ½ pt.; bread, 2 oz., with butter.	Milk, ½ pt.; bread, 2½ oz., with treacle or butter.	Bread, 2½ oz., with butter, treacle, or drippings; milk, ¼ pt.
Supper, 6 P. M......	Biscuit (cracker) or slice of bread and butter.	Bread, 2 oz., with butter, or cracker.	Bread, 2 oz., with butter, or cracker.

DIETARIES OF ARMY HOSPITALS

United States Army Hospitals

Special Diet.—The medical officer will select from this list according to his discretion: Bread, butter, coffee, tea, toast (dry), toast (milk), eggs (boiled), eggs (poached), milk, beefsteak, milk porridge, ham, beef extract, oatmeal mush and milk, chicken (stewed), chicken broth, mutton chop, mutton broth, chocolate, oysters (stewed), beef tea, rice (boiled), farina pudding, cornstarch, crackers (soda or cream), potatoes (baked), potatoes (mashed), beef essence, macaroni (boiled), canned peaches (stewed), canned apples (stewed), canned pears, grapes, oranges, lemons, apples, watermelons, cantaloupes, etc.

The following comprises the list of articles allowed in the ration of the U. S. A. post hospitals:

BREAKFAST

Bread	6 ounces.
Butter	½ ounce.
Coffee	1 pint.
Tea	1 "
Toast, dry	4 ounces.
Toast, milk	6 "
Eggs, boiled	1
Eggs, poached	1
Milk	12 ounces.
Beefsteak	6 "
Milk porridge	1 pint.
Ham	4 ounces.
Beef essence	2 "

DINNER

Bread	4 ounces.
Chicken, stewed	6 "
Chicken broth	1 pint.
Mutton chop	6 ounces.
Mutton broth	1 pint.
Milk	12 ounces.
Oysters, stewed	1 gill.
Beef tea	12 ounces.
Rice, boiled	1 ounce.
Farina pudding	4 ounces.
Cornstarch pudding	4 "
Milk porridge	1 pint.
Beefsteak	6 ounces.
Potatoes, mashed	6 "
Beef essence	2 "

SUPPER

Tea	1 pint.
Butter	½ ounce.
Bread	4 ounces.
Toast, dry	4 "
Milk	12 "
Eggs	1
Milk porridge	1 pint.
Beef essence	2 ounces.

Following is the diet list issued in 1900 for a large United States Army General Hospital (at the Presidio of San Francisco):

UNITED STATES ARMY GENERAL HOSPITAL

BREAKFAST.	DINNER.	SUPPER.
Sunday. Oatmeal and milk. Ham and eggs. Bread and butter. Fruit. Coffee.	Vermicelli soup. Roast veal, sage dressing, or Turkey or chicken and dressing. Stewed peas. Mashed potatoes. Farina pudding. Fruit. Bread and butter. Coffee.	Veal stew or boiled ham. Apple sauce. Cake. Bread and butter. Tea.
Monday. Germea and milk. Beefsteak. Fried potatoes. Bread and butter. Fruit. Coffee.	Roast beef. Mashed potatoes. String beans. Tapioca pudding. Bread and butter. Fruit. Coffee.	Codfish balls or hash. Bread and butter. Pickles. Jam. Sweet crackers. Prun Tea.
Tuesday. Oatmeal and milk. Sausage. Fried potatoes. Bread, butter, coffee. Fruit.	Vegetable soup. Baked pork and beans. Baked tomatoes. Bread pudding. Bread, butter, cocoa, fruit.	Fried liver and bacon. Corn bread and sirup or Biscuits. Bread, butter, tea. Fruit.
Wednesday. Milk toast. Beefsteak. Bread, butter, coffee. Fruit.	Roast mutton with dressing. Mashed potatoes. Corn or fresh vegetables. Chocolate pudding. Fruit. Bread, butter, coffee.	Mutton stew. Pickles. Sweet crackers. Bread, butter, tea. Peach cobbler.
Thursday. Germea and milk. Hash. Bread, butter, coffee. Fruit.	Oyster soup. Corned beef and cabbage. Boiled potatoes. Radishes. Rice pudding. Fruit. Bread, butter, coffee.	Sliced roast beef. Macaroni and cheese. Preserves. Bread and butter. Tea.
Friday. Oatmeal and milk. Bacon and eggs. Bread, butter, coffee. Fruit.	Baked fish with sauce. Plain boiled potatoes. Fresh salad. Farina pudding. Fruit. Bread, butter, cocoa.	Salmon salad. Potato salad. Apple sauce. Ginger crackers. Bread and butter. Tea.
Saturday. Germea and milk. Beefsteak. Fried potatoes. Bread, butter, coffee. Fruit.	Roast beef, veal, or pork. Mashed potatoes. Hot slaw. Cauliflower. Bread pudding. Bread, butter, coffee.	Baked hash or stew. Stewed prunes. Assorted cakes. Bread and butter. Tea.

LIGHT DIET

Breakfast.	Dinner.	Supper.
Sunday.		
Oatmeal and milk.	Rice soup.	Milk toast.
Soft-boiled eggs.	Farina pudding.	Cup custard.
Milk toast. Coffee.	Coffee.	Tea.
Monday.		
Germea and milk.	Plain tomato soup.	Farina mush and milk.
Milk toast.	Bread pudding with lemon sauce.	Sweet crackers. Jelly.
Boiled eggs.	Coffee.	Toast.
Coffee.		Tea.
Tuesday.		
Oatmeal and milk.	Barley soup.	Biscuits or corn bread.
Boiled eggs.	Tapioca pudding.	Maple sirup. Boiled rice.
Coffee.	Cocoa.	Milk toast and tea.
Wednesday.		
Oatmeal and milk.	Consommé vermicelli.	Sweet crackers. Jam.
Soft-boiled eggs.	Cornstarch pudding.	Milk toast.
Coffee.	Vanilla sauce. Coffee.	Tea.
Thursday.		
Germea and milk.	Oyster soup.	Macaroni and cheese.
Boiled eggs.	Rice pudding.	Milk toast. Maple sirup.
Coffee.	Coffee.	Tea.
Friday.		
Oatmeal and milk.	Fish chowder.	Tapioca pudding.
Boiled eggs.	Farina pudding.	Milk toast. Ginger crackers.
Milk toast.	Cocoa.	Boiled eggs.
Coffee.		Tea.
Saturday.		
Oatmeal and milk.	Vermicelli soup.	Germea mush.
Boiled eggs.	Sago pudding.	Assorted cakes. Jelly.
Coffee.	Coffee.	Milk toast.
		Tea.

In addition to the regular diet table a special diet list is provided for use of ward surgeons for cases requiring this class of diet; it also contains a list of broths intended for liquid diets.

Daily Order List of Special Diet

U. S. A. GENERAL HOSPITAL,

Ward_____ *Presidio of San Francisco,* __________ *1900.*

	B.	D.	S.			
Number of light diets..................						
Number of full diets....................						
Stewed chicken.........................						
Chopped beef...........................						
Steaks..................................						
Mutton chops...........................						
Baked potatoes........................						
French-fried potatoes..................						
Saratoga chips.........................						
Creamed potatoes......................						
Baked apples..........................						
Wine jelly..............................						
Cup custard............................						
Milk toast..............................						
Poached eggs..!.......................						
Coffee..................................						
Tea.....................................						
BROTHS						
Beef broth..............................						
Mutton broth...........................						
Chicken broth..........................						
Consommé broth.......................						
Oyster broth...........................						

____
Ward Officer.

BRITISH ARMY HOSPITALS

The following statement is quoted from a report made by Col. Alfred A. Woodhull, who was sent abroad by the U. S. Army Department to investigate certain medical features of the British army:

"The British army uses seven [diets], known as tea, milk, beef tea, chicken, convalescent, roast, and varied. Each is formulated with exactness, and parts of two diets may not be ordered together. The tea diet is: Bread, twelve ounces; tea, half an ounce; sugar, two and a half ounces; milk, six ounces. The varied diet is: Beef or mutton, twelve ounces without, or fifteen ounces with, bone; bread, eighteen ounces; tea, half an ounce; sugar, one and a half ounce; milk, six ounces; butter, one ounce; potatoes, sixteen ounces; vegetables, four ounces, with salt, pepper, and mustard, and optionally wine, spirits, malt liquors, and diet drinks may be ordered. These diets represent the extremities of the scale through which the others run. The ordinary drinks allowed for patients are: Barley water, rice water, gruel, and lemonade, each prepared by formula."

Prussian Army Hospitals

According to Roth and Lex, in four grades of diet in Prussian military hospitals the proportionate allowance of food classes is as follows:

	I.	II.	III.	IV.
Albumin	115	81	52	18
Fat	55	39	32	15
Carbohydrates	522	315	179	127

French Army Hospitals

Kirchner gives the following analysis of the nutrient ingredients of the seven different classes into which diet in the French military hospitals is divided. "Absolute diet" (*diète absolue*) is practical starvation, at most, only a little toast water being given, and is of service for such cases as may require exclusive rectal feeding.

	Albumin.	Fats.	Carbohydrates.
	Grammes.	*Grammes.*	*Grammes.*
Full diet	119	57	448
¾ diet	91	47	357
½ "	70	39	225
¼ "	35	25	134
⅛ "	19	17	89
Bread diet	14	36	89
Absolute diet	..	..	..

APPENDIX

RECEIPTS FOR INVALID FOOD AND BEVERAGES, SUITABLE FOR FEVERS AND CONVALESCENCE FROM ACUTE ILLNESS

BEVERAGES

1. Demulcent and Nutritive

Barley Water (*Pavy*).—Take two ounces of pearl barley and wash well with cold water, rejecting the washings. Afterwards boil with a pint and a half of water for twenty minutes in a covered vessel, and strain. The product may be sweetened and flavoured with lemon peel, or lemon peel may be introduced while boiling is carried on. Lemon juice is also sometimes added to flavour. A bland, demulcent, and mildly nutritive beverage.

Barley Water (*Bartholow*).—Wash two ounces of pearl barley with cold water. Then boil it for five minutes in some fresh water, and throw both waters away. Then pour on two quarts of boiling water, and boil it down to a quart. (Stir and skim occasionally.) Flavour with thinly cut lemon rind; add sugar to taste, but do not strain unless at the patient's request.

Barley Water (*Ringer*).—To a tablespoonful of pearl barley washed in cold water add two or three lumps of sugar, the rind of one lemon, and the juice of half a lemon. On these pour a quart of boiling water, and let the mixture stand for seven or eight hours. Strain. The barley water should never be used a second time. Half an ounce of isinglass may be boiled in the water. If not needed at once, these barley preparations should be kept in the refrigerator and warmed when required.

Rice Water or Mucilage of Rice (*Pavy*).—Thoroughly wash one ounce of rice with cold water. Then macerate for three hours in a quart of water kept at a tepid heat, and afterwards boil slowly for an hour, and strain. A useful drink in dysentery, diarrhœa, and irritable states of the alimentary canal. It may be sweetened and flavoured in the same way as barley water.

Demulcent Drink (*Ringer*).—Take a pinch of isinglass, and boil it in half a pint of new milk with half a dozen bruised sweet almonds and three lumps of sugar.

Linseed Tea (*Chambers*).—Whole linseed, white sugar, each one ounce; licorice root, one half ounce; lemon juice, two ounces. Mix. An agreeable demulcent.

Flaxseed Tea.—One half cupful of flaxseed to one quart of boiling water; boil thirty minutes and let stand a little while near the fire to thicken more. Strain, and add lemon juice and sugar.

Currant Jelly (*Fagge*).—Red or black currant jelly, dissolved in hot or cold water or strained tamarind tea, make excellent invalid beverages.

2. Diuretic and Refrigerant

Lemonade (*Pavy*).—Pare the rind from a lemon thinly, and cut the lemon into slices. Put the peel and sliced lemon into a pitcher with one ounce of white sugar, and pour over them one pint of boiling water. Cover the pitcher closely, and let stand until cold. Strain or pour off the liquid.

Citron may be used instead of lemon, and it likewise furnishes a grateful and refrigerant beverage.

Lemonade, Effervescing (*Ringer*).—To the expressed juice of a large lemon add a lump or two of sugar previously lightly rubbed on the rind. Pour on it half a pint of cold or iced water. To cause it to effervesce put it into a large tumbler and add half a teaspoonful of bicarbonate of soda or potash. Stir and drink while effervescing. A very agreeable and refreshing beverage.

Lemonade (*Ringer*).—Pare the rind of three lemons as thin as possible, add one quart of boiling water and a quarter of an ounce of isinglass. Let them stand till next day covered; then squeeze the juice of eight lemons upon half a pound of lump sugar; when the sugar is dissolved, pour the lemon and water upon them, mix all well together, strain, and it is ready for use.

Orangeade (*U. S. Army Hospitals*).—One orange. One teaspoonful of sugar. Three fourths of a coffee cup of water (six ounces). Wash and wipe the orange. Squeeze the juice into the sugar. Add the cold water, previously boiled. Strain and serve.

Cream-of-tartar Drink. — Potus Imperialis. — Imperial Drink (*Pavy*).—Dissolve a drachm or a drachm and a half of cream of tartar in a pint of boiling water, and flavour with lemon peel and sugar. When cold, strain and take *ad libitum* as a refrigerant drink and diuretic.

Cream-of-tartar Whey (*Pavy*).—Stir a quarter of an ounce of cream of tartar (a large teaspoonful piled up) into a pint of boiling milk, and strain. A refrigerant and diuretic drink, which is rendered more agreeable by the addition of sugar.

White Wine Whey or Posset (*Pavy*).—To half a pint of milk while boiling in a saucepan add one wineglassful of sherry, and afterwards strain through a muslin cloth. Sweeten with pounded sugar according to taste. A useful diuretic drink in colds and mild febrile disorders. For a child, give a tablespoonful every two hours.

Wine Whey.—Milk, one pint; wine of pepsin, one teaspoonful. Heat gently to 115° or 120° F., let stand, break the curd, strain, and add sherry in the proportion of 1 to 4 or 6. Drink cold.

Tamarind Whey (*Pavy*).—Stir two tablespoonfuls of tamarinds into a pint of milk while boiling, and afterwards strain. This forms a refrigerant and slightly laxative drink.

Mulled Wine (*Ringer*).—Boil some spice, cloves, nutmeg, cinnamon, or mace in a little water just to flavour the wine; then add a wineglassful of sherry or any other wine and some sugar; bring it to the boiling point, and serve with sippets of toast. If claret is used, it will require more sugar.

3. Milk Beverages

Koumiss, kephir, matzol, malted milk, whey, skimmed milk, buttermilk, milk diluted with equal parts of Vichy, carbonic water, or lime water; milk flavoured with coffee, caramel, vanilla, or spice; cream diluted with water or Vichy to the consistency of milk.

FLUID BEEF PREPARATIONS

Beef Juice (*Bartholow*).—Broil quickly some pieces of round or sirloin of a size to fit in the cavity of a lemon squeezer previously heated by being dipped in hot water. The juice, as it flows away, should be received into a hot wineglass, and, after being seasoned to the taste with salt and a little Cayenne pepper, taken while hot.

Beef Essence (*Yeo*).—Cut the lean of beef into small pieces and place them in a wide-mouthed bottle securely corked, and then allow it to stand for several hours in a vessel of boiling water. This may be given to infants, who cannot take milk, in teaspoonful doses, and in larger quantities to adults.

Beef Tea (*Pavy*).—Put a pound of finely minced beef into a suitable vessel with a pint of cold water. Let it stand for an hour, stirring occasionally. Place the vessel containing the beef into a saucepan of water, place over the fire, and allow the water to boil gently for an hour (or the vessel containing the beef tea may be put into an ordinary oven for an hour). Pass the beef tea through a strainer. It contains a quantity of fine sediment, which should be drunk with the liquid. Flavour with salt. In this process the beef extract should not be exposed to a temperature of more than 170° F.

Beef Tea (*Bryce*).—Lean beef, chopped fine, free from fibre, one pound; water, one pint; sodium bicarbonate, ten grains; simmer half an hour in a glass-covered preserve jar, decant the fluid, squeeze the meat to a pulp in a lemon squeezer, return both to jar, add extract of pancreas, cover, keep at 140° F. for twelve hours, shaking occasionally. When an acid taste appears, boil two or three minutes to stop further fermentation.

This tea, it is claimed, equals the same bulk of peptonised milk in nutrient value.

Chrystie's Beef Tea.—Macerate for one hour one pound of finely minced lean beef in a pint of water, containing fifteen grains of sodium chloride and five drops of dilute hydrochloric acid, at 100° F.

Filter through cheese cloth, and wash the residue with half a pint of fresh water. The filtrate is transparent, has a not unpleasant taste, and contains a considerable amount of albuminoids. A child of two years may take two or three ounces daily.

Beef Tea (*Bartholow*).—Chop fine a pound of lean beef free from fat, tendons, etc., and digest with a pint of cold water for two hours. Let it simmer on the stove for three hours, at a temperature never over 160° F. Make up the water lost in evaporation by adding cold water, so that a pint of beef tea shall represent a pound of beef. Strain, and carefully express all fluid from the beef.

Beef Tea (*U. S. Army Hospital Receipt for Twelve Men*).—Beef, twelve pounds; salt, one ounce.

Directions.—The beef should be lean and juicy, and cut into small pieces. Put it into one gallon and a half of cold water with the salt. Let it boil gently three hours. If it should boil away too fast, add the requisite quantity of boiling water and let it boil fifteen minutes longer. When done it should measure twelve pints. Set it aside to cool. Remove every particle of grease, and heat when required. In case of a deficiency of fresh beef, use the beef extract supplied in the hospital stores.

Beef Extract (*U. S. Army Hospital Receipt for Twelve Men*).

Directions.—Infuse a third of a pound of fresh beef, finely minced, in fourteen ounces of cold soft water, to which a few drops (four or five) of muriatic acid and a little salt (from ten to eighteen grains) have been added. After digesting for an hour to an hour and a quarter, strain it through a sieve and wash the residue with five ounces of cold water, pressing it to remove all soluble matter. The mixed liquid will contain the whole of the soluble constituents of the meat (albumin, creatin, etc.), and it may be drank cold or slightly warmed. The temperature should not be raised above 100° F., as at the temperature of 113° F. a considerable portion of the albumin, a very important constituent, will be coagulated.

Meat Extract (*Rosenthal and Leube*).—One thousand grammes of lean meat, minced fine, are placed in a porcelain vessel with one thousand grammes of water, and twenty centigrammes of dilute hydrochloric acid. This is placed in a closed Papin's digester and boiled for ten to fifteen hours. The mass is then taken out and rubbed in a mortar to a paste. It is again boiled in the closed digester for another sixteen to twenty hours; after this it is neutralised with pure sodium carbonate, and evaporated to a sirupy consistence.

Restorative Beef Essence (*Ringer*).—Take one ounce of fresh beef, free from fat, chop fine, and pour over it eight ounces of soft water, add five or six drops of dilute hydrochloric acid, and fifty or sixty grains of common salt, stir it well, and leave for three hours in a cool place. Then pass the fluid through a hair sieve, pressing the meat slightly, and adding gradually toward the end of the straining about two more ounces of water. The liquid thus obtained is of a red colour, possessing the taste of soup. It should be taken cold, a teaspoonful at a time. If preferred warm, it must not be put on the fire, but heated in a covered vessel placed in hot water.

BROTHS AND SOUPS

Chicken Broth (*Bartholow*).—Skin and chop up fine a small chicken or half a large fowl, and boil it, bones and all, with a blade of mace, a sprig of parsley, and a crust of bread, in a quart of water for an hour, skimming it from time to time. Strain through a coarse colander.

Chicken, Veal, or Mutton Broth (*Yeo*).—Chicken, veal, or mutton broth may be made like beef tea, substituting chicken, veal, or mutton for beef, boiling in a saucepan for two hours, and straining. For chicken broth the bones should be crushed and added. For veal broth the fleshy part of the knuckle should be used. Either may be thickened and their nutritive value increased by the addition of pearl barley, rice, vermicelli, or semolina.

Mutton and Chicken Broths (*Osler*).—Mince a pound of either chicken or mutton, freed from fat, put into a pint of cold water, and let stand in a cold jar on ice two to three hours. Then cook three hours over a slow fire, strain, cool, skim off fat, add salt, and serve hot or cold. Such broth is much better than any manufactured meat preparations. Good mutton broth is difficult to make on account of the meat containing so much fat.

Chicken Broth (*U. S. Army Hospital Receipt for Twelve Men*).—Chicken, one; salt, two ounces; flour, two ounces.

Directions.—Cut the chicken into pieces. Put it with the salt into the kettle with twelve pints of cold water. Let it simmer gently two or three hours, carefully and frequently skimming off the grease. Make a paste of the flour with some cold water; stir it in and boil ten minutes longer. It should measure ten pints when done.

Mutton Broth (*U. S. Army Hospital Receipt for Twelve Men*).—Mutton, six pounds; salt, two ounces; rice, two ounces.

Directions.—Break the bones without separating the meat. Put it into twelve pints of cold water, with the salt and rice or barley. Boil gently two hours and a half, carefully removing all the scum and fat. If the broth should boil away too much, add the requisite quantity of boiling water to make twelve pints, and let it boil fifteen minutes longer.

Invalid Broths.—To one pound of chopped lean meat, either chicken, mutton, or beef, add one pint of cold water (or one pint and a half on ice for a young infant), let stand in a covered glass fruit jar for four to six hours, cook for three hours in a closed jar over a slow fire, strain, cool, skim off the fat, clear with egg, season, and feed warm or cold.

Bouillon (Broth) as used in the Hospitals of Paris (*Yeo*).—Raw meat, without bone, one kilogramme; fresh vegetables, four hundred grammes (about one pound); salt, ten grammes (about one hundred and fifty grains). Boil very slowly over a gentle fire.

Nourishing Soup (*Ringer*).—Stew two ounces of the best well-washed sago in a pint of water till it is quite tender and very thick; then mix it with half a pint of good boiling cream and the yolks of two fresh eggs. Blend the whole carefully with one quart of essence of beef. The beef essence must be heated separately, and mixed while both mixtures are hot. A little of this may be warmed at a time.

Consommé.—*Consommé* may be flavoured with vegetable extracts or expressed juice of vegetables boiled in it. Thicken soups with arrowroot, ground rice, or cornflour.

Beef Tea with Oatmeal (*Anderson*).—This forms a very nutritious food. Take two tablespoonfuls of oatmeal and two of cold water and mix them thoroughly; then add a pint of good beef tea which has just been brought to the boiling point. Boil together for five minutes, stirring it well all the time, and strain through a hair sieve.

SOLID MEAT PREPARATIONS

Raw-meat Diet (*Ringer*).—From two ounces of rump steak take away all fat, cut into small squares without entirely separating the meat, place in a mortar, and pound for five or ten minutes; then add three or four tablespoonfuls of water and pound again for a short time, afterwards removing all sinew or fibre; add salt to taste. Before using, place the cup or jar containing the pounded meat in hot water until just warm.

Or scrape the beefsteak with a sharp knife and, after removing all fat and tendon, if not already in a complete pulp, pound in a mortar. Flavour with salt and pepper. This may be taken in the form of a sandwich between thin bread and butter or mixed with water to the consistence of cream. If preferred, the meat may be rolled into balls with a little white of egg and broiled for two minutes, or until the outside turns gray—just long enough to remove the raw taste.

This diet is excellent for children with diarrhœa, also for adults who suffer from irritable bowels or chronic diarrhœa.

Scraped Beef (*U. S. Army Hospitals*).—Cut a piece of steak from the round, about half a pound in weight and about an inch thick. Lay it on a clean meat board and with a dull knife scrape out the pulp until there is nothing left but stringy fibre. Season the scraped pulp with salt and make it into small cakes. Broil for two minutes either by direct heat over a clear fire, or by heating a clean pan or plate and, when hot, placing the meat on it. Have both sides cooked sufficiently. This is a safe food for a patient beginning to take solid nourishment. Scraped beef may be prepared very easily over an alcohol lamp.

Scraped-beef Sandwiches (*U. S. Army Hospitals*).—Place a piece of round steak on a meat board and scrape out all of the pulp with a dull knife; add to the pulp a little salt and pepper and enough raw beef juice to make it into a firm jelly. Have stale bread cut into very thin slices and spread the beef pulp on them; cut the sandwiches quite small. Never use butter in making beef sandwiches.

Meat Biscuits (*Parkes*).—Mix together, cook, and bake one pound of flour, one pound of meat, one quarter of a pound of suet, one half pound potatoes with a little sugar, onion, salt, pepper, and spices. A palatable meat biscuit, weighing about one pound and a quarter, containing 10 to 12 per cent of water, is thus obtained which keeps quite unchanged for four months.

Raw-meat Sandwiches (*from Food*).—Three ounces of raw beef or mutton, one ounce of very fine bread crumbs, one teaspoonful of sugar; cut the meat very fine, rub it through a hair sieve, then pound it in a mortar into a paste. Mix with it the bread crumbs, sugar, a little salt and pepper; spread it between thin slices of either brown or white bread and butter.

Chicken Jelly (*Adams*).—Clean a fowl that is about a year old, remove skin and fat; chop fine, bones and flesh, place in pan with two quarts of water; heat slowly; skim thoroughly; simmer five to six hours; add salt, mace, or parsley to taste, strain; cool. When cool, skim off the fat.

The jelly is usually relished cold, but may be heated. Give often in small quantities.

Enema of Meat and Pancreas (*Leube*).—Mince from one hundred and fifty to three hundred grammes of meat, and mix with fifty to one hundred grammes of finely chopped pancreas, free from fat. Beat the mixture into a paste with a pestle or spoon, adding a little lukewarm water to make it of a suitable consistence for injection through the enema tube. Use warm; if cold it may excite the rectum and cause expulsion. If thought desirable, from twenty-five to fifty grammes of fat may be mixed intimately with the mass by the help of a warm pestle. A syringe with a wide nozzle must be used.

MILK PREPARATIONS

Milk-and-cinnamon Drink (*Ringer*).—Boil in one pint of new milk sufficient cinnamon to flavour it pleasantly, and sweeten with white sugar. This may be taken cold with a teaspoonful of brandy, and is very good in cases of diarrhœa. Children may take it warm without brandy.

Albuminised Milk (*U. S. Army Hospitals*).—Beat up the white of an egg till light. Add a good-sized pinch of salt, and four ounces of fresh, cool milk which has been sterilised. A little sugar may be added if desired.

Milk Punch.—Make by adding brandy or whisky or rum to milk in the proportion of about one to four or six parts of milk; flavour with sugar and nutmeg; shake well.

Sherry or Brandy and Milk (*Ringer*).—To one tablespoonful of brandy or one wineglassful of sherry, in a bowl or cup, add powdered sugar and a very little nutmeg to taste. Warm a breakfast cupful of new milk and pour into a pitcher. Pour the contents from a height over the wine, sugar, etc. *The milk must not boil.*

Rum and Milk (*Fothergill*).—Half a pint of new milk, one egg, one to two teaspoonfuls of powdered sugar, grated nutmeg, one to two teaspoonfuls of good old Jamaica rum. Mix.

Junket (*Anderson*).—Sweeten with white sugar one pint of good milk. If wine is allowed, a dessertspoonful of sherry is an improvement. Heat to new milk warmth, pour into a shallow dish, and stir in two teaspoonfuls of essence of rennet. This will form a slight curd. Grate a little nutmeg over it or add a pinch of powdered cinnamon. Serve when quite cold. In cold weather the milk should be placed in a warm room to set. An excellent food, and good substitute for milk in typhoid fever, etc.

Artificial Human Milk (*Frankland*).—Allow one third of a pint of new milk to stand twelve hours, remove the cream, and mix it with two thirds of a pint of perfectly fresh cow's milk. Take the milk from which the cream was removed and put a piece of rennet about an inch square (fluid rennet may be employed) into it. Keep the vessel containing it in a warm place until the milk is fully curdled, an operation requiring five to fifteen minutes, according to the activity of the rennet, which should be removed as soon as the curdling commences, and put into an eggcup for use on subsequent occasions, as it may be employed daily for a month or two. Break up the curd repeatedly, and carefully separate the whole of the whey, which should then be rapidly heated to boiling in a small tin pan, placed over a spirit or gas lamp. During the heating a further quantity of casein [albumin?], technically called "fleetings," separates, and must be removed by straining through clean muslin. Now dissolve one hundred and ten grains of powdered sugar of milk in the hot whey, and mix it with two thirds of a pint of new milk to which the cream from the other fluid has already been added, as already described. The artificial milk should be used within twelve hours of its preparation.

Biedert's Cream Mixture.—Mix four ounces of cream with twelve ounces of warm water and add one half ounce of milk sugar.

Koumiss (*Anderson*).—To one pint of new milk add three ounces of water, three ounces of old koumiss (for a ferment), and one ounce of saturated solution of sugar of milk. Put all in a large jug, cover carefully, and set the jug in a warm place for twenty-four hours. By that time a thick crust will have formed on the surface of the mixture; beat this up thoroughly and mix all well. Then put the whole into champagne bottles, which should be no more than two thirds full, and cork and wire. Shake the bottles daily. The koumiss will be fit for use in two days, but it is much improved by keeping for about six weeks. It should be drawn off with a tap.

Home-made Koumiss.—Boil fresh milk, and when nearly cold put into quart bottles, leaving room to shake. Add half an ounce of crushed lump sugar and a piece of Vienna yeast the size of a hazel nut (i. e., twenty grains), cork with new corks, tie down, keep cool, lay the bottles horizontal, but shake twice daily. Ready to drink on sixth day, or earlier in hot, later in cold weather.

The koumiss can be made thinner by using skimmed milk.

Home-made Lime Water.—Pour two quarts of hot water over fresh, unslacked lime (size of a walnut), stir till slacked, let stand till clear and bottle. Often ordered with milk to neutralise acidity of the stomach.

EGG PREPARATIONS

Eggnog.—Eggnog is made by adding the beaten yolk of egg and a little spirits to a tumblerful of milk, stirring well, adding sugar and the white of the egg, separately beaten. The digestibility of both of these highly nourishing and stimulating preparations is enhanced by the addition of half an ounce of lime water, which does not affect the taste.

Egg and Wine (*Ringer*).—Take one egg, half a glass of cold water, one glass of sherry, sugar, and a very little nutmeg grated.

Beat the egg to a froth with a tablespoonful of cold water. Make the wine and water hot, but not boiling; pour on the egg, stirring all the time. Add sufficient sugar to sweeten, and a very little nutmeg. Put all into a porcelain-lined saucepan over a gentle fire and stir one way till it thickens, but *do not let it boil.* Serve in a glass with crisp biscuits or sippets of toast.

Eggnog (*Bartholow*).—Scald some new milk by putting it, contained in a jug, into a saucepan of boiling water, but it must not be allowed to boil. When quite cold beat up an egg with a fork in a tumbler with some sugar; beat quite to a froth; add a dessertspoonful of brandy and fill up the tumbler with scalded milk. A nutritive drink in acute disease.

Brandy and Egg Mixture (*British Pharmacopœia*).—Rub together the yolks of two eggs and half an ounce of refined sugar, and add four ounces of Cognac and four ounces of cinnamon water. A more generally useful mixture may be made with half this quantity of brandy.

Stokes's Cognac Mixture.—Best Cognac, distilled water, each fifteen ounces; yolk of one egg; sirup, six ounces. Mix. Give a tablespoonful every two or three hours.

Egg and Brandy Mixture (*Anderson*).—Beat up three eggs to a froth in four ounces of cold water and then add four ounces of brandy. Mix well and sweeten to taste. A little nutmeg may be added. Give a tablespoonful or so at a time.

Lemonade with Eggs (*Ringer*).—The juice of four lemons, the rinds of two, half a pint of sherry, four eggs, six ounces of loaf sugar, one pint and a half of boiling water.

Pare the lemon rind thinly, put it into a pitcher with the sugar, and pour the boiling water on it. Let it cool, then strain, and add the wine, lemon juice, and eggs, previously well beaten and strained. Mix all together and it is ready for use.

Savoury Custard (*Anderson*).—Add the yolks of two eggs to a cupful of beef tea, with pepper and salt to taste. Butter a cup or jam pot, pour the mixture into it, and let it stand in a pan of boiling water till the custard is set.

Milk for Puddings or Stewed Fruit (*Ringer*).—Boil a strip of lemon and two cloves in a pint of milk; mix half a teaspoonful of arrowroot in a little cold milk and add it to the boiling milk; stir it until about the consistence of cream. Have ready the yolks of three eggs beaten up well in a little milk. Take the hot milk off the fire and as it cools add the eggs and a tablespoonful of orange-flower water, stirring it constantly till quite cool. Keep it in a very cool place till required for use.

Rice Soup (*Ringer*).—Take three ounces of rice, the yolks of two eggs, half a pint of cream or new milk, one quart of stock.

Boil the rice in the stock and rub half of it through a tammy, put the stock in a stewpan, add the rest of the rice whole, and simmer gently for five minutes. Have ready the milk or cream, boiled. Beat the yolks of the eggs and mix them gradually with the cream. Take the soup off the fire, add the cream and egg, stirring them well together as you mix them. Heat gradually, *but do not boil*, or the eggs will curdle.

A Gruel (*Ringer*).—Beat an egg to a froth, add a wineglass of sherry, flavour with a lump of sugar, a strip of lemon peel, and a little grated nutmeg. Have ready some gruel, very smooth and hot, stir in the wine and egg, and serve with crisp toast. Arrowroot may be made in the same way.

Caudle (*Yeo*).—Beat up an egg to a froth; add a glass of sherry and half a pint of gruel. Flavour with a lemon peel, nutmeg, and sugar.

FARINACEOUS FOODS

Arrowroot Blancmange (*Ringer*).—Take two tablespoonfuls of arrowroot, three quarters of a pint of milk, lemon, and sugar to taste.

Mix the arrowroot with a little milk to a smooth batter; put the rest of the milk on the fire and let it boil, sweeten, and flavour it, stirring all the time, till it thickens sufficiently. Put into a mould till quite cold.

Arrowroot Blancmange (*U. S. Army Hospitals*).—Two tablespoonfuls of arrowroot. Two thirds pint of hot water. Two tablespoonfuls of sherry or brandy. Two teaspoonfuls of sugar.

Mix the arrowroot into a smooth paste with three tablespoonfuls of cold water. Add this to the hot water. Bring to a boil, stirring constantly till well blended and free from lumps. Let boil for ten minutes. Add the sugar and sherry or brandy. Beat up quickly and pour into a bowl or mould to cool. Arrowroot blancmange may be made with fresh hot milk or condensed milk diluted. If boiling water is used it causes the starch of the arrowroot, when first poured in, to form into lumps. Hence it is best to have the water not quite at boiling point.

Arrowroot (*Pavy*).—Mix thoroughly two teaspoonfuls of arrowroot with three tablespoonfuls of cold water, and pour on them half a pint of boiling water, stirring well meanwhile. If the water is quite boiling, the arrowroot thickens as it is poured on, and nothing more is necessary. If only warm water is used, the arrowroot must be afterwards boiled until it thickens. Sweeten with loaf sugar and flavour with lemon peel or nutmeg, or add sherry, port wine, or brandy, if required. Boiling milk may be employed instead of water, but when this is done no wine must be added, as it would otherwise curdle.

Oatmeal Gruel (plain) (*from Food*).—Two tablespoonfuls of oatmeal, one saltspoonful of salt, one scant teaspoonful of sugar, one cupful of boiling water, one cupful of milk. Mix the oatmeal, salt, and sugar together, and pour on the boiling water. Cook for thirty minutes; then strain through a fine wire strainer to remove the hulls, place again on the stove, add the milk, and heat just to the boiling point. Serve hot.

Scotch Beef Broth.—To a pint of beef broth which has been carefully strained and seasoned and from which all the fat has been removed, add a teaspoonful of oatmeal and boil gently for two hours. Strain and serve hot.

In this preparation the oatmeal should be soft and jellylike, and if too much water evaporates during the boiling, more should be added.

Cornstarch (*U. S. Army Hospital Receipt for Twelve Men*).—Cornstarch, six ounces; milk, three pints; water, twelve ounces.

Directions.—Mix the cornstarch into a smooth paste with cold water. The milk and water must be boiling, to which add a little salt. Stir in the cornstarch. Let it boil three or five minutes.

Farina Pudding (*U. S. Army Hospital Receipt for Twelve Men*).—Farina, half a pound; milk, two pints; water, one pint; sugar, two and a half ounces; eggs, four ounces; nutmeg, half an ounce.

Directions.—Put the water into a stewpan with a little salt. When it boils, stir in the farina. Let it boil twenty minutes. Stir in the milk, which must be hot. Beat the eggs until they are very light; mix the sugar with them. Stir in the eggs and sugar with the farina. Add the spice. Put it into a moderate oven and bake a half or three quarters of an hour.

Farina Gruel (*U. S. Army Hospitals*).—One tablespoonful of farina. One pint of water. One teaspoonful of sugar. One half teaspoonful of salt. Into one pint of water, raised to boiling, put a half teaspoonful of salt; then add the farina and cook for twenty minutes. Flavour with sugar and condensed milk, if fresh milk is not available. Strain and serve hot.

In this recipe, as in others, condensed milk is used in a strength of one teaspoonful to the half pint of gruel.

Boiled Rice (*U. S. Army Hospital Receipt for Twelve Men*).—Rice, twelve ounces; salt, half an ounce; water, three pints.

Directions.—Put the salt and water into a stewpan. When boiling, add the rice, previously thoroughly washed. Boil for ten minutes, or until each grain becomes soft. Drain it on a colander. Grease the stewpan with clarified drippings or lard. Put back the rice. Let it swell slowly near the fire, or in a slow oven, for about twenty minutes, until the grains are well separated.

Rice Gruel (*Chambers*).—Ground rice, two ounces; powdered cinnamon, quarter of an ounce; water, four pints. Boil forty minutes and add a teaspoonful of orange marmalade.

Rice Gruel (*U. S. Army Hospitals*).—Two tablespoonfuls of rice, or one tablespoonful of rice flour. One pint of boiling water. One half teaspoonful of salt. One teaspoonful of sugar. Wash the rice thoroughly in two waters, after removing any specks that may be mixed in the grain. Have the cooking water boiling.

Rice Milk (*Anderson*).—Wash two tablespoonfuls of good rice and put it into a saucepan with a quart of milk. Let it simmer gently till the rice is tender, and stir from time to time to prevent burning; sweeten to taste. If desirable, serve with stewed apples or prunes. Sago, tapioca, etc., are prepared in the same way. If an egg is to be added, beat the white and yolk separately, and add them to the rice after it has been taken from the fire.

Rice and Apple (*Ringer*).—Boil about two tablespoonfuls of rice in a pint and a half of new milk, and simmer, stirring it from time to time till the rice is quite tender. Have ready some apples, peeled, cored, and stewed to a pulp, and sweetened with a very little loaf sugar. Put the rice round a plate and the apple in the middle, and serve.

Rice Cream (*Ringer*).—To a pint of new milk add a quarter of a pound of rice, a lump of butter the size of a walnut, a little lemon peel, and a tablespoonful of powdered sugar. Boil them together for five minutes, then add half an ounce of isinglass which has been dissolved, and let the mixture cool. When cool add half a pint of good cream whisked to a froth, mix together, and set it for a time in a very cool place, or on ice; when used, turn it out of the basin into a dish, and pour fruit juice around it, or some stewed apple or pear may be served with it.

Rice Cream (*from Food, January, 1894*).—Two tablespoonfuls of rice. Two cups of milk. One saltspoonful of salt. Two tablespoonfuls of sugar. Two eggs.

Cleanse the rice by washing it several times in cold water; cook it in a double boiler with the milk until the grains will mash. Three hours will generally be required to do this. Should the milk evaporate, restore the amount lost. When the rice is perfectly soft, press it through a coarse soup strainer or colander into a saucepan, return it to the fire, and while it is heating beat the eggs, sugar, and salt together until very light. When the rice boils, pour the eggs in rather slowly, stirring lightly with a spoon for three or four minutes, or until it coagulates, and the whole is like a thick, soft pudding; then remove from the fire, and pour it into a dish. By omitting the yolks and using the whites of the eggs only, a delicate cream is obtained.

Malt (Ground) and Rice Pudding (*Yeo*).—Stir an ounce of ground malt into a pint of boiling milk, strain through a sieve, and add the milk to two ounces of well-soaked rice. Mix well, and stand for ten minutes in a warm place, then bake for an hour.

Cracker Gruel (*from Food, January, 1894*).—Two tablespoonfuls of cracker crumbs. One scant saltspoonful of salt. One scant teaspoonful of sugar. One cup of boiling water. One cup of milk.

To make the cracker crumbs, roll some crackers on a board until they are fine. Water crackers are good, cream crackers are better; mix the salt and sugar with the crumbs, pour on the boiling water, put in the milk, and simmer it for two minutes. The gruel does not need long cooking, for the cracker crumbs are already thoroughly cooked. Do not strain.

Indian-meal Gruel (*from Food, January, 1894*).—Two teaspoonfuls of cornmeal. One tablespoonful of flour. One teaspoonful of salt. One teaspoonful of sugar. One quart of boiling water. One cup of milk.

Mix the cornmeal, flour, salt, and sugar into a thin paste with cold water, and pour into it the boiling water. Cook it in a double boiler for three hours. No less time than that will cook the cornmeal thoroughly. Then add the milk, and it is ready to serve.

Hard-bread Gruel (*U. S. Army Hospitals*).—Toast hard bread thoroughly and grind it into a powder. To one pint of boiling water, to which one half teaspoonful of salt has been added, add two tablespoonfuls of hard-bread powder. Boil ten minutes and then strain. Flavour with one teaspoonful of sugar and one teaspoonful of condensed milk to each cupful of the gruel.

Bread Jelly (*Chrystie*).—Pour boiling water on stale bread, and let it soak for an hour. Pour off the water, add fresh water, and boil down until a thick mass is obtained which becomes jellylike on cooling, and may be eaten with milk or cream and sugar.

Milk Porridge (*U. S. Army Hospital Receipt for Twelve Men*).—Milk, eight pints; flour, twelve ounces; water, three pints.

Directions.—The flour to be used for milk porridge should be previously prepared by being tied up closely in a bag and boiled four or five hours. It can then be grated to powder, which should be mixed into a smooth paste with cold water. Add to the milk the prescribed quantity of water, and stir in the flour, with a little salt. Let it boil ten minutes, stirring all the time.

Fothergill's Amylaceous Food.—Of rice, well washed, of arrowroot, tapioca, and pearl barley, take each an ounce, add two quarts of water, and boil down to a quart; then flavour with candied eringo.

Barley Jelly (*Eustace Smith*).—Put two tablespoonfuls of washed pearl barley into a pint and a half of water, and slowly boil down to a pint; strain, and let the liquid settle into a jelly. Two teaspoonfuls of this, dissolved in eight ounces of warmed and sweetened milk, are enough for a single feeding, and such a meal may be allowed twice a day.

Panada (*Ringer*).—Take the crumb of a penny roll and soak it in milk for half an hour, then squeeze the milk from it; have ready an equal quantity of chicken or veal, scraped very fine with a knife; pound the bread crumb and meat together in a mortar. It may be cooked either mixed with veal or chicken broth, or poached like an egg. By taking it up in two spoons, in pieces the shape of an egg, after seasoning, it may be served with mashed potato.

Another Caudle (*Ringer*).—Mix well together one pint of cold gruel with a wineglassful each of good cream and sherry and a tablespoonful of noyau, and sweeten with sugar candy.

Almond Cakes for Diabetics (*Seegen*).—Take of blanched, sweet almonds a quarter of a pound, beat them as fine as possible in a stone mortar; remove the sugar contained in this meal by putting it into a linen bag and steeping it for a quarter of an hour in boiling water acidulated with vinegar; mix this paste thoroughly with three ounces of butter and two eggs. Next add the yolks of three eggs and a little salt, and stir well for some time. Whip up the whites of three eggs and stir in. Put the dough thus obtained into greased moulds, and dry by a slow fire.

Macaroni Boiled (*U. S. Army Hospital Receipt for Twelve Men*).—Macaroni, one pound; salt, a quarter of an ounce; boiling water, six pints.

Directions.—Wipe the macaroni carefully. Break into four-inch lengths. Put with the salt into cold water and boil until tender, but not until it bursts or becomes a pulp. Drain off the water at once, and season with butter. The liquor from the macaroni makes a good broth.

GELATIN PREPARATIONS

Port-wine Jelly (*Ringer*).—Put into a jar one pint of port wine, two ounces of gum arabic, two ounces of isinglass, two ounces of powdered white sugar candy, a quarter of a nutmeg grated fine, and a small piece of cinnamon. Let this stand closely covered all night. The next day put the jar into boiling water and let it simmer until all is dissolved, then strain, let stand till cold, and then cut into small pieces for use.

Milk, Rum, and Isinglass (*Ringer*).—Dissolve in a little hot water over the fire a pinch of the best isinglass; let it cool, and mix a dessertspoonful of rum with it in a tumbler, and fill up the glass with new milk.

Nutritious Coffee (*Ringer*).—Dissolve a little isinglass in water, then put half an ounce of freshly ground coffee into a saucepan with one pint of new milk, which should be nearly boiling before the coffee is added; boil both together for three minutes; clear it by pouring some of it into a cup and dashing it back again, add the isinglass, and leave it to settle on the hob for a few minutes. Beat up an egg in a breakfast cup, and pour the coffee upon it; if preferred, drink it without the egg.

Lemon Jelly (*U. S. Army Hospitals*).—One fourth box of gelatin (one half ounce). One fourth cup of cold water. One fourth cup of fresh lemon juice (about the amount yielded by two lemons). Three tablespoonfuls of sugar. One and one fourth cups of boiling water. Put the gelatin to soak in the cold water, about twenty minutes being required for this process. When dissolved, pour on the boiling water. Add the lemon juice and sugar. Stir thoroughly and strain through a fine-meshed cloth into a china or granite-ware mould, cooling in a refrigerator or by placing in a pan of cold water. Never use tin moulds for lemon jelly.

Coffee Jelly (*U. S. Army Hospitals*).—One fourth box of gelatin (one half ounce). One fourth cup of cold water. One cup of boiling water. One half cup of strong coffee. Two tablespoonfuls of sugar. Soak the gelatin in the cold water for half an hour. Pour on the boiling water, then put in the sugar and coffee. Strain it through a cloth into a mould or dish in which it may be cooled, either in a pan of iced water or in a refrigerator. Coffee jelly may be served with cream and sugar.

Have the coffee strong, two tablespoonfuls of coffee to each cup of water. Where vanilla extract is available, one half teaspoonful will be advantageously added to the above recipe.

Wine Jelly (*U. S. Army Hospitals*).—One fourth box of gelatin (one half ounce). One fourth cup of cold water. One half cup of sugar. One half cup of sherry wine. One and one fourth cup of boiling water. One small piece of cinnamon. Put the gelatin and cold water together in a dish large enough to hold the whole mixture. Let it soak for half an hour, then pour the boiling water (in which the piece of cinnamon has been simmering) over the softened gelatin. Add the sugar and wine, strain through a clean cloth into a china or granite-ware mould, and cool in a refrigerator or a pan of cold water.

FAT FOODS

(Useful in diabetes and in emaciation not due to gastro-intestinal disorder, such as that of chronic phthisis and chronic sepsis, empyema, etc.)

Fresh butter, one quarter pound or more per diem; suet, lard, margarine, and " drippings " used in excess in cooking, fat soups and broths, bone marrow, rich cheese, Devonshire clotted cream, cream diluted with water to the consistency of milk, and drank as a beverage (a pint or more per diem), olives, olive oil on salads, sardines, etc.; fat fish, such as mackerel and salmon; the fats of Russell's Emulsion, cod liver oil, oily nuts, such as fresh English walnuts, pecan, and Brazil nuts; bacon, pork, fat ham, fat goose and duck, and any form of fat meat, such as the tender fat of corned beef, bone marrow, egg yolk.

VEGETABLES CLASSIFIED ACCORDING TO THEIR DIETETIC VALUE

1. Useful for nutriment, mainly protein, but also starch and fats:

White beans.
Lima beans.
Kidney beans (haricots).
Soya beans.
French beans.
Red beans.
Frijole.
Peas (dried and split, or fresh).
Lentils.
Peanuts.

2. Useful for nutriment, mainly for starch and sugar:

White potatoes.
Sweet potatoes.
Yams.
Jerusalem artichokes.
Beets.
Corn.

3. Useful for variety of flavour, as antiscorbutics, and to add bulk of undigested fibrous tissue to the fæces in cases of chronic constipation:

Carrots.
Parsnips.
Turnips.
Kohl rabi.
Salsify (oyster plant).
Radishes.
Cabbages (including cole, seakale, and sauerkraut).
Cauliflower.
Broccoli.
Spinach.
Beet tops.
Turnip tops.
Dandelion tops.
Lettuce (including romaine).
Sorrel.
Cress and peppergrass.
Green peppers.
Capers.
Mint.
Parsley.
Endive.
Chicory.
Okra.
Celery.
Artichokes.
Eggplant.
Tomatoes.
Cucumbers.
Asparagus.
Rhubarb (pieplant).
Pumpkins.
Squash.
Onions.
Garlic.
Leeks.
Shallots.
Vegetable marrow.
Cranberries.

CONCENTRATED FLUID NOURISHMENT

(Sometimes useful in fevers and conditions in which only very small quantities of food can be taken.)

1. Milk, peptonised, to which is added in each tumblerful one or two teaspoonfuls of (1) milk sugar (first dissolved in hot water), (2) the albumen of one or two eggs, (3) a tablespoonful of malted milk, Nestlé's, Carnrick's, Benger's, or other proprietary food.

2. Meat juice squeezed, or strong broths, to which may be added one or two teaspoonfuls of such concentrated foods as Plasmon, Nutrose, or Somatose, or one of the fluid beef preparations, such as Johnson's Fluid Beef, Bovinine, etc.

3. Cream, half a tumblerful, with the albumen of one egg and a teaspoonful of some cordial, such as Curaçoa or Benedictine, and a teaspoonful of milk sugar. (Suitable especially for consumptives.)

SUBSTITUTES FOR THE MORNING TEA OR COFFEE

Patients often insist upon having some form of hot drink to replace the breakfast cup of tea or coffee of which they have been deprived. There is no true substitute for these beverages in the sense that their mildly stimulating effects are replaced, but the habit of taking "something hot" with the first meal may be satisfied by use of one of the following:

Hot water flavoured with lemon and cloves; hot malted milk, hot cocoa or alkathrepta; a cup of hot broth or of hot water, with addition of a teaspoonful of some meat extract like Liebig's or Valentine's Meat Juice. There are also the artificial "coffees," made from parched grains, beans, etc., which are much advertised, and one made from torrefied bananas; caudle; gruels made with Irish or Iceland moss and spiced, or flavoured with lemon.

GENERAL RULES FOR PRESCRIBING A DIETARY

1. All directions should be made specific, and in writing.

2. The patient's previous experience with the foods recommended should be investigated. Often a supposed difficulty in digestion is due to errors in cooking or in the combination with other foods.

3. The patient should understand that no one food is curative, and in recommending any dietary, however limited, regard should be had, as far as possible, to the patient's taste and to stimulation of the appetite by acceptable flavours.

4. In some cases it is preferable to have the patient submit his own diet list for correction.

5. In some cases it is the quantity of a food which requires reduction rather than its total proscription.

6. The relation of proper intervals of rest, exercise, and work to meals should be as definitely prescribed for those who are not bed-ridden as the diet.

7. The daily quantity of fluid ingested may be as important a consideration as the regulation of food.

8. It is undesirable to prescribe any strict dietary for too long a period, or for an indefinite period, otherwise failure of appetite, inanition, anæmia, and weakness may ensue. If a strict diet is beneficial, it will become so within a few days, or, at the most, within from three to six weeks. The question of its continuance or modification should then be reviewed, for in some cases positive harm may result without such revision.

9. In some few cases radical changes in diet should be made gradually at the outset, but in the majority of cases immediate change does no harm, and produces more prompt results. On the other hand, a return to the normal diet should be made by slow gradation.

10. It is most undesirable to base any dietary upon too rigid formulæ or preconceived "systems." Normal idiosyncrasies in regard to digestion and assimilation are numerous, but morbid idiosyncrasies in disease are far more so; hence, each important case should be made the subject of independent study and frequent careful observation of the excreta should be made.

11. In cases requiring protracted dieting the use of the scales in determining the body weight is most important.

FOOD WEIGHTS

Most persons have but little idea of the weight of the foods they eat, yet the usual dietetic tables of "food values" are based upon gramme measurements. Following is a list of approximate weights of foods as used in ordinary "helpings" at the table by the average person in health. Of course such an estimate cannot be very accurate, yet it may afford interest.

Quantities of Foods for Single Meals

	Grammes.	Ounces (approximate).	Calories.
Porridge, oatmeal, wheat, cornmeal, etc.	200	6	175
Sugar on porridge	10	⅓	10
Milk (one tumblerful)	180	6	200
Bread (three slices)	100	3	200
Butter on bread	15	½	120
Steak	50	1½	165
Soup, or meat broth or purée	120	4	100–200
Fish	200	6	200
Potatoes	50	1½	60
Green vegetables	100	3	50
Peas, beans or corn	75	2½	300
Crackers and cheese	75	2½	300
Bread or Indian pudding	100	3	200
Cocoa (one cup)			150

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THE END