Food in Health and Disease

I. Burney Yeo, M.D., F.R.C.P.


LIBRARY OF THE ROYAL COLLEGE OF PHYSICIANS EDINBURGH
non
sinit esse

CLINICAL MANUALS

FOR

PRACTITIONERS AND STUDENTS

OF MEDICINE.

FOOD

IN

HEALTH AND DISEASE.

BY

I. BURNEY YEO, M.D., F.R.C.P.,

PROFESSOR OF CLINICAL THERAPEUTICS IN KING'S COLLEGE, LONDON, AND PHYSICIAN TO KING'S COLLEGE HOSPITAL.

CASSELL & COMPANY, LIMITED:

LONDON, PARIS, NEW YORK & MELBOURNE.

1889.

To

SIR WILLIAM ROBERTS, M.D., F.R.S.,

IN ADMIRATION OF HIS

MASTERLY RESEARCHES IN PRACTICAL DIETETICS,

THIS HUMBLE CONTRIBUTION TO THE STUDY OF THAT SUBJECT

IS DEDICATED.

PREFACE.

In writing this work on Food, the object I have especially aimed at has been to make it one of practical utility, and to render it, as far as possible, representative of the modern aspects of the subject it treats of. In a hand-book like this, which has necessarily to be kept within strictly allotted limits, compression in certain points has been essential in order to obtain space to give adequate development to the more generally interesting details of practical dietetics.

I have thought it desirable, in the first part of the book, to enter fully and in detail into the important subjects of Army and Prison Dietaries, School Dietaries, and Feeding during the critical period of Infancy and Childhood. In connection with the first of these subjects I have been at pains to present as fully as possible the admirable system of feeding our soldiers at home stations, so ably devised and carried out by Colonel C. J. Burnett, a system which may serve as a model of wholesome, economical, and intelligent feeding.

The second part of the book is, to some extent, founded on a short course of lectures on "The Therapeutics of Food," which it was my duty to give in King's College Hospital as Professor of Clinical Therapeutics.

In preparing this Manual I have been under great obligations to many contemporary writers on Dietetics. To the writings, amongst others, of Bauer, König, Landois, Oertel, Dujardin-Beaumetz, Germain Sée, Weir Mitchell, Parkes, Pavy, Sir Henry Thompson, and Sir William Roberts, I am deeply indebted.

The subject-matter of this work does not lend itself well to orderly classification. Few previous writers on Dietetics have attempted any. I have, however, thought it would be practically convenient to arrange the subjects dealt with under two main divisions—Food in Health, and Food in Disease. Beneke's Diet for Carcinoma will, nevertheless, be found in Part I., as it was difficult to separate it from the discussion of the subject of Vegetarianism, with which it seemed to have a natural connection.

I can only hope this book will be found to be—what I have endeavoured to make it—a practically useful guide to the study of the important subject of Dietetics.

CONTENTS.

PART I.—FOOD IN HEALTH.

CHAPTER PAGE

I.—The Nature, Origin, and Purpose of Food—Classification of Food—Metabolism 1

II.—The Nutritive Value and Uses of the different Classes of Food 13

ORDINARY ARTICLES OF FOOD AND DRINK.

III.—Animal Foods 35

IV.—Vegetable Foods 73

V.—Beverages 106

Condiments 144

VI.—The Annexation of Food; its Digestion, Assimilation, and Utilisation 146

VII.—The Cooking, Preparation, and Preservation of Food 173

VIII.—The Scientific basis of Dietaries and Rations . 209

IX.—Certain Dietaries: Prison Dietaries—Soldiers' Dietaries—Seamen's Dietaries 237

X.—The Order and Frequency of taking Food . . 278

XI.—Food in relation to Age and Condition—Food in Infancy and Childhood—Food at School—Food in Adult Life—Food in Advanced Age 286

A*—26

CHAPTER
XII.—THE RELATIVE ADVANTAGES OF ANIMAL AND VEGETABLE FOODS—VEGETARIANISM (BENEKE'S DIET FOR CARCINOMA) . . . .

PART II.—FOOD IN DISEASE.

INTRODUCTORY REMARKS 355
I.—FEEDING IN ACUTE DISEASE AND CONVALESCENCE . 357
II.—THE DIETETIC TREATMENT OF DISEASES OF THE DIGESTIVE ORGANS — ACUTE AND CHRONIC GASTRIC CATARRH—GASTRIC ULCER—CANCER OF STOMACH—DILATATION OF THE STOMACH—DYSPEPSIA—CONSTIPATION—DIARRHŒA 377
III.—FOOD IN DIABETES 414
DIABETIC DIETARIES 436
IV.—DIET IN ALBUMINURIA 445
V.—DIET IN GOUT AND CALCULOUS DISORDERS . . . 459
VI.—THE DIETETIC TREATMENT OF OBESITY . . . 477
VII.—DIET IN ANÆMIA, CHLOROSIS, NEURASTHENIA, AND ALLIED DISTURBANCES OF NUTRITION . . . 493
VIII.—FOOD IN SCROFULA, CONSUMPTION, AND CHRONIC FEBRILE CONDITIONS—FORCED FEEDING (*Suralimentation*) 509
IX.—CERTAIN SPECIAL DIETETIC CURES: THE "DRY" CURE—MILK AND WHEY CURES—THE KOUMISS CURE—THE GRAPE CURE 526
X.—ON ARTIFICIAL DIGESTIVE AGENTS AND ON ARTIFICIAL ALIMENTATION 538
APPENDIX I.—HOSPITAL DIETARIES 551
" II.—INVALIDS' DIETARY—SELECT RECIPES . . 559
INDEX 569

FOOD IN HEALTH AND DISEASE.

Part I.

FOOD IN HEALTH.

CHAPTER I.

THE NATURE, ORIGIN, AND PURPOSE OF FOOD—CLASSIFICATION OF FOOD—METABOLISM.

ALL living things undergo change. Change is a necessary condition of growth and development, of decay and of repair. Change, *change of substance*, is, then, a necessary and constant condition of life and activity.

In the living and normally active body there are, therefore, always changes taking place, losses proceeding from within, and gains accruing from without to compensate for those losses; otherwise it would cease to be active, it would cease to live.

These gains from without are derived from what we call Food, and the purpose of food is to supply the living organism, however complex or however simple it may be, with the substances or elements necessary for its growth and repair, and for the production and execution of those forms or modes of energy which we speak of as its functions.

A perfect and complete food for any living thing must necessarily comprise all the elements of which its tissues and all the solids and fluids of its body are composed.

When its composition is simple, its food may be simple. The simplest vegetable organisms require for their food nothing beyond water and the gases of the atmosphere. The carbon and nitrogen which enter into the composition of their simple structures are derived from the carbonic acid and the minute quantity of ammonia always found in the atmosphere, and in solution in rain-water.

But when we come to consider the food of so complex an organism as that of man, with which we are now mainly concerned, we shall find his food requirements to be correspondingly complex.

The simplest organisms also appropriate their food in a very simple manner; and in the whole of the vegetable kingdom there is nothing to be found comparable to the function of *digestion* in the higher animals; but in these latter, most elaborate processes, mechanical and chemical, are called into operation in the appropriation of the complex substances they take as food. These processes are comprised in what are known as the functions of digestion and assimilation.

So, then, we may define food to be any substance which, when introduced into the living organism, can minister to the maintenance of its structure and its activities; and a perfect and complete food for any living body will be one which comprises all the elements which enter into the composition of the tissues, juices, and secretions of the body, as well as those which are needed for the maintenance of the chemical changes connected with its functional activity.

In the young and growing animal a considerable amount of food is needed for the growth and development of its organs. When these are complete, and growth is at an end, food is needed to maintain the integrity of the body structures, and to repair such waste as is involved in the exercise of their functions; while alike in the growing and in the mature body, food is needed to supply the elements necessary for the maintenance of those chemical changes which are essential to the development of animal activities, such as muscular and nervous action, heat formation, nutrition, secretion, assimilation, and reproduction.

But a substance in order to be suitable for food must not merely possess the elements indicated, it must also contain them in a mode or combination which enables them to be appropriated, *i.e.* to be digested and assimilated, by the organs of the body it is to feed. The plant—the grass-plant for example—is enabled to appropriate, and therefore to use as food, the soluble mineral matters of the soil in which it grows, dissolved in the rain-water which falls upon it, together with what it absorbs from the gases of the air. It is a characteristic of the members of the vegetable kingdom that they are able to feed on *inorganic* substances. Animal organisms are unable to do so; they are dependent on vegetable organisms to provide them with food that they can appropriate.

The ox is enabled to appropriate, and use as food, the grass that is itself fed on inorganic substances, upon which the ox cannot feed; and from this grass it is enabled to build up structures, and to perform functions of the same kind as those possessed by man himself. Yet grass, such as the ox feeds on, is not a suitable food for man, because its component elements are not so arranged as to enable his organs to digest and assimilate them; but, on the other hand, the same elements having undergone some further elaboration, as in the ripe seed of certain *species* of grass, when fitly prepared, form one of the most useful foods that man can obtain, as the meal of wheat, barley, oats, etc.

Thus, in considering the *origin* of food, we learn how the simplest vegetable forms grow and feed on the constituents of the atmosphere alone, the carbon and nitrogen of their tissues being derived from the carbonic acid and ammonia always present in small quantity, together with aqueous vapour, in the air.

The larger vegetable forms feed also, to some extent, on the gases of the air, but they also feed largely on the organic and inorganic constituents of the soil in which they are planted. The organic substances in the soil consist chiefly of decomposing vegetable matter, and these must be resolved by decomposition into carbonic acid and ammonia before they can be absorbed by plants. The animal, unable to construct organic substances from inorganic matters, is dependent on the vegetable kingdom for his food.

If we examine the chemical composition of those organic compounds prepared by the vegetable world, and which serve as food for animals, we find they consist chiefly of the following elements:—carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus.

Of these elements nitrogen is the most important as it is *the* essential element of all *living* things; vital phenomena, the activity and change characteristic of all *living* things, are only found where this element is present.

"Every structure in the body in which any form of energy is manifested (heat, mechanical motion, chemical or electrical action, etc.) is nitrogenous. The nerves, the muscles, the gland-cells, the floating cells in the various liquids, the semen, and the ovarian cells, are all nitrogenous. Even the non-cellular liquids passing out into the alimentary canal at various points, which have so great an action in preparing the food in different ways, are not only nitrogenous, but the constancy of this implies the necessity of the nitrogen in order that these actions shall be performed; and the same constancy of the presence of nitrogen, when function is performed, is apparently traceable through the whole world. Surely such constancy proves necessity." (*Parkes.*)

We see, then, that the simplest forms of vegetable life derive their food from the atmosphere in which they live and grow. The elements of the carbonic acid, and the ammonia, and the water always present therein, sufficing for their nutrition and growth. The higher vegetable forms, in addition to the elements they derive from the constituents of the atmosphere, are able by their roots to absorb and use as food the inorganic salts of the soil. In this way, under the influence of the solar rays, vegetable organisms prepare and store up organic compounds suitable for the food of animals.

Animals, in the processes of nutrition, and in the development of their various forms of energy, feed upon, that is to say, appropriate, these products of vegetable life; convert them into other organic compounds, or decompose them in the processes of nutrition, with the aid of the oxygen absorbed from the air, into simpler substances, which are in course of time restored to the atmosphere and to the soil, and resolved finally into the simple elements from which they originally proceeded.

It is not necessary, for our present purpose, that we should pursue the subject of the origin and nature of food, in its general sense, further than this. The subject of dietetics is a practical one, and it is with the question of food in relation to the various practical wants of the human body, in health and in disease, that we are now concerned.

The various organic and inorganic compounds which enter into the composition of the human body may all be resolved into the following twelve elements:—carbon, hydrogen, oxygen, nitrogen (these four in far greater proportions than the others), sulphur, phosphorus, chlorine, iodine, potassium, calcium, magnesium, and iron. A few other elements (such as fluorine, silicon, manganese, etc.) have been discovered in the human body, but it is doubtful if they are invariably or necessarily present.

All these twelve elements must be represented in the food of man, and they must be, for the most part, combined in the form of organic products capable of being appropriated by his digestive organs.

Classification of food: alimentary principles.—In attempting a general classification of foods, it is convenient and usual to examine, in the first place, the various definite compounds which can be derived by chemical analysis from the different substances commonly used as food, and these are termed *alimentary principles.*

The classification generally adopted was originally founded on the analysis of that perfect and *complete* food upon which the young of all mammalian animals for a time are fed, and which is therefore proved to contain all that is necessary for supporting and maintaining the growth, development, and activities of the animal body in its highest form. That perfect and *complete* food is *milk.* On analysing this fluid we find :—

1st. That it contains a large quantity of a principle rich in nitrogen, termed *casein,* as well as some other nitrogenous or *albuminous* substances in small quantity.

2nd. It contains a considerable quantity of *oil* or *fat* (cream or butter).

3rd. It contains a *form of sugar*, namely, *lactose* or *lactine* (milk sugar).

4th. It contains *water* holding in solution various *mineral constituents* or salts (chiefly chlorides, phosphates, and sulphates of magnesium, calcium, potassium, sodium, and iron).

Adopting this convenient basis of classification, we are enabled to establish four great divisions of alimentary principles, the members of each group possessing a remarkable similarity of composition, and differing widely both in physical and chemical characters from the members of the other groups.

These different groups also appear to serve, more or less, different purposes in nutrition, although to some extent the members of one group may replace those of another; and a combination of all four classes appears to be necessary for the maintenance of the body in perfect health.

1. The 1st class, comprising the chief *nitrogenous* alimentary principles, may be conveniently termed *albuminates* (albumen being taken as the typical member of the group). These used at one time to be named *proteids* (a term still employed by many authors), from the circumstance that they could all be made to yield the substance *protein*, which is now, however, simply regarded as a product of chemical manipulation.

The chief of these nitrogenous alimentary principles are :—

Blood fibrin.
Syntonin, or muscle fibrin.
Myosin, from muscle.
Albumen in its various forms.
Vegetable fibrin, or *Gluten.*
Casein, animal and vegetable, the latter sometimes termed *Legumin.*
Globulin, occurring in the contents of the blood corpuscles.

The members of this class present a remarkable uniformity of chemical composition, and can replace one another in nutrition. They contain from 15·9 to 16·5 per cent. of nitrogen; their other elements being carbon, hydrogen, oxygen, and sulphur, or phosphorus.

The following is a close approximation to their percentage composition :—

Nitrogen	15·5
Carbon	53·5
Hydrogen	7·0
Oxygen	22·4
Sulphur	1·6 *

It is usual to consider as nearly related to the members of this class the substances *gelatin* and *chondrin*, which approach the albuminates in chemical composition and in their richness in nitrogen; but they have not the same nutritive value, nor can they be made to yield protein. *Gelatin* is derived from bone and fibrous tissues; and *chondrin* from cartilage. They contain a larger proportion of nitrogen than the albuminates.

2. The 2nd group, the *fats*, or *hydro-carbons*, comprise the various animal and vegetable fats, oils, wax, etc. These resemble one another in chemical composition, and are especially rich in carbon, their percentage composition being represented by the following figures:—

Carbon	79
Hydrogen	11
Oxygen	10

They differ somewhat in their physical state, some being solid and hard, like wax; others softer, like

* *Chemical composition of the albuminates.*—The following has been suggested as a hypothetical general formula for the albuminates. It represents an albuminoid as a compound of cellulose plus ammonia minus water:—

$$\underbrace{C^{32}H^{17}N^{5}O^{4}}_{\text{Albuminoid}} = \underbrace{2(C^{6}H^{10}O^{5})}_{\text{Cellulose}} + \underbrace{3NH^{3}}_{\text{Ammonia}} - \underbrace{6H^{2}O}_{\text{Water}}$$

Mülder's view that all these bodies had a special principle, which he termed *protein*, as a base, is no longer accepted; and A. Gautier has advanced the view (by no means generally held) that they are built up on the *cyanogen* compounds as a sort of chemical framework, and that in the body these toxic compounds are eliminated, as useless or dangerous, in the form of *leucomaines.*—*Vide* Dujardin-Beaumetz, "L'Hygiène Alimentaire," p. 17.

butter; others quite fluid, as the oils. They vary also in their digestibility, and therefore in their value as foods.

3. The 3rd class comprises all the *starchy* and *saccharine* substances used as food, and these are termed *carbo-hydrates*, from their chemical composition, in which hydrogen and oxygen exist in the proportions to form water. The composition of starch, which may be taken as a type of this group, is

$$C_6H_{10}O_5.$$

The chief members of this class are :—

The various vegetable Starches.
Cane, Grape, and Milk Sugar (Sucrose, Glucose, and Lactose).
Gum : Dextrin.
Cellulose :

together with a few other substances closely related to them in chemical composition. *Pectin*, or vegetable jelly, is sometimes referred to this class, although it does not contain hydrogen and oxygen in the proportions to form water.

4. The 4th class includes *water* and the various *mineral substances* which occur in the animal body.

These four groups of alimentary principles comprise all that is necessary for the growth, maintenance and activities of the animal body.

In addition, however, to these four groups, may be mentioned the various substances termed *food accessories*, comprising the several condiments which give flavour to food, or stimulate the digestive secretions, and the well-known "stimulants," tea, coffee, cocoa, alcohol, etc.

Foods have also been classified into *organic*, those derived from the animal and vegetable kingdoms, and *inorganic*, namely, mineral substances or salts ; also into *nitrogenous*, those containing the element nitrogen, and *non-nitrogenous*, those containing no nitrogen.

Arranged in tabular form, these various classifications may be thus represented :—

NITROGENOUS.	1. **Albuminates**—Nitrogenous substances, having the same or nearly the same chemical composition as Albumen. *Examples.*—Albumen, Fibrin, Syntonin, Myosin, Globulin, Casein, from the *Animal;* Gluten and Legumin, from the *Vegetable* Kingdom. (*a*) *Subordinate* nitrogenous substances referred to this class, and known as— Gelatigenous substances { Gelatin. Casein. Chondrin.	ORGANIC.
NON-NITROGENOUS.	2. **Fats or Hydro-Carbons**, containing Carbon, Hydrogen and Oxygen—the proportion of oxygen being insufficient to convert all the hydrogen into water. *Examples.* — Olein, Stearin, Margarin (Butter is a familiar one). 3. **Carbo-Hydrates** contain Carbon, Hydrogen and Oxygen, the two latter elements in the proportions to form water. *Examples.*—Starch, Dextrin, Cane Sugar, Grape Sugar, Lactose or Milk Sugar. (*a*) The *Vegetable Acids*, Oxalic, Tartaric, Citric, Malic, Acetic and Lactic, are by some authors referred to this class.	ORGANIC.
MINERAL.	4. **Mineral.** Water. Salts.—Sodium and Potassium Chlorides, Calcium and Magnesium Phosphates, Iron, etc.	INORGANIC.

Metabolism.—The word " metabolism " is often used in connection with the utilisation of the food received into the body.

It refers in the first place to those phenomena manifested by all living organisms in the exercise of their power of appropriating the substances taken in as food and incorporating them into the tissues of their bodies ; the process, in short, of *assimilation.* It also refers to that power which the animal organism possesses of accumulating from its food supplies a store of *potential* energy, which it is able to transform into *kinetic* energy, and which manifests itself commonly in the form of muscular work and the production of heat. It further includes the formation of those *excretory* products which result from the changes which occur in the constituents of the tissues as the necessary accompaniment of such transformations of energy.

Normal, healthy metabolism, therefore, requires a due supply of suitable food, suitable in quality and quantity; it also involves the storing up of a portion of this food within the body; and it demands a regular chemical transformation of the tissues, and the formation of the effete excretory products resulting from these changes, which have to be eliminated through the organs provided for that purpose.

The term *equilibrium of the metabolism* is used to signify that the bodily income and expenditure are balanced; that while the normal physiological conditions are maintained, there is exactly the same amount of new material absorbed and assimilated as there is of effete matter, the products of the retrogressive tissue-changes, removed by the organs of excretion; the destruction of tissue is exactly compensated for by the formation of new tissue. Of course, while the body is *growing* rapidly there is greatly increased formation in the parts participating in the rapid growth, and the metabolism in these parts is correspondingly increased; on the other hand, during senile decay the expenditure is in excess, and the body in consequence wastes.

The *physiological equilibrium* is practically determined by physicians by simply weighing their patients, and observing that the body remains of the normal weight with a given diet.

When the body is in this state of physiological equilibrium, about 90 per cent. of all the carbon taken in the food is excreted, in the form of carbonic acid, by the lungs and skin, and about 10 per cent. in the urinary excreta and fæces. Almost all the nitrogen of the food is excreted in the form of urea within twenty-four hours. The hydrogen is eliminated chiefly in the form of water; the oxygen chiefly in the form of carbonic acid and water. Owing to the oxidation of hydrogen, more water is eliminated than is taken in. The soluble salts are mostly discharged in the urine; the insoluble and less soluble ones (especially those of potash) in the fæces; some pass off in the perspiration.

The sulphur which is contained in albumen is, in part, excreted in the form of urinary *sulphates*, and in part in the fæces (Taurin), and a small proportion by the skin (epidermal scales).

CHAPTER II.

THE NUTRITIVE VALUE AND USES OF THE DIFFERENT CLASSES OF FOOD.

WE must, in the next place, pass on to the consideration of the purposes or uses, in the nutrition and maintenance of the structure and functions of the body, of the several groups of alimentary substances set forth in the last chapter.

As the human body is chiefly composed of albuminous or nitrogenous substances,* and as the various functions of the body are mainly concerned with the physical and chemical changes these undergo, we shall be prepared to find that the class of *albuminates*, or the nitrogen-containing group of foods, plays a very important part in its nutrition, and in the development and maintenance of its energies.

It has been pointed out † "that the presence of nitrogen in an organised structure, and its participation in the actions going on there, is a necessary condition for the manifestation of any energy, or any chemical change. . . If the nitrogen be cut off from the body, the various functions languish. This does not occur at once, for every body contains a store of nitrogen, but it is at length inevitable. . . If it is wished to increase the manifestations of the energies of the various organs, more nitrogen must be supplied; . . . without the participation of the nitrogenous bodies, no oxidation or manifestation of energy is possible."

Liebig's theory, which taught that the functional

* "The skeletal muscles form nearly half the body."—Foster, "Text-Book of Physiology."

† Parkes's "Hygiene," chap. v. on Food, 6th edition. By Professor de Chaumont.

activity of the nitrogenous tissues involved a proportionate waste of the structural elements of those tissues, and necessitated a corresponding consumption of nitrogenous material to replace that loss, has been found inconsistent with later researches, and his conclusion that the class of albuminates or nitrogenous foods was *solely* applied to the repair of the waste or destruction of the nitrogenous tissues, involved in their functional activity, is no longer accepted, nor his definition of this class as exclusively the "plastic" or "tissue-forming" foods, in contradistinction to the carbo-hydrates and the fats, which he termed "respiratory" or "heat-forming" foods.

The functions of the class of albuminates are no doubt threefold—

1st, They contribute to the formation and repair of the tissues and fluids of the body, and in an especial manner of the nitrogenous tissues.

2nd, They regulate the absorption and utilisation of oxygen, and so play a very important part in the chemistry of nutrition.

3rd, Under special conditions they may also contribute to the formation of fat, and to the development of muscular and nervous energy, and to the production of heat.

We have already pointed out how large a part of the whole body the nitrogenous tissues form, and that it is entirely through their agency that all bodily energy is developed; the active principles in the various *secretions* of the body are also nitrogenous; the development and maintenance of these tissues and secretions are, therefore, the *primary* functions of the class of albuminates.

It has, however, been proved that the elimination of urea in the urine is closely proportioned to the amount of the nitrogenous ingesta, and it is therefore certain that the nitrogenous alimentary principles must undergo such chemical changes in the system as result finally in the production of urea. They must therefore play an important part in the "absorption and utilisation" of oxygen in the system.

It has in the third place been experimentally established that *fat* may be formed at the expense of albuminates; "so that the nitrogenous substance plays two parts: 1st, that of the organic framework, *i.e.* of the regulator of oxidation and of transformation of energy; and 2nd, it may form a non-nitrogenous substance which is oxidised and transformed." *

Voit has pointed out that the albumen in the body exists in two conditions: 1st, that which is organised, and which forms part of the tissues, and which may, therefore, be termed "*organic* albumen;" and 2nd, that which exists in the fluids, permeating all the tissues, and which may be called "*circulating* albumen." The former is relatively stable, but the latter undergoes rapid changes in the processes of functional activity: whereas, according to Voit, 70 per cent. of the latter is used up in twenty-four hours, only 1 per cent. of the former is consumed.

It is now generally admitted that, in ordinary conditions, only a small amount of the "organic albumen" undergoes decomposition, and that metabolism of the nitrogenous tissues is but slightly influenced by the activity of the organism. On the other hand, the "*circulating* albumen" under the influence of the cellular elements of the tissues undergoes transformation to a considerable extent, such transformation probably taking the form of a splitting-up of its constituent elements into nitrogenous waste substances such as creatin, uric acid, and especially urea, which are rapidly eliminated, and non-nitrogenous substances, some of which may be deposited in the tissues in the form of fat, and some may be consumed and

* Parkes's "Hygiene," chap. v., on Food.

oxidised in the production of heat and functional energy.

It is quite true, however, that in certain pathological conditions, and especially in febrile maladies, the "*organic* albumen" becomes less stable, and may then undergo rapid changes, attended by notable waste of tissue and emaciation.

It is certain that the functional activity of the organism is greatly dependent on the presence of albuminates in the food; and no other class of alimentary substances can adequately replace albumen in sustaining the vital processes. Albumen "exerts the greatest influence on the energy of the metabolic processes, since it easily undergoes a splitting-up in the nutrient fluids, and at the same time enables the living cells to break up other matters in larger quantities."

Albumen (together with water and salts) is able *alone* to support the vital processes, and it is the only alimentary substance that can do so. It can, therefore, replace in nutrition the fats and carbo-hydrates, but, when taken exclusively, it is very unsuitable diet, as the amount thus required to maintain the constitution of the body is disproportionate and wasteful. *

As has already been said, it is now generally admitted that *fat* can be formed from albuminates. Pettenkofer and Voit concluded from their experiments that albumen is split up in the body into a nitrogenous and a non-nitrogenous part, the latter having nearly the same composition as fat, this may be either stored up in the organism or further transformed into carbonic acid and water; and Henneberg states that 100 grammes of albumen split up into 33·5 grammes of urea (which carries off all the nitrogen) and 66·5 grammes of non-nitrogenous matter,

* "Asparagin, in combination with gelatin, can replace albumen in the food."—Landois' "Physiology."

which combine with 12·3 grammes of water, and after the elimination of 27·4 grammes of carbonic acid, yield 51·39 grammes of fat. *

Lawes' and Gilbert's experiments on the fattening of pigs appeared to show that two-thirds of the total fat stored up must have originated in other sources than the fat taken in the food. It would seem, also, that even glycogen and sugar can be formed from albuminous substances, for glycogen has been found in the liver of animals fed exclusively on albumen and fibrin,† and in certain forms of diabetes, the sugar must be derived "either from albuminates or fats, most probably the former." ‡

In the pathological condition known as *fatty* degeneration, the fat deposited in the tissues appears to be formed at the expense, and by the splitting-up, of the "organic albumen."

The functions of the class of albuminates may now be thus briefly recapitulated :—(1) They are the essential agents by which the nitrogenous organised tissues are developed and repaired, as well as all the other nitrogenous substances in the fluids and secretions of the body ; (2) They stimulate functional activity, and promote oxidation and metabolism in the body ; (3) They are capable of splitting-up in the organism into a nitrogenous and a non-nitrogenous part, and from the latter fat may be formed and deposited in the tissues or consumed in the production of force.

Before passing on to the consideration of the food-value of the other classes of alimentary substances, it will be well to state what has been determined as to the utility in nutrition of the *gelatigenous* substances,

* Bauer, "Dietary of the Sick," p. 27. Von Ziemssen's "Handbook of General Therapeutics."

† G. Sée, "Du Régime Alimentaire," p. 13.

‡ Parkes's "Hygiene," 6th edition.

as these are also *nitrogenous*, and are even richer in nitrogen than the albuminates.

It has been long known that gelatin cannot replace the albuminates in the repair and maintenance of the tissues, as it undergoes rapid and complete metabolism within the body, being eliminated chiefly in the form of urea. It is, therefore, of no *direct* value as a "plastic" food. It must not, however, be hastily concluded, as was at one time done, that gelatin is on that account worthless, and that it answers no nutritive purpose. The very rapidity and ease with which gelatin undergoes decomposition within the body gives it a value as a substitute, in a certain sense, for albuminates, the metabolism of which it diminishes. It is, therefore, an *albumen-sparing* food, and, except for the purposes of building-up and repairing the tissues, can suitably, and to a certain limited extent, take the place of albuminates in nutrition. "By the administration of gelatin very large quantities of albumen can be spared in the body, or devoted to increase of bulk." (*Bauer.*)

Gelatin has been observed to induce a slight diminution also in the metabolism of the non-nitrogenous substances in the body. Owing to the larger proportion of nitrogen that enters into its composition, gelatin, when introduced into the body, leads to a greater elimination of urea than albumen, and this excessive excretion of urea induces increased diuresis and consequent thirst and demand for fluid, if large quantities are consumed.

Schiff has stated that gelatigenous substances promote the secretion of the gastric juice, and therefore belong to the group of peptogenic foods.

It may be accepted as a practical conclusion that gelatin is useful as an "albumen-sparing" food, and that alimentary substances containing it tend to prevent the destruction of albuminates and fats. It is especially appropriate to those febrile states in which the stability of the "organic albumen" is threatened, and at the same time the capacity of assimilating albuminous food is greatly diminished.

In the next place we must consider the purposes served by the class of *fats* or *hydro-carbons* in nutrition. Liebig's views with regard to this subject also have been shown to be erroneous. He considered the function of fats to be *entirely* respiratory, and that by combining with oxygen, admitted into the system in respiration, they were consumed in the production of heat, and that the completeness of this combustion depended on the amount of inspired oxygen. But it has been observed that when an exclusive diet of fat has been taken, there has been *less* fat metabolised and less oxygen absorbed than in fasting, and also that, in certain circumstances, the whole of the albumen in the food is metabolised in the body, and the fat is appropriated to increase the body-weight; an inversion of the formerly assumed *rôles* of hydrocarbons and albuminates. From which it would appear that, under certain conditions, fat is split up into simpler bodies with greater difficulty than albumen, and must not, therefore, be regarded as the same easily combustible substance in the organism that it is outside.

It is not then through the direct action of oxygen that the non-nitrogenous foods any more than the nitrogenous ones are split up into simpler products, but *by the agency of the cellular tissues*, and the oxygen enters into these products "little by little." Indeed, under the influence of fat tissue-waste is lessened, and, therefore, less oxygen is taken into the system; less oxygen being abstracted from the blood by the products of metabolism.

We thus see that one of the great purposes served by fat in the food is to diminish albuminous metabolism, and it is, therefore, regarded as an "albumen-sparing" food. "If flesh alone be given, large quantities are required in order that nutrition and waste may balance one another, but if fat be added the demand for flesh is less." (*Bauer.*)

But the fats have also an important relation in the body to the production of force and heat, to body-work and body-temperature. While, unlike the albuminates, the metabolism of hydro-carbons is independent of the amount taken in as food, it is notably affected by bodily exercise, which produces little effect on nitrogenous metabolism. The fats, therefore, undoubtedly minister to force-production, and undergo destruction and oxidation in the process; so that the amount of carbonic acid given off during exercise is much greater than during rest.

External temperature also influences the metabolism of the hydro-carbons, and therefore the amount of carbonic acid excreted; the lower the temperature, so long as that of the body itself is maintained, the greater the metabolism of non-nitrogenous foods, and the greater the amount of carbonic acid discharged from the body. This is one of the chief means of regulating the temperature of the body, and keeping it constant.

When, however, the temperature of the body itself is disturbed, as in fever, then the higher the temperature the greater the waste of the non-nitrogenous, as well as of the nitrogenous, constituents of the body, and the greater the excretion of carbonic acid, as well as of urea.

It is probably through the nervous system that the external temperature influences the metabolic processes in the body, and especially through the peripheral sensory nerves.

It would appear that albuminates and fats are, to a certain extent, opposed to one another in their action on the organism, as the former increase waste and promote oxidation, while the latter have the effect of diminishing them, and this they do probably by affecting the metabolic activity of the cells of the tissues themselves. It is a matter of common observation that fat animals bear privation of food better than thin ones; in the latter, their small store of fat is quickly consumed, and then the albumen is rapidly decomposed. It is for the same reason that corpulent persons, even on a very moderate amount of food, are apt to become still more corpulent.

The influence of fat in the storage of albumen is exemplified by the fact that if 1,500 grammes of lean meat be given alone, it will be wholly decomposed; but if 100 to 150 grammes of fat be added, then it will yield only 1,422 grammes of waste. It has also been shown that the balance of income and expenditure of albuminates, although the amount taken in the food may be very small, is readily established as soon as one adds a certain quantity of fat. A dog who took daily 1,200 grammes of lean meat was observed to be still losing some of the albuminous constituents of the body; whereas, with only 500 grammes of flesh and 200 grammes of fat, the nutritive balance was rapidly re-established. The same has been observed in man. Rubner found that an individual taking daily 1,435 grammes of meat, containing 48·8 grammes of nitrogen, lost by the kidneys 50·8 grammes of nitrogen; whereas another taking meat and bread containing 23·5 grammes of nitrogen, to which were added 191 grammes of fat, only eliminated 19 grammes of nitrogen on the second day of the diet; * so that a small quantity of albumen, when combined with fat, is sufficient to maintain the albuminous structures of the body. As a practical conclusion from these

* Germain Sée, "Du Régime Alimentaire."

considerations, we should note, that if we wish to increase the weight of the body and add to its constituents, we must not rely on an excess of albuminates, as these given alone only lead to increased waste; but if we combine fats with albuminates in proper proportions, an appreciable increase of both the nitrogenous and non-nitrogenous constituents of the body can be maintained for a considerable time.

We see, then, how a proper use of fat economises the albuminous elements of food and checks the waste of the albuminous tissues. Fat enters into all the tissues. By its decomposition and oxidation it yields muscular force and heat, and it is therefore largely consumed in muscular exercise. By its capacity of being stored up in the body as adipose tissue, it provides a reserve store of force-producing and heat-generating material which can be utilised as required.

The supporting influence of fat under great muscular fatigue is strongly maintained by Ebstein; and it is stated that the German Emperor, in the war of 1870, recognised this fact by requiring that each soldier should have served out to him daily 250 grammes of fat bacon!

As *glycerin* is derived from fats, it was thought it might possess the same *albumen-sparing* functions, but experiment has shown that this is not the case; on the contrary, it raises the amount of albuminous waste, and increases the flow of urine, in which it is eliminated in large proportion.

The class of *carbo-hydrates* have much in common with the fats. They serve the same purpose of checking albuminous waste; like them, they are resolved by combustion within the body, ultimately, into carbonic acid and water, and so, like the fats, are capable of yielding heat and mechanical work. Unlike the fats and the albuminates, however, they do not appear to enter into the structure of the tissues, although they are found in some of the fluids and organs of the body.

All the carbo-hydrates are converted into glucose, or grape sugar (or maltose), before they are absorbed, and in this form they are much more readily metabolised than the fats or albuminates.

It is believed by many, and the weight of evidence, as will be seen, is in favour of the conclusion, that carbo-hydrates can be converted into fat within the organism. Bauer,* however, is indisposed to accept this view. Basing his opinions on the experiments of Pettenkofer and Voit, who showed that carbo-hydrates, even when administered in great excess, are almost completely destroyed within the body, he maintains that although the carbo-hydrates, when given together with albumen and fat, favour an increase of the constituents of the body, and especially of fat, yet it is not because they are themselves converted into fat, but because, owing to the facility with which they are metabolised, they protect the other food-stuffs from destruction.

"When fat and carbo-hydrates co-exist in the food, the latter are always the first to be consumed; and when they are present in sufficient amount, the consumption of fat in the body may be completely suspended." And he explains in a similar manner the fact that a deposit of fat may be observed to take place when the diet consists of albuminates and carbo-hydrates alone, *without any fat;* for in that case, he says, the fat, which "originates as a product of the splitting-up of albumen, is withdrawn from further metabolism in favour of the carbo-hydrates, and contributes to the gain." He also rejects the view that the ready decomposition of the carbo-hydrates in the body depends on their great

* "Dietary of the Sick: Value of Food Stuffs," p. 32.

affinity for oxygen; he considers it lies rather in the properties of the animal tissues, and he points out that the assumed equivalents of starch and fat, as 240 of the former to 100 of the latter, calculated on the quantity of oxygen required for their combustion, are incorrect; and that in the living organisms "175 parts of starch are in the material actions approximately equivalent to 100 of fat."

Germain Sée begins by supporting the view taken by Bauer, and asserts that the principal function of the carbo-hydrates is the immediate development of heat and mechanical work; that they are not annexed in any way directly or indirectly to the organisms; and that the fat that is deposited in consequence of their use is derived from the splitting-up of albuminates. He urges the experiments of Boussingault, who found that when he fed ducks on a pure carbohydrate like rice, they grew thin; but on adding a small quantity of butter they grew fat. The same experimenter also asserted that milch-cows only gave out the quantity of fat in their milk that was contained in their food.* Sée also points out that the particular kinds of grain selected for fattening animals are always such as contain, like maize, a considerable quantity of fat. But, notwithstanding all this, he appears in the end to yield to the weight of evidence that fat may be, under certain circumstances, formed from carbo-hydrates.

Dujardin-Beaumetz† believes in the possibility of the transformation of glucose, the product of the digestion of carbo-hydrates, into fat. He sees a great analogy between the formula for glucose, $C_6H_{12}O_6$, and that of glycerine, $C_3H_8O_3$, and thinks that the latter may result from the splitting-up of the former with

* The accuracy of Boussingault's conclusions was called in question by Liebig.

† "L'Hygiène Alimentaire."

the addition of hydrogen. He also shares, to a certain extent, Pavy's views, and considers that a portion of the glucose derived from the digestion of carbo-hydrates is deposited as "hepatic glycogen" in the liver, and thus furnishes the glucose necessary to the organism when the food does not contain any carbo-hydrates. Pavy maintains, as is well known, that saccharine matter, when absorbed, "on reaching the liver is transformed by that organ into amyloid substance [glycogen], which is stored up in its cells for subsequent further change preliminary to being appropriated to the purposes of life." The occurrence of this "amyloid substance" in the liver, even when a purely animal diet has been taken, he accounts for by the supposition that the liver is the organ in which the splitting-up of the albuminates into urea and a non-nitrogenous substance occurs, and that the latter is metamorphosed by the liver into "glycogen." Pavy believes that carbo-hydrates are first converted into this "amyloid substance," and that this is afterwards converted into fat. But he points out what is doubtless a most important condition in the conversion of carbo-hydrates into fat, namely, "the co-operation of nitrogenous in conjunction with saline matter," for it is probably by the changes occurring during the metabolism of the albuminates that this transformation is excited. The presence of a small amount of fat with the carbo-hydrates would seem also to favour this conversion, for the rapid deposition of fat which sometimes occurs when animals are fed on such a mixture appears to be more than can be accounted for by the small quantities of fat ingested. Pavy does not admit that any of the carbo-hydrates undergo *direct* oxidation in the system, or contribute *directly* to force production.

In connection with this interesting and important discussion, the following observations by Tscherwinsky are referred to in Landois' "Text-Book of Human Physiology."* He "fed two similar pigs from the same litter. No. 1 weighed 7,300 grammes; No. 2 7,290 grammes. No. 1 was killed, and its fat and proteids estimated. No. 2 was fed for four months on grain, and then killed. The grain and excreta and the undigested fat and proteids were analysed, so that the amount of fat and proteid absorbed in four months was estimated. The pig then weighed 24 kilos.; it was killed, and its fat and proteids were estimated:—

No. II. contained	2·50	kilos. of	albumen	and	9·25	kilos.	of fat.
No. I. ,,	0·96	,,	,,	,,	0·69	,,	,,
Assimilated	1·56	,,	,,	,,	8·56	,,	,,
Taken in in food	7·49	,,	,,	,,	0·66	,,	,,
Difference	− 5·93	,,	,,	,,	+ 7·90	,,	,,

There were therefore 7·90 kilos. of fat in the body which could not be accounted for in the fat of the food. The 5·93 kilos. of albumen of the food which were not assimilated as albumen could yield only a small part of the 7·90 kilos. of fat, so that at least 5 kilos. of fat must have been formed from carbo-hydrates. Lawes and Gilbert calculated that 40 per cent. of the fat in pigs was derived from carbo-hydrates. How the carbo-hydrates are changed into fat in the body is entirely unknown."

As has already been stated, the weight of evidence appears to be distinctly in favour of the conclusion that, in some way or other, the carbo-hydrates are capable of being converted into fat in the system; but, in any case, the same result occurs, and they promote, either directly or indirectly, the deposition of fat within the body.

The probability that lactic and other acids of the

* Note by Professor Stirling at p. 365 of the 3rd English edition.

same class are formed in the body, chiefly or solely from carbo-hydrates, is drawn attention to by Parkes. "The formation of these acids is certainly most important in nutrition, for the various reactions of the fluids which offer so striking a contrast (the alkalinity of the blood, the acidity of most mucous secretions, of the sweat, urine, etc.), must be chiefly owing to the action of lactic acid on the phosphates or the chlorides, and to the ease with which it is oxidised and removed."

We may conclude, then, that the carbo-hydrates by their capacity for rapid metabolism contribute largely to the production of heat and mechanical work, and also that their use greatly favours an increase in the constituents of the body, and especially of the albumen and fat. If we desire to increase the albumen without adding greatly to the store of fat, we should (according to Bauer) give a liberal allowance of albuminates with relatively small quantities of carbo-hydrates. But if we desire a substantial addition to the fat, the food should contain less albumen and more carbo-hydrates, with a fair proportion of fats.

Our fourth class of foods comprised *mineral substances and water.* These are of great importance, and are as essential to nutrition as the albuminates. There is no tissue that does not contain lime, chiefly in the form of phosphate, and it would seem that cell growth cannot go on without it; indeed, calcium phosphate is the most abundant salt in the body, seeing that it forms more than one-half our bones. Calcium carbonate occurs associated with this phosphate, but in relatively much smaller quantity. Sodium chloride is also a very important salt which likewise occurs in all the tissues and fluids of the body. It plays a very important *rôle* in promoting the diffusion of fluids through membranes, and its presence is necessary for maintaining the globulins in solution. It is absolutely necessary to existence, and its *entire* withdrawal from food would be speedily fatal.* Rather more than 200 grains are excreted daily, chiefly in the urine. It is a matter of common experience in the feeding of cattle that the addition of common salt to their food greatly improves their condition. The phosphates of sodium and potassium are also important salts. The alkaline reaction of the blood-plasma and some of the other fluids is due partly to these alkaline phosphates. The acid sodium phosphate is the chief cause of the acid reaction of the urine. Sodium carbonate † and bicarbonate are also found in the blood-plasma; they are ingested in small quantities in the food, and they are partly formed in the body from the decomposition of the salts of the vegetable acids. They play an important part in the blood in carrying the carbonic acid from the tissues to the lungs. Sodium and potassium sulphates occur only in small quantity in the body, and are partly derived from the oxidation of organic substances containing sulphur. Potassium chloride is widely distributed, and is found especially in the coloured blood corpuscles and in muscular tissue. Magnesium phosphate occurs together with calcium phosphate, but in much smaller amount; it is probably essential to the growth of some tissues. Iron is an essential constituent of hæmo-globin, and therefore of the red blood corpuscles; it is found, also, in striped muscle and in other tissues in minute quantity. The two alkalies, potash and soda, have a different distribution in the body, and cannot replace one another. The potassium salts exist especially in the

* "Deprival of common salt causes *albuminuria*."—Landois' "Physiology."

† "The alkaline salts serve to neutralise the sulphuric acid formed by the oxidation of the sulphur of the proteids."—*Ibid.*

formed tissues, as the blood corpuscles and muscular fibre; and the sodium salts are found more abundantly in the interstitial fluids; so in the blood, sodium and the chlorides are found especially in the plasma, and potassium and phosphates in the corpuscles.

The chlorine of the chlorides would appear to be easily set free in the body, so that it can combine with hydrogen and form a powerful acid, having a special solvent action on albuminates. The sulphur and phosphorus of the tissues appear to be introduced, as such, in the albuminates.

All these mineral substances are introduced into the body as constituent parts of the various ordinary articles of human food, animal and vegetable, with the exception of sodium chloride, which is usually added to various articles of food, in greater or less amount, in addition to what they may themselves contain.

Certain salts, such as the lactates, tartrates, citrates, and acetates, become converted into carbonates within the body, and confer upon the system that alkalinity which appears to be necessary to the integrity of the molecular currents. "The state of malnutrition, which in its highest degree we call scurvy, appears to follow inevitably on their absence; and as they exist in fresh vegetables, it is a well-known rule of dietetics to supply these with great care, though their nutritive power otherwise is small." *

Rabuteau observed that the addition of 150 grains of sodium chloride to the daily rations increased notably the amount of urea excreted; it would seem, therefore, to promote the metabolism of albuminates; it acts probably simply by stimulating the digestive functions, and possibly increasing the acidity of the gastric juice. It is itself almost wholly eliminated in the urine.

* Parkes's "Hygiene," 6th edition, by De Chaumont.

The utility of adding phosphates to food with the view of increasing its nutritive qualities has been warmly discussed, and it has been pointed out, as a proof of their inutility, that the soluble phosphates, so given, are eliminated in their totality in the urine, and the insoluble ones in the fæces. But, as has been argued by Dujardin-Beaumetz, the same happens with regard to chloride of sodium, and it does not follow because of this that it has no influence on nutrition. The favourable action of the phosphates, soluble or insoluble, which is certainly at times observed, is probably due, as he suggests, either to a regulating action on the functions of the alimentary tube, or to the acid elements they convey into the stomach, or to some other indirect action. "As a rule, we take in with our food a far larger quantity of salts than is necessary for the replacement of those of the tissues. The excess is excreted with the urine, and only when an increase of the body-weight occurs is any large amount of salts retained in the body." (*Bauer.*)

Water enters into the composition, in greater or less proportion, of most solid and all fluid foods, and it is the essential basis of all beverages. It forms 58·5 per cent. of the human body, from which it is continually passing off by the urine and fæces, and by the skin and lungs. Water is essentially requisite in the processes of digestion and absorption as a solvent for food substances, and it is also required for the solution of the various substances which have to be removed from the body in the excretions, especially in the urine. Indeed, there is no vital action possible without water. The amount of water needed by the body depends on various circumstances, especially on bodily temperature and bodily labour. The greater the functional activity of the bodily organs the greater the need for water. The temperature and humidity of the surrounding air also exercise an influence, as well as the nature and amount of solid food. The need of the organism for water is usually indicated, when in health, by the sensation of thirst. An insufficient supply of water leads to disturbances in the circulation, and in the distribution of heat, and to the retention in the body of the waste products of metabolism. The free ingestion of water promotes an active circulation of the fluids, accelerates albuminous metabolism, and increases the activity of the kidneys and the amount of urine secreted. It has been asserted and denied by different observers that an increased consumption of water leads to an increased elimination of urea, and acts, therefore, as an accelerator of nutritive changes. The weight of evidence and authority are in favour of the affirmative view, but the influence is only temporary.

The various substances known as *stimulants* and *condiments*, although not included in either of the preceding classes, and although they may have no *direct* nutritive function, undoubtedly exercise an important indirect influence on the processes of nutrition. They stimulate appetite, and give relish to food, and by acting on the peripheral nerves, especially those of taste and smell, they promote the digestive secretions and rouse the digestive functions.

It has now been seen that each of these four classes of alimentary substances has a special value in nutrition, and although the members of one group may be competent to serve, to a certain extent, the purposes of those of another, yet in order to accomplish the best results a combination of all of them is required. An adequate diet must contain a mixture of several articles of food, in which all those classes are represented in due proportion.

Some differences of opinion exist as to the *relative* *value of foods of the same class.* Albuminates, as has been seen, can be obtained from either the animal or vegetable kingdom; they have a similar chemical composition, and they serve the same purposes in the body. It has, however, been suggested that they are probably utilised in a somewhat different manner or with different degrees of rapidity, and that the man who feeds on meat, like carnivorous animals, "will be more active, and more able to exert a sudden violent effort, than the vegetarian or the herbivorous animal, whose food has an equal potential energy, but which is supposed to be less easily evolved." In support of this view it has been urged that the movements of carnivorous animals, especially in the pursuit of their prey, are far more active than those of herbivorous cattle; that the form in which they take their food enables them to give out sudden spurts of energy of which the vegetable feeder is incapable. But this view has been questioned by others, who refer to the known activity and speed of the horse, the rapid movements of the wild antelope and cow, and even of the wild pig, all animals mostly herbivorous, as inconsistent with the conclusion that vegetable feeders cannot give forth energy as rapidly and continuously, or even more so, than the predaceous carnivora. It is further stated that with the human race also, the East Indian native, if well fed on corn, or even on rice and peas, shows, when in training, no inferiority in capacity for active physical exertion to the animal feeder. It had also been argued that the complicated alimentary canal of the herbivora pointed to a slower digestion and absorption of food; and with certain kinds of vegetable food this would certainly seem to be the case; but it has again been contended that this is chiefly intended for the digestion of cellulose, and that the digestion and absorption of albuminates may be as rapid as in other animals.

It must, we think, be admitted that all practical observations tend to prove that animal food is digested more rapidly than vegetable food, and it therefore seems highly probable that meat can replace the waste of the nitrogenous tissues more rapidly than meal of any kind, and it is probably true that there is a more active change of tissue in meat eaters than in vegetable feeders, and that the former require more frequent supplies of food. Apparent differences in nutritive value in different meals, as in wheat-meal and barley-meal, probably depend on difference of digestibility.

The difference in the nutritive value of different fats would seem to depend on the relative facility with which they are digested and absorbed. Animal fats appear to be more easily absorbed than vegetable. And even different animal fats differ much in digestibility, and, therefore, in nutritive value. This depends partly on chemical composition, and partly on mechanical aggregation or subdivision. Mutton-fat is generally found difficult of digestion, while pork-fat is easily digested. Butter can be readily digested by many persons who cannot digest other forms of fat; and the ready digestibility of cod-liver oil is one of its chief advantages.

The different carbo-hydrates are generally supposed to be of equal value in nutrition. Sugar, from its ready solubility, should be more easily absorbed and more quickly utilised than starch, but it is found that when both are procurable a mixture of the two is usually preferred.

It will be convenient now to pass in review the

Ordinary Articles of Food and Drink;

the various Alimentary Substances, or "Food-stuffs," as they are also termed.

Man, being an omnivorous animal, obtains his food supplies from a variety of sources. The various substances commonly employed in alimentation will therefore now be described, their composition, properties, digestibility, and nutritive value. Those derived from the *animal* kingdom will be first treated of; then those derived from the *vegetable* kingdom. Those substances used as condiments will also be considered, as well as the various *beverages* in common use.

CHAPTER III.

ANIMAL FOODS.

Animal foods, by which is usually meant the flesh of animals, have certain decided advantages. In the first place, they contain the same chemical elements as the bodies they are destined to feed. They are very rich in albuminous or nitrogenous substances, combined with a certain amount of fat; they are more easily and completely digested and assimilated than vegetable foods; they are easily cooked, and develop agreeable flavours in the process; and they contain important salts (chiefly salts of potassium) and some iron.

Animal foods are therefore exceedingly well adapted to minister to the growth and maintenance of the organic structure of the body; their disadvantage is the absence of starch, so that they are not so well adapted as non-nitrogenous substances for the production of force. When, however, there is a mixture of a considerable proportion of fat with the muscle tissue, this disadvantage is greatly lessened.

In the flesh of all animals we find, besides muscular fibre, blood-vessels, nerves, fibrous connective tissues, and a variable proportion of fat.

Analysis of pure muscle shows it to consist, on an average, of 76 per cent. of water and 24 per cent. of solids.

The albuminates amount to about 20 per cent. in fresh muscle free from fat; by far the greater portion of this is in an *insoluble* form. The soluble albuminates consist chiefly of *myosin*, which, after death, undergoes spontaneous coagulation, and cooking causes a further coagulation; the other soluble albuminates are in small proportion, the chief in quantity being one identical with serum albumen. The colouring matter of muscle belongs to the soluble albumen. Of the insoluble albuminates of muscle but little is known.

Moleschott's analysis of the composition of *fresh beef* is thus given by Parkes :—

Water		73·4
Nitro-genous substances	Soluble Albumen and Hæmatin	2·25
	Insoluble ,,	15·2
	Gelatinous substances	3·3
	Extractives	1·38
	Kreatin	0·068
Mineral Matter or Ash		1·6

Pavy gives the following as the composition of *lean* and *fat* beef :—

	Lean Beef.	Fat Beef.
Nitrogenous Matter	19·3	14·8
Fat	3·6	29·4
Salines	5·1	4·4
Water	72·0	51·0

It will be seen that the fatter the meat the less water it contains, and the smaller the proportion of albuminates.

It is well known that soon after an animal's death the muscles pass into a state of "rigidity," known as *rigor mortis.* This is due to the spontaneous coagulation of the *myosin* of the muscular fibre. It sets in within a variable period after death, ten minutes to seven hours, and may last an equally variable period, from one to six days. Its duration varies greatly in different animals. It is not usual to eat the flesh of animals until this has passed off, unless, which is rarely convenient, it can be cooked before its onset. The meat is more tender and has a better flavour after it has disappeared. Hence the practice of "hanging" meat before cooking.

Different kinds of flesh differ considerably in quantitative composition, in flavour, in digestibility, and in nutritive qualities, according to a variety of circumstances, such as age, sex, state of nutrition, part of the body, etc., etc. Meat containing much fat is generally less digestible and less palatable than leaner varieties.

The flesh of young animals is less digestible than that of more mature ones; veal and lamb than beef and mutton; and with advancing age the flesh becomes tough and uneatable. There is less flavour, less stimulating properties, less nutritive value in the tissues of young animals than in mature ones, and they contain more gelatin. A four-year-old ox yields the best beef, and a three-year-old sheep the best mutton.

The flesh of the female has a finer grain and is more delicate than that of the male; while that of the entire male, during the breeding season, has a coarse and unpleasant flavour. Removal of the testes in the male and the ovaries in the female greatly improves their edible qualities.

It is usual in slaughtering animals for food to allow the blood, before or after death, to drain away as completely as possible; although this practice undoubtedly involves a loss of nutritive material, and is therefore wasteful, yet it is to some extent justified by the consideration that it improves the appearance of the meat, gives it delicacy of flavour, and enables it to be kept longer.

In civilised life all the animals used for food are vegetable feeders, and the character of the meat is often affected in a recognisable manner by the nature of the food. Pastures containing fragrant herbs, certain roots as turnip and mangold, and oil-cake, will each impart a peculiar character to the flesh.

Beef.—Beef is, perhaps, the most extensively consumed and most nutritious of all animal foods. It is best when procured from well-fed oxen of four to five years old.

The composition of the flesh, especially with regard to fat, will vary much according to the condition of the animal when killed. The following figures refer to three different examples of butcher's beef :—

	Water.	Nitrogenous Substances.	Fat.
From very fat Ox .	54·76	16·93	27·23
,, moderately fat Ox	72·25	21·39	5·19
,, lean Ox . .	76·61	20·61	1·50

The flesh varies also in quality, according to the part of the animal from which it is taken. The best, or first quality, includes rump, sirloin, fore-ribs ; the second, a portion of shoulder, buttock, middle-rib, etc. ; the third, flank, shoulder, brisket; and the fourth, cheek, neck, and shin.

The difference in composition between different parts of a very fat ox is shown in the following table :—

	Water.	Nitrogenous Matters.	Fat.
Neck	73·5	19·5	5·8
Loin	63·4	18·8	16·7
Shoulder . . .	50·5	14·5	34·0
Hind Quarter, lean part	55·01	20·81	23·32
,, streaky ,,	47·99	15·93	35·33
Fore Quarter, lean ,,	65·05	19·94	19·97
,, streaky ,,	32·49	10·87	56·11

Beef-fat consists of glycerides of the fatty acids in the proportion of 3 of stearic and palmitic to 1 of oleic. Its melting-point ranges between 41° and 50° C.

Veal.—Veal has, in Great Britain, always had the reputation of being less digestible and less nutritious than beef or mutton. It certainly contains a larger proportion of gelatin than beef. But it is more highly valued in other countries; and Bauer maintains that its fibres are tender, and that it is better borne by enfeebled digestive organs than beef. This difference of opinion no doubt depends on the different manner in which veal is killed and prepared in Britain and on the Continent. In England it is a much paler, ex-sanguine, and drier meat than on the Continent. It is probably killed younger, and bled too much before killing. The following table presents the composition of different joints of veal:—

	Water.	Nitrogenous Matters.	Fat.
Lean Veal	78·82	19·76	0·82
Fat ,, ...	72·31	18·88	7·41
Loin	76·25	15·12	7·12
Ribs	72·66	20·57	5·12
Shoulder	76·57	18·10	3·62
Leg	70·30	18·87	9·25

Mutton.—Mutton is generally considered to be more easy of digestion than beef. Its fibre is shorter and more tender. It often, however, contains a large proportion of fat, which is harder than beef-fat, as it contains more of the glyceride of stearic acid. Such fat mutton is unsuited to invalids, and often has a tallowy flavour.

Mutton, however, differs very greatly in quality and flavour; when of best quality, it is no doubt a most excellent form of animal food.

The following table (König) gives the composition of mutton:—

	Water.	Albuminates.	Fat.
Moderately fat	75·99	18·11	5·77
Very fat	47·91	14·80	36·39
Hind quarter	41·97	14·39	43·47
Breast	41·39	15·45	42·07
Shoulder	60·38	14·57	23·62

Lamb, like veal, is less digestible than mutton, and is very much richer in fat.

Venison.—Of other ruminants, the flesh of the deer alone is consumed in Britain. On the Continent, the flesh of the goat is also eaten; it resembles mutton, but has much less flavour, and is much more difficult of digestion. Venison from young deer is tender, short-fibred, dark-coloured and highly savoury, and is very digestible. It is, however, rather too stimulating and highly flavoured for delicate stomachs.

The following is the composition of venison (Von Bibra): Water, 74·63; albuminates (very little gelatin), 19·24; and fat, 1·3 per cent.

Pork.—Pork, on account of the large quantity of fat it contains, is the most difficult of meats to digest. Like all fat meats, it contains proportionately less water. Its fat differs from that of venison, in consisting almost entirely of palmitic and oleic glycerides.

The mean composition of *fat* pork, according to König, is: Water, 47·40; albuminates, 14·54; fat, 37·34. And of *lean* pork: Water, 72·57; albuminates, 19·91; fat, 6·81.

Of **bacon,** Pavy justly remarks that it "is less likely to disagree with the stomach than the fat of pork. It contains but a small proportion of water, and therefore, weight for weight, is an advantageous kind of food. . . . Its popular use, like that also of boiled pork, with lean meats such as veal, chicken, and rabbit, and also with other articles rich in nitrogenous matter, as eggs, beans, and peas, is founded upon a rational principle, serving, as it does, to establish a proper proportion in the supply of nitrogenous and carbonaceous material."

Besides the muscular tissue and fat of animals, some of the viscera, the blood, and even the bones may be utilised for food.

By breaking the **bones** into small pieces, and boiling for many hours, a nutritious extract is obtained, consisting chiefly of gelatin; 3 lb. of bone yielding about as much carbon as 1 lb. of meat, and as much nitrogen as 7 lb. of meat.

Bones can therefore be utilised advantageously in the composition of soup, especially in large public institutions.

The **brain** of animals is of soft consistence, and is no doubt nutritious, but it contains a large percentage of fat which renders it difficult of digestion by weak stomachs: the *tongue* also is tender, but is intimately permeated by fat.

The **blood** of the pig is made into a kind of food known as "black pudding," which contains also fat, groats, and some flavouring condiments.

Bullock's blood has also, at times, been prescribed for invalids, on the erroneous conception that it is especially nutritious and easy of assimilation. Not only is it repulsive to the palate, but it is probably difficult of digestion.

The **liver** of the pig, the calf, and the lamb is largely consumed as human food. Its richness and closeness of texture render it difficult of digestion. The composition of calf's liver has been given as water, 72·33; albuminates, 20·10; fat, 5·58; carbohydrates (amyloid matter), 0·45; salines, 1·54.

Kidneys are of close firm texture, and when much cooked become very hard and difficult of digestion. Sheep's kidneys contain about 17 per cent. of albuminates and 2 per cent. of fat.

The muscle of the **heart** has the same composition as other muscular structures, but it is of close hard texture, and therefore not easy of digestion.

Sweetbread is a reputed delicacy, and is generally considered easy of digestion. There are two kinds commonly eaten—one is composed of the pancreas, and the other of the thymus gland of the calf. Simply cooked it is a useful food for convalescents.

Tripe consists of the paunch or first part of the ruminant stomach of the ox. Its involuntary muscular fibre is easy of digestion, but it contains a large proportion of fat which renders it rich and unsuitable for delicate stomachs. The following is its approximate composition: Water, 68·0; albuminates, 13·2; fat, 16·4; salines, 2·4.

Poultry and game.—The various kinds of poultry, game, and wildfowl are favourite forms of food, and some of them are especially serviceable to invalids and persons of feeble digestion. Their flesh differs from that of ruminating mammals in not having its muscular fibres permeated by fat, and it is also short-fibred, and therefore more easily disintegrated. Those with white flesh, as the fowl, guinea-fowl, and turkey amongst poultry, and the pheasant and partridge amongst game, are especially tender, delicate in flavour, and easy of digestion; but the flesh of ducks and geese is dark-coloured, harder, richer, with a stronger flavour, and is much more difficult of digestion. Of all these, the young well-fed domestic fowl or chicken is perhaps the most valuable to the invalid. The young partridge and hen pheasant yield also very delicate food. The pigeon has less flavour, and the large amount of fat in the duck and goose renders them unsuited for invalids.

Deprivation of the sexual organs at an early age is well known to add to the size, flavour, tenderness, and edible qualities generally of certain poultry, as is well seen in the capon and poulard.

The flesh of **game** contains less fat than that of poultry, and has a finer flavour. It is tender and easy of digestion. Keeping develops the flavour of game, as is especially notable in grouse. The absence of fat and the finer flavour will often commend it to invalids in preference to poultry. Snipe, quail, and woodcock are delicate in flavour, but they are too rich for invalids. Game for invalids should only be kept long enough to secure tenderness, and the breast is the most suitable part for them to eat. Wildfowl generally have close and firm flesh, of strong and often fishy flavour, not suited to the digestion of invalids.

The flesh of a young **hare** is short-fibred, very tender, and of excellent flavour ; it is nearly as digestible as chicken, but more stimulating.

The flesh of the rabbit when young is fairly digestible, but when older it becomes dry and hard in cooking, and cannot be said to be easy of digestion.

The following table presents the composition of several kinds of fowl :—

	Water.	Albuminates.	Fat.
Fat chicken	70·03	23·32	3·15
Fat goose	38·02	15·91	45·59
Partridge	71·96	25·26	1·43

FISH.

Fish afford a large and important part of human food. The different kinds vary greatly in nutritive value, in edible quality, and in digestibility. The relative proportions of fat they contain are especially subject to variation, and this determines greatly their flavour and their facility of digestion. The lighter kinds, as the sole and whiting, contain least fat, and are of more delicate flavour and easy of digestion. Many contain a large proportion of water, and their nitrogenous matter consists greatly of gelatin. The flesh of many fish has a peculiar odour and flavour. In the brine of herring *Trimethylamine* occurs in abundance.

The following table gives the composition of some of the more important kinds :—

	Water.	Albuminates.	Fat.
Salmon	74·36	15·01	6·42
Eel	57·42	12·82	28·37
Herring (fresh) . . .	80·71	10·11	7·11
Sole	86·14	11·94	0·25

Dujardin-Beaumetz divides fish, from a nutritive point of view, into three classes. (1) Fish with white flesh, like the whiting and sole; (2) Fish with red flesh, like the salmon; and (3) Fish with greasy flesh, like the eel. The last he considers most nourishing, but least digestible.

Of the great nutritive value of fish no doubt can exist, and whole populations exist entirely upon it. It has been maintained that a fish diet predisposes to cutaneous affections, but this is doubtful. In Siberia dried fish ground into powder is made into a kind of bread.

Fish is considered to be less satisfying and less stimulating than the flesh of birds and mammals; it appears to be digested more rapidly, and therefore requires to be taken at shorter intervals or in larger quantity. For these reasons it forms an especially useful food for invalids whose digestive powers are unequal to cope with the stronger kinds of animal food.

Other white-fleshed fish, besides the sole and whiting, and containing but very little fat, are the turbot, brill, cod, plaice, flounder, etc.

In the salmon, the type of red-fleshed fish, there is, as the above table shows, a much larger proportion of fat, which is interspersed amongst the muscular fibres and accumulated under the skin. It is most abundant in the thinner abdominal part of the fish.

The pilchard, sprat, herring, and mackerel, as well as the eel, contain much fat mixed with their flesh, and these fish are, on that account, unsuited to persons with delicate digestions.

The flounder, like the sole and whiting, is light and easy of digestion, and has a delicate flavour if cooked very fresh. Cod and haddock are not very easy of digestion; the former varying greatly in quality, and sometimes being hard and tough. When cod is in season, there is a white curdy matter found between the flakes after boiling; this consists of coagulated albumen, and is absent when the fish is out of season.

Turbot is a fine-flavoured fish, and its flesh is firmer and richer than that of the sole, etc. Brill resembles turbot, but is of inferior flavour.

There are many circumstances which influence the edible qualities of fish. It is in the greatest perfection just before spawning; during that process it loses fat and becomes poor and flabby and "out of season." The salmon on its return to the sea, after spawning, is thin and wasted, and is regarded as unfit for food. Immature fish, not arrived at the spawning age, are always in season.

The flavour of sea-fish caught in deep rapidly-flowing water off rocky headlands, is better than that found in shallow bays. Fresh-water fish are best when taken in deep lakes or ponds with clear water and a rocky or stony bottom; the delicate flavour of the fish caught in Alpine lakes is well-known.

The common ray, and most of the order of cartilaginous fishes—unlike other fish which *cannot be cooked too fresh*—improve by keeping, for their muscular fibre, which is firm and resistant, then yields and becomes tender. Turbot is also considered to improve in flavour and tenderness by being kept for a short time.

The *roe*, or reproductive organ of the fish, is considered a delicacy; the *hard* roe is the ovary of the female, the *soft* roe or *milt* is the spermatic organ of the male. *Caviare* is the salted hard roe of the sturgeon.

The swimming-bladder of the cod is known as the sound.

Fish that have no scales are generally regarded as unwholesome and indigestible.

Fish dried, salted, smoked, or pickled is much less digestible than when fresh.

It has been the custom to speak of fish as an "intellectual" or "brain food" on account of the phosphorus contained in it, but much of its reputation in this respect may be due to its being readily digested by persons of sedentary and studious habits.

Louis Agassiz spoke of fish as a food "refreshing to the organism, especially after intellectual labour; not that its use can turn an idiot into a wise or witty man, but a fish diet cannot be otherwise than favourable to brain development."

The presumed aphrodisiac effect of a fish diet we are disposed to think not without a basis of experience. There is a remarkable passage in Montesquieu's "Esprit des Lois" on this point. "The founders of the religious orders," he says, "who desired to subject their unhappy victims to the impracticable law of chastity, wholly missed their end in prescribing for them the habitual use of fish."

Crustacea and mollusca (shell-fish).—Many of the *crustacea* are highly popular as articles of diet—the lobster, crab, crayfish, shrimp, and prawn especially. They are, as their composition shows, highly nutritious, but they have also the reputation of being very indigestible; indeed, in many persons, some of them, the lobster and crab in particular, give rise even to toxic symptoms, such as nausea, vomiting, diarrhœa, giddiness, and frequently to cutaneous eruptions of an erythematous nature. The rheumatic and gouty are considered to be peculiarly prone to such attacks. The following is Payen's analysis of the different parts of a lobster:—

	Flesh.	Soft internal substance.	Spawn.
Water	76·618	84·313	62·983
Nitrogenous matter	19·170	12·140	21·892
Fatty matter	1·170	1·144	8·254
Saline ,, (ash)	1·823	1·749	1·998
Non-nitrogenous (ash) and loss	1·219	0·354	4·893

The flesh of the lobster is more delicate and more digestible than that of the crab, and is usually much preferred to it. They both suffer decomposition rapidly, especially in hot weather, and should therefore be eaten quite fresh.

The spawn of the female lobster is much used in making sauces, both for its colour and flavour. It is highly nutritious, as is shown by the above analysis. The flesh of the claws is more tender and delicate than that of the tail. The bright red part inside the animal is the ovary.

The sea crawfish, or spiny lobster (*La Langouste*), is by some preferred to the lobster; others consider its flesh inferior in flavour and tenderness.

The flesh of the crab is tougher and more resistant to the action of the gastric juice; the soft part within the shell (*liver*), on account of its richness and the fat it contains, is more likely to disagree than the flesh of the claws.

The river or fresh-water crawfish (*l'Écrevisse*) is the most popular of crustacea in Paris, where enormous numbers are consumed. Those taken from the Meuse are thought the best. Being small, its flesh is much more delicate than that of the lobster. It is credited with aphrodisiac properties, and enters into the composition of Bisque soup. They are usually eaten hot, as they are esteemed more digestible then than when cold.

"Taken occasionally, and with moderation, they constitute a strengthening, tonic, and stomachic food, capable of increasing appetite and promoting the secretions of the digestive tube." *

Shrimps and prawns, taken occasionally and in moderation, freshly cooked in sea-water, are stimulating and appetising, and capable of exciting appetite in the feeble and anæmic.

* D. E. Monin, "L'Hygiène de l'Estomac."

The oyster is the chief of the edible MOLLUSCA. In England the mussel, scallop, cockle, periwinkle, whelk, and limpet are also eaten.

The **oyster**, when in season and eaten raw, is esteemed a very digestible form of food; but when cooked, it is by no means easy of digestion.

Analysing the whole contents of the oyster shell, König and Krauch found it to contain:—Water, 89·69 per cent.; albuminates, 4·95; fat, 0·37; and extractives, 2·62.

The oyster consists chiefly of a soft and a hard portion. The soft part is the liver; this is very digestible. The hard part is the muscle that binds the shells together, and is not nearly so digestible, and should not be given to invalids of weak digestion.

The digestibility of the oyster, according to Dujardin-Beaumetz, is due to the fact that "its edible part consists almost exclusively of liver;" when this is crushed, the hepatic cells are set free and "the glycogen is brought into contact with the hepatic ferment, so that a veritable auto-digestion of the liver takes place. The digestion of the oyster, therefore, makes but little demand on the stomach digestion. But if its digestibility is great, its nutritive value is small . . . for ten dozen oysters would be required to yield the nitrogenous substances needed in a day's ration."

Oysters vary greatly in delicacy of flavour; some are large and coarse; others, like the "native," small and delicate.

The **mussel** is a nutritious bivalve, the consumption of which is chiefly confined to the poorer classes of seaport towns. They are usually cooked in their own liquor, and vinegar is added. This mollusc has an evil reputation for causing toxic symptoms, often of great severity. This is said to happen more frequently between May and September than at other seasons. Poisoning by mussels has been studied by Brieger, who succeeded in isolating a toxic principle, which he names *Mytilotoxine* ($C_6H_{15}NO_2$). He considers it to belong to the group of Ptomaines, and to be developed in the liver of these mollusca.

It is not necessary to dwell on the other mollusca we have named; but a few words must be said of the Escargot, or *Helix pomatia* (Vineyard Snail), which possesses so high a reputation in France and other parts of the Continent for its nutritive qualities.

They are collected in considerable numbers in the vineyards of Burgundy, Champagne, Franche-Comté, and Lorraine. Those are preferable that are found on elevated parts, and where the soil is free from decomposing organic matters.

At the end of the winter season they are considered to be most delicate, having had a long period of partial fasting. As they feed often on poisonous plants, especially on the poisonous solanaceæ, it is usual to allow a few days to elapse after their collection before cooking them, in order that they may get rid of any poisonous substances they may have eaten. By cooking, the flesh becomes compact and firm, somewhat insipid, and not easy of digestion. It contains, however, a large proportion of nitrogenous matters, and is no doubt highly nutritive and may form a useful food for the poor. It has been called "the poor man's oyster." It enjoys a reputation in certain districts of being peculiarly beneficial to the consumptive. Selected varieties, seasoned with aromatic herbs and other condiments, form a costly article of luxury for Parisian gourmets.

Milk and its derivatives—cream, butter, cheese, etc.—Eggs.—It will be necessary to consider at some length the properties of that very important animal food—milk—a food which is remarkable as containing all the alimentary substances required for the support and maintenance of animal life, and which is, on that account, termed a *complete* or typical food. The only other *complete* food afforded by the animal kingdom is eggs. We shall therefore consider the food qualities of eggs also in this section.

Not only does milk form the exclusive food, for a time, of the young of all the mammalia, but it is also capable of being advantageously employed as the chief food for adults under various circumstances, which will be fully considered in the second part of this work.

In milk we find the four classes of alimentary substances necessary for health combined in proportions well adapted for the period during which growth is active; but when applied to the feeding of adults, the proportions of albuminates and fat are in excess as compared with the amount of sugar.

The percentage composition of good cow's milk is thus given by Parkes:—

	Specific Gravity, 1029 and over.
Water	86·8
Albuminates	4·0
Fats	3·7
Carbo-hydrates	4·8
Salts	0·7

The albuminates consist of casein and a small quantity of serum, or true albumen, which remains in solution after the casein is thrown down. Cow's milk is said (Parkes) to contain as much as 5·25 grammes of albumen per litre. Casein, the chief nitrogenous constituent of milk, differs from albumen in not being coagulated by heat; but it is readily coagulated by acids, and also by *rennet*, an organic substance extracted from the fourth stomach of the calf.

The fat of milk, as is well known, can be separated in the form of *butter*. It consists of glycerides of stearic, palmitic, myristic, oleic, butyric, and some soluble fatty acids. It is suspended in the fluid or *plasma* of milk, in the form of *milk globules*, and these give to milk its white, opaque appearance. It has been stated by some authorities (but denied by others) that these globules are enclosed in a delicate albuminous membrane; and that it is on this account that ether, when shaken up with cow's milk, does not dissolve out the fat, unless acetic acid or potash be also added to dissolve these envelopes. But shaking with ether alone is said to be sufficient to extract the fats from human milk; and those who deny the existence of these envelopes assert that milk is a simple emulsion, and that the fat globules are kept suspended by the casein, which is not in solution, but in a swollen-up colloidal state; and that when potash and ether are added, the casein is no longer able to maintain the emulsion.

The carbo-hydrate of milk is in the form of *lactose*, lactine, or milk sugar. It remains dissolved in the fluid or plasma after the casein and the fat globules have been separated. It is not so sweet, and is less soluble in water, than ordinary sugar. It is nearly insoluble in alcohol and ether; and it reacts like grape-sugar on the cupro-potassic solution. It is not *directly* prone to alcoholic fermentation, but under the influence of an organism (the *bacillus acidi lactici*) introduced from without, it is converted into *lactic acid*, and it is this which causes milk to "turn sour" on keeping.

$$\underbrace{C_{12}H_{24}O_{12}}_{\text{Lactose}} = \underbrace{4(C_3H_6O_3)}_{\text{Lactic Acid}}.$$

The *salts*, together with the water of milk, supply the necessary inorganic substances required for the nutrition of the animal organism.

Potash salts are more abundant in milk than soda salts; and calcium phosphate is a considerable and important constituent, as it is needed for the bone formation of young animals. These salts are chiefly in the form of chlorides, phosphates, and sulphates.

The amount of salts in cow's milk varies, especially with the animal's food, from 0·5 to 0·8 per cent.; the normal average is 0·7 to 0·75. In poor milk it may be as low as 0·3 per cent.

The total amount of *solids* in cow's milk, of an average specific gravity of 1030, is 13·2 per cent., and a pint (or 20 oz.) of such milk will contain in round numbers—

	350	grains of Casein,
	324	,, ,, Fat,
	420	,, ,, Lactose,
and	66	,, ,, Salts.
Total . .	1,160	grains, or more than 2½ oz. average of water-free food.

If an adult requires daily 23 oz. of water-free food, it would take 9 pints of milk of a specific gravity of 1030 to supply this; but such a quantity of milk would give a considerable excess of albuminates and fat, and a very great excess of water; and although this excessive proportion of water and fat is essential for the rapid growth and due elimination of the young, it would be a wasteful food for an adult. So that it is not a food well suited for the nourishment of adults, unless mixed with other foods, which should consist chiefly of carbo-hydrates.

It has, however, been suggested that it might prove a valuable food in old age, and remedy the defective tissue formation and elimination common at that period.

The relative proportions of these different constituents vary considerably in the milk of different animals, as is shown in the following tables:—

Fery's Analysis—given by Dujardin-Beaumetz.

	Woman.	Ass.	Cow.	Goat.
Specific Gravity	1033·5	1032·1	1033·4	1033·85
Average Composition per litre, 1,000 *grammes.*				
Water . .	900·10	914·00	910·08	869·52
Casein . .	10·52	12·30	28·12	44·27
Butter . .	43·43	30·10	34·00	60·68
Lactose . .	76·14	69·30	52·16	48·56
Salts . .	2·14	4·50	6·00	9·10

The following is quoted by Bauer, after König:—

	Water.	Casein.	Albumen.	Fat.	Sugar.	Salts.
Cow .	87·41	3·01	0·75	3·66	4·92	0·70
Goat .	86·91	2·87	1·19	4·09	4·45	0·96
Sheep	81·63	4·09	1·42	5·83	4·86	0·73
Mare .	90·71	1·24	0·75	1·17	5·70	0·37

These tables, it must be remembered, only represent the *average* composition, or the means of several analyses, the actual composition being somewhat variable.

It will be seen from the first table that the specific gravity varies very little, the lowest being that of the *ass*, 1032·1, and the highest that of the *goat*, 1033·85.

The milk of the sheep is rarely used as human food, and therefore has less interest for us. It is particularly rich in casein and butter. The milk of this animal, as well as that of the goat, would seem, according to the second table, to have much of its nitrogenous matter in the form of albumen, which is there estimated separately.

But if we confine our attention to the first table we shall notice that whereas human milk and ass's milk each contain about the same proportion of casein, cow's milk contains nearly three times, and goat's milk more than four times as much casein (or nitrogenous matter, *i.e.* casein and albumen together) as human milk.

On the other hand, human milk and ass's milk are richer in sugar than cow's or goat's milk; human milk being especially rich in lactose. Human milk is also rich in butter, considerably more so than the milk of the cow or the ass, but not so rich in this ingredient as that of the goat. Of the four milks compared together in the first table, goat's milk is richest in solids, and contains the largest proportions of nitrogenous and fatty constituents, as well as of salts; but it is comparatively poor in sugar. It also contains a peculiar smelling acid (hircin or hircic acid). It is the most highly nutritious of these milks, but it is the least digestible.

Ass's milk, on the contrary, contains the smallest amount of solids, but is rich in sugar, although not quite so much so as human milk. It is poor in casein and in fat, resembling human milk in all but the latter particular. Ass's milk is, therefore, light, sweet, and easy of digestion, and is a most useful food for persons whose stomachs are too delicate to digest cow's milk easily. It is said to occasionally give rise to diarrhœa.

If we now glance at the second table we shall notice a certain resemblance between the composition of mare's milk and ass's milk. Mare's milk is poor in solids, remarkably so when compared with that of the other animals in the same table. It is, however, proportionately rich in sugar, and on this account in Tartary it is fermented, and an alcoholic beverage known as *koumiss* is made from it, of which we shall have to speak hereafter.

The composition, quality, and quantity yielded of cow's milk are influenced by a variety of circumstances—

1. There is the influence of *race*. *Alderneys* give a milk very rich in butter, *long-horns* a milk proportionately rich in casein.

2. The period after delivery of the calf also exerts an influence. The milk which immediately succeeds delivery differs from ordinary milk, and is known as *colostrum*. It has a somewhat viscid, turbid, and yellowish aspect, and strongly alkaline reaction. It contains very little casein, but much serum-albumen, and is particularly rich in all the other solid constituents, especially butter. It coagulates on boiling. The milk of the cow may remain in this condition for nearly a month after delivery. It has a sickly odour, and is said to possess purgative properties, and to be unfit for human food.

3. The milk with a first calf contains less water and is richer, but the quantity yielded is less than in subsequent pregnancies.

4. The oftener the mammæ are emptied the richer the milk becomes in casein; and the milk withdrawn at the end of a milking is always richer in butter than that at the beginning, as it comes from the most distant part of the gland—the *acini*.

The evening milk contains a larger proportion of butter than that of the morning.

5. The nature and quality of the food exercise

considerable influence over the amount and quality of the milk. A poor diet soon leads to a diminution of the solid constituents. Fresh green pastures in the country produce the sweetest-flavoured and best milk. Beet-root and carrots increase the amount of sugar. Turnips, brewers' grains, etc., impart a peculiar flavour. The colour, the odour, and even poisonous properties may pass from the vegetables or plants consumed into the milk secreted. In autumn it is desirable, on this account, that cows should not be allowed to eat a quantity of dead leaves which may be scattered over their pastures.

It is a familiar experience that wet-nurses have to be careful in their diet or their milk will excite intestinal disorders in the infants they are suckling: medicines, also, taken by nurses will through their milk influence the infants. It is possible to take advantage of this circumstance, and so administer *medicated* milk to sucking infants; in this way iodides, preparations of mercury, salicylic acid, arsenic, quinine, and other substances, may be carried with the milk from the nurse to the child.

The frequency with which contagious diseases are communicated by milk necessitates great care in its collection and storage.

Excessive physical exertion and morbid mental states are also known to injuriously affect the properties of the milk secreted under such conditions.

We have already incidentally alluded to the fact that milk undergoes a particular *change* when it is allowed to stand for a certain time, the length of which varies according to the temperature to which it is exposed. This *spontaneous coagulation* of milk is due to the production of *lactic acid*, which is formed, as we have shown, from the *lactose* of the milk by the action of a ferment (*bacillus acidi lactici*) introduced from without. It is the casein in the milk which becomes coagulated. In fresh milk the casein is combined with calcium phosphate which keeps it fluid; acids which act on the calcium phosphate bring about coagulation of the casein. The lactic acid when developed converts the neutral alkaline phosphate into acid phosphate, and the casein is thus precipitated. Warmth hastens this tendency in milk to spontaneous coagulation, and it is a common observation that milk "turns sour" much more rapidly in the heat of summer than in cold wintry weather; moreover, contact with the smallest quantity of milk that has undergone this process will rapidly induce it in fresh milk.

It is sometimes noticed that milk which is fluid and apparently fresh at ordinary temperatures, curdles on boiling; this is explained by supposing that lactic acid has already been formed in small quantity, and the rise of temperature increases its energy.

In perfectly fresh milk coagulation may be delayed by boiling it, or by adding a small quantity of bicarbonate of soda, or of salicylic acid to it.

Casein produced by the action of "rennet" on milk "displays in its properties a considerable difference from the casein which has been obtained by acidification or spontaneous coagulation." *

Milk is such an exceedingly important food, both for the sick and the sound, that it is most essential for all who are responsible for the feeding of others that they should be familiar with some *systematic method of examining it*, in order to test its quality and purity.

Good milk, as it is withdrawn from the cow, is perfectly fluid, often slightly frothy on the surface, opaque and white, with a faintish buff tint. It has a slight, agreeable, and peculiar odour, and a sweetish taste. On standing, a large proportion of the fat globules it contains rise to the surface, and accumulate there as a layer of "cream," which is of lower specific

* Bauer, "Dietary of the Sick," p. 50.

gravity than the rest of the fluid. The average specific gravity of cow's milk may be taken as 1030, but it varies somewhat. Its reaction is neutral or slightly alkaline, but not long after removal it may be found faintly acid.

The specific gravity is ascertained by the hydrometer or lactometer; it is usually found to vary between 1026 and 1034. The addition of water lowers the specific gravity, and therefore a low specific gravity is one of the indications of adulteration with water; but it is necessary to remember that, owing to the lightness of fatty matter, an excess of cream also lowers the specific gravity. A specimen of milk containing 26 per cent. of cream has been found to have a specific gravity of 1019, and one with 80 per cent. of cream a specific gravity of 1008. These specimens when skimmed had a specific gravity of 1027 and 1026 respectively. Milk with a specific gravity of 1026 or 1027 *unskimmed*, will when *skimmed* often have a specific gravity of 1030 or 1031. It is advisable then to skim the milk before taking its specific gravity, and if it is found of a lower specific gravity than 1027 or 1028 it is highly probable that it has been watered.

In order to estimate the amount of *cream* in a given specimen of milk, a *creamometer* is employed; this consists of a long glass tube graduated to 100 parts; this is filled with milk, and then placed in a protected spot for twenty-four hours. The cream rises as a more or less thick layer to the top, and the number of degrees it occupies can be read off. About 8 per cent. is the average. If it falls below 5 per cent. it is probable that the milk is adulterated with water. In some very rich milks it may be as much as 20 per cent.*

* Full details for the examination of milk will be found in Parkes's "Hygiene," and in other works dealing with the analysis of food.

Various methods have been adopted for preserving milk. If a bottle be quite filled with boiled milk, immediately corked up, and hermetically sealed, the milk on cooling diminishes in bulk and a vacuum is formed. It may then be kept for some time, especially if a little cane sugar be added, which aids its preservation. If the milk is heated in a close vessel to 250° Fahr. it may be preserved for years. Boiling milk and then adding sodium sulphite or passing sulphur dioxide through it is another method of preserving it. By adding a little sodium bicarbonate and sugar, with or without boiling, it may be kept ten or twelve days. The addition of salicylic acid, of borax, of boracic acid, and of boro-glyceride, are useful preservative measures.

Preserved condensed milk is now largely sold in air-tight tins. It is condensed by the removal of water *in vacuo*, and cane sugar is added in variable quantity. Condensed milk thus prepared contains on an average 26 per cent. of water, 12 of nitrogenous matter, 11 of fat, 16 of lactose, and 22 of added cane sugar. There is also an "unsweetened" kind prepared which is better for feeding infants.

Skimmed milk is simply milk from which the cream has been removed by skimming, after it has stood some hours. It is more easily digested, under some circumstances, than unskimmed milk, as it is less rich. It contains—

	Letheby.	Bauer.
Water . . .	88·0	90·63
Albuminates . .	4·0	3·06
Fat	1·8	0·79
Lactose . . .	5·4	4·77
Salts	0·8	—

Cream varies somewhat in composition according to the quality of the milk from which it is obtained, and the method adopted of obtaining it. The following table shows approximately its composition :—

	Letheby.	Bauer.
Water . . .	66·0	Varies from 22·0 to 83·0
Albuminates . .	2·7	,, 2·2 ,, 7·4
Fat	26·7	,, 8·2 ,, 70·2
Lactose . . .	2·8	,, 0·74 ,, 4·5
Salts . . .	1·8	——

Clotted or Devonshire cream is solid, not fluid like ordinary cream. The milk from which it is collected is previously heated just to the point of simmering. It is then allowed to stand and cool, and the fatty matter rises to the surface together with a coagulated scum, which *clots* the cream. It is richer and less digestible than fluid cream.

Curd and **Whey.**—It has already been stated that when an acid, or when rennet, is added to milk, the casein coagulates and forms the so-called *curd* of milk, from which cheese is made, and the fluid from which it separates is termed *whey*.

Rennet coagulates milk with an alkaline reaction, and forms what is called "sweet whey." In this process the casein is decomposed into the precipitated cheese and the slightly-soluble whey-albumen. It is a process quite distinct from the coagulation of milk by the gastric and pancreatic juices, or from that produced by other acids out of the body.

The *curd* consists of casein with some milk globules entangled in it. The *whey* contains some soluble albumen and fat, and a great proportion of the salts and lactose, together with some lactic acid.

Mean Composition of Whey (BAUER).

Water	93·3
Albuminates	0·82
Fat	0·24
Lactose	4·65
Lactic Acid	0·33
Salts	0·65

Whey, though not very nutritious, is an exceedingly useful fluid food in some febrile and other diseases, when milk cannot be digested. As it is also a pleasant beverage it can be given freely, and so a considerable amount of nutritive substance may in this manner be administered. It also acts usefully as a diuretic. It can be made with lemon juice, or white vinegar, or white wine, or cream of tartar, or alum, as well as with rennet. (In the section on "Food in Infancy," a mode of preparing "whey" will be described by which a considerable proportion of casein and fat globules are retained in it.)

Butter-milk is the milk that is left after the manufacture of butter. It is a sour-tasting, thickish fluid, in which the casein of the milk exists in a finely coagulated state, a more easily digested form than when in coarse curd.

It contains but a small quantity of fat, and the lactose has been in great part converted into lactic acid. The composition as given by Pavy is :—

Water	88·0
Nitrogenous Matter	4·1
Fatty Matter	0·7
Lactine	6·4
Saline Matter	0·8

It is a very nutritious fluid, and its use has been largely advocated by German physicians in feeble states of the digestive organs on account of its digestibility.

Koumiss.—Milk can be made to undergo alcoholic fermentation by the conversion of its lactose into alcohol and carbonic acid.

Advantage has been taken of this property in certain countries to produce an alcoholic drink from milk. The Kirghis tribes and the Tartars, who dwell in the immense plains surrounding the Caspian Sea, utilise mare's milk for this purpose, and prepare from it an alcoholic beverage which is known as koumiss. There are two or three qualities prepared of varying strength.

The following comparison of the composition of mare's milk and koumiss is quoted from Hartier by Dujardin-Beaumetz :—

In 1000 parts.	Mare's Milk.	Koumiss.
Albuminates	19 to 28	11·20
Fatty Matter	12 ,, 15	12·00
Lactose	53 ,, 57	22·00
Lactic Acid	—	11·50
Carbonic Acid	—	7·85
Alcohol	—	16·50
Salts (Ash)	0·280	0·28

A form of koumiss is also prepared in England from cow's milk.

It is a valuable food in the dietetic treatment of phthisis and other diseases.

Kefyr is another fermented drink, prepared in the mountains of the Caucasus from cow's milk. This fermentation is brought about through the agency of a micro-organism, the *Dispora caucasica*, which is added to the milk, and it possesses the property of converting the lactose into alcohol and carbonic acid.

As cow's milk contains proportionately much less sugar than mare's milk, *kefyr* therefore contains less alcohol than koumiss.

The following analysis, quoted by Dujardin-Beaumetz, shows the relations between cow's milk and *kefyr* :—

In 1000 parts.	Skimmed Cow's Milk. Sp. Gr. 1·028.	Kefyr (Medium Quality). Sp. Gr. 1·026.
Albuminates	48·00	38·00
Fats	38·00	20·00
Milk Sugar	41·60	20·025
Lactic Acid	—	4·00
Alcohol	—	8·00
Water and Salts . . .	873·00	904·975

Galazyme is the name given to a fermented drink made on the Continent from milk by adding to it sugar and a special ferment.

Deschiens, in France, has employed the same ferment as is used in the preparation of the best alcohols. A certain proportion of this and a certain amount of sugar are dissolved in a little water and added to a bottle of milk, which is then hermetically sealed. This rapidly undergoes fermentation, and an effervescing milky beverage is produced, containing 1 per cent. of alcohol and a large amount of carbonic acid.

The following is the composition of the beverage thus prepared :—*

In 1000 parts.	Sp. Gr. 1028.
Butter	32·40
Albuminates	27·65
Lactose	29·50
Alcohol	12·00
Carbonic Acid	7·00
Lactic Acid	10·50
Water	880·95

* Dujardin-Beaumetz, "L'Hygiène Alimentaire," p. 43.

Butter.—Butter is one of the most digestible of animal fats, and one of the most agreeable and delicate in flavour.

It is obtained, as is well known, by the process of churning cream or milk, which causes the fat globules to run together and coalesce into a solid mass.

It is rarely made from any but cow's milk, which alone yields butter of the pleasant delicate flavour so generally appreciated.

The butter, when formed, is well washed and kneaded with water, for the purpose of freeing it, as completely as possible, from adherent casein and the other constituents of milk. The more completely this is done, the better will the butter keep. It is usual also to add a certain proportion of common salt to aid in its preservation; this varies in amount according to whether the butter is to be consumed "fresh" or "salted."

König gives the composition of good butter as :—

Fat	87·0
Casein	0·5
Milk Sugar	0·5
Water	11·7

Parkes gives the water as varying from 5 to 10 per cent.; when purposely mixed up with butter to increase its weight, as much as 23·6 per cent. of water has been detected in fresh, and 28·5 in salt, butter.

Such large admixtures of water can be detected by *melting* the butter, when the water will collect below the oil.

All butter contains a small amount of casein which is taken up from the milk; the best butter contains the least. The changes in butter which render it *rancid* are apparently dependent on alterations in the casein, which acts as a ferment and liberates fatty acids. The more completely, therefore, the casein is removed from it, the better will the butter keep.

The fat, which should amount to from 86 to 92 per cent., consists of volatile and non-volatile fatty acids, combined with glycerine. The volatile acids are butyric, caproic, caprylic, and capric; and the non-volatile, stearic, palmitic, and oleic.

Salt preserves butter by checking the decomposition of the casein, and sugar has the same effect.

Butter may be made to keep longer either by repeated washings or by melting down, both of which processes diminish its agreeable fresh flavour; or by the more common method of adding salt. Covering it with water which has been boiled, or in summer time with iced water, will help to preserve it.

Butter melts at a comparatively low temperature; it is rarely completely solid at a temperature of 82° Fahr.; hence it is prepared with difficulty in southern countries, and is more especially a product of the north.

Butter, when perfectly fresh, is one of the most easily digested forms of fatty matter, and it is on that account a very valuable food; but when it is *rancid*, or when its fatty acids have been set free from exposure to heat, as in cooking, it is often badly tolerated by the stomach.

Cheese.—Cheese is composed of the casein or curd of milk, together with a variable amount of the fat of milk, according to the manner in which it is prepared.

The milk is usually coagulated by the addition of rennet, and a certain amount of salt, 5 or 6 per cent., is added. The fat globules are entangled in the coagulated casein.

The curd, after coagulation, is subject to pressure, in order to express as much of the retained fluids, milk and whey, as possible. It is placed in moulds for a time to consolidate, and subsequently it is removed and ranged on shelves in a cool situation, where it remains for some time to *ripen*. In this *ripening* process the fats increase at the expense of the casein, and volatile fatty acids are developed, which impart to the cheese its characteristic odour and flavour. The richer the cheese in fat, the more highly flavoured it is capable of becoming. These fermentative processes may go on to actual putrefaction, and even poisonous ptomaines may be developed; or vegetable organisms in the form of mould (*Aspergillus glaucus*, blue and green mould, and *Sporendonema casei*, red mould) may appear in it, as well as a microscopic animal, the *acarus domesticus*, or cheese mite.

There are a great many varieties of cheese. In the first place, there is the so-called "fresh," or "sour-milk," cheeses, as they are sometimes termed, such as our own cream cheeses. These are not intended to be kept, but to be eaten as soon as made. "When cheese is made from sour milk, the milk is gently warmed to about 50° C., in order to obtain a firmer coagulation of the casein. The whey is then pressed out, and the resulting sour-milk cheeses are generally eaten fresh." (*Bauer.*)

Cheeses, however, that are intended to be kept are made from fresh milk.

The quality and character of the several varieties of cheese depend to some extent upon whether they are made from *skimmed* or *unskimmed* milk, or from *milk* to which *cream* is added.

The richer cheeses as Stilton and Double Glo'ster, contain a considerable amount of added cream. The best quality Cheshire is made from *unskimmed* milk; the second quality Chester, Glo'ster, and many American are made from milk, some of the cream of which has been removed. Dutch and Parmesan cheese and some of the poorer qualities made in many counties in England, are made from *skimmed* milk.

The poorer cheeses keep best, but become very hard and dry. Parmesan has even to be grated; the richer fatty cheeses are more prone to decomposition.

The average percentage composition of cheese is thus given in Parkes's "Hygiène":—*

Water	36·8
Albuminates	33·5
Fats	24·3
Salts	5·4

Dividing cheeses into three classes, their mean analyses Bauer gives as follows:—

	Rich.	Middling.	Poor Cheese.
Water	35·75	46·82	48·02
Albuminates	7·16	27·62	32·65
Fat	30·43	20·54	8·41
Extractives	2·53	2·97	6·80
Ash	4·13	3·05	4·12

The following analyses of well-known varieties of cheese are compiled from various authorities:—

	From Skim Milk.	Dutch.	Cheshire.	Gruyère.	Camembert.	Roquefort.
Water	44·0	36·10	35·92	40·0	51·94	34·55
Albuminates	44·8	29·43	25·99	31·5	18·90	26·52
Fat	6·3	27·54	26·34	24·0	21·05	30·14
Undefined Substances	—	6·93	7·59	1·5	4·40	3·72
Salts	4·9	—	4·16	3·0	4·71	5·07

Cheese is an exceedingly valuable, nutritive, and economical food on account of the large proportion of nitrogenous substances it contains, twice as much, weight for weight, as meat; it is also agreeable to the

* 6th ed., by Du Chaumont.

palate. Cheese with bread forms a popular, convenient, and highly nutritious diet for the labouring poor. When taken at the end of a meal by the opulent classes, it is rather as a condiment than a food, especially when highly flavoured and in a state of advanced decomposition, as, for example, old Stilton and Gorgonzola.

Cheese is popularly regarded as a food difficult of digestion, but this has, doubtless, been much exaggerated. The poorer harder kinds of cheese, which contain a large proportion of casein, are certainly difficult to digest, but the richer, softer, finer-flavoured, and less compact cheeses by no means merit this reproach, and may, in small quantity, promote the digestion of other food by, as Pavy has maintained, "its stimulant action on the stomach."

Eggs.—Eggs form another *complete* food, like milk. They contain all the elements of the blood, and the organism of the young chick is developed from them. But when regarded in the light of a complete food the shell must be taken into account, for it is from the shell that certain essential constituents of the organism of the chick is obtained. In the process of incubation the earthy salts in the shell are dissolved by phosphoric acid, which is developed by the oxidation of phosphorus, and they are thus in a condition to be absorbed. Eggs therefore provide us with a highly nutritious food in a concentrated form.

The egg of the domestic fowl is the one chiefly utilised for human food, but those of the duck, goose, turkey, and guinea-fowl are occasionally eaten. Plovers' eggs are greatly esteemed for their delicacy of flavour. The eggs of all birds have the same composition, and are suitable for food, but their quality and flavour depend greatly on the food of the bird which yields them.

Bauer gives 750 grains as the mean weight of a hen's egg, of which 105 grains are shell, 405 white, and 240 yolk. Parkes roughly estimates the average weight of a hen's egg to be 2 ounces, and to range between 600 and 950 grains, and, including the shell, in every 100 grains he calculated there would be 10 grains of shell, 22·8 of albuminates and fat, and 67·2 of water. He also estimated that an egg weighing 2 ounces would contain just 200 grains of solids. Pavy calculates that such an egg would yield 110 grains of nitrogenous substance, 82 grains of fat, and 11 grains of saline matter.

The composition of the shell is stated by Landois to be 91 per cent. calcic carbonate, 6 per cent. calcic phosphate, and 3 per cent. organic matter.

The **white** of the egg contains less solids than the yolk and much less fat, and consists chiefly of albumen dissolved in water and enclosed in a delicate membrane. Egg albumen resembles serum albumen, but is not identical with it. It coagulates at 70° Cent. (158° Fahr.). It contains a small amount of fat and salts.

The **yolk** contains much more fat than the white. Its chief albuminous constituent is the characteristic proteid substance *vitellin*, and besides the ordinary fats, olein and palmitin, the yolk contains cholesterin, much *lecithin*, and a yellow colouring matter; also inorganic salts, extractives, and a little grape sugar. Landois gives the following comparative analysis of the white and the yolk of egg.

	White of Egg.	Yolk.
Water	84·8	51·5
Albuminates	12·0	15·0
Fats, etc.	2·0	30·0
Mineral Matter	1·2	1·4
Pigment Extractives	—	2·1

It is here seen that the *yolk* differs from the *white* chiefly in its greater richness in solids, especially in fats, and in the presence of pigment. The saline constituents are the same as those found in the blood; the *white* has an excess of chlorides, the *yolk* an excess of phosphates.

The *yolk* is of more importance than the *white* from an alimentary point of view, as it contains a quantity of fat as well as a peculiar form of albumen, whereas the *white* is chiefly a simple solution of albumen. In some persons certainly, if not in all, white of egg, if taken uncooked in large quantities, gives rise to albuminuria, but the slightest amount of cooking is said to prevent this.

Eggs are an easily digested food if taken raw or lightly cooked, but if cooked so as to be *hard* they are difficult of digestion. Some persons present the peculiarity of being unable to take eggs in any form or in the smallest quantity without manifesting toxic symptoms.

Eggs may be preserved for a long time by various devices which are intended to prevent the entrance of air through the porous shell.

Eggs are extensively employed in ordinary cookery, as well as in the diet of the sick, and it has been said that they can be prepared in "more than five hundred different ways." *

The yolk of egg is considered unsuitable in the *uric acid* diathesis because of the amount of *lecithin* it contains, and eggs are altogether forbidden by many physicians in albuminuria.

The well-known *lait de poule* is made by beating up the yolk of egg in hot water, and adding sugar and some aromatic flavouring substance, such as orange-flower water; sometimes a little rum or cognac is added.

* "L'Hygiène de l'Estomac," par Dr. E. Monier.

The following table of the various constituents of the ash of the most important animal foods is taken from Bauer :—

	Potassium.	Sodium.	Calcium.	Magnesia.	Oxide of Iron.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Ash of Flesh	41·27	3·63	2·82	3·21	0·70	42·54	1·56	3·85
,, ,, Milk	24·67	9·70	22·05	3·05	0·53	28·45	0·30	14·28
,, ,, Hen's Egg .	19·22	17·52	8·44	2·43	1·16	38·05	0·96	13·97

We may call attention to the richness of animal flesh in potassium and in phosphoric and sulphuric acids, and its comparative poorness in sodium, calcium, and chlorine ; to the richness of milk in calcium and chlorine ; and to the richness of eggs in sodium, iron, and phosphoric acid.

CHAPTER IV.

VEGETABLE FOODS.

We derive from the vegetable kingdom a great variety of foods, many of them of a highly nutritious character, and therefore of great importance to the human race.

The foods obtained from the vegetable kingdom, like those derived from the animal world, contain both albumen and fat, but, as a rule, in vegetable foods the non-nitrogenous constituents are greatly in excess of the nitrogenous ones, and occur chiefly as carbo-hydrates; and, save in the case of certain fruits and seeds, they contain but little fat.

The remarkable difference in these respects between animal and vegetable food is well shown in the following table from Hofmann :—

	Nitrogenous Constituents.	Fat.	Carbo-hydrates.	Salts.
Fat Beef .	51·4	45·6	—	3·0
Lean ,, .	89·4	5·5	—	5·1
Pea Flour .	27·3	0·8	68·9	3·0
Wheat . .	16·6	0·9	81·9	0·6
Rice . .	7·7	0·4	91·2	0·7

Vegetable foods differ further from animal foods in being less digestible and less capable of complete assimilation by the digestive organs of man.

There are several modifications of albuminates found in vegetable as well as in animal food.

1. There is *vegetable albumen* which separates from vegetable juices by coagulation when heated, and then presents a close resemblance to egg albumen both in properties and composition.

2. There is *legumin* or *vegetable casein*, abundant in the seeds of the leguminosæ, and resembling in all essential particulars the casein of milk, and being, like it, precipitated from its solution by rennet and acetic acid, but not by heat.

3. There is *gluten* found in large amount in wheaten flour and in other cereals. It is broken up by alcohol into *vegetable fibrin* and *gliadin*.

The following table will show the close relationship in chemical composition between some of these vegetable and animal albuminates :—

	C.	H.	N.	O.	S.
Flesh Albumen . . .	52·89	7·17	16·18	22·18	1·58
Egg " . . .	53·40	7·0	15·70	22·40	1·60
Vegetable " . . .	53·06	7·33	16·58	21·93	1·10
Milk Casein . . .	53·55	7·10	15·83	25·52	
Legumin	51·48	7·02	18·22	22·88	0·40
Syntonin	53·97	7·21	15·57	22·03	1·21
Vegetable Fibrin . .	54·49	7·35	16·91	20·41	0·84

Certain other nitrogenous substances are found in vegetables, such as *asparagin*, not belonging to the albuminates, and which are eliminated in the form of urea, and have no nutritive value.

The vegetable fats are some solid and some liquid, at ordinary temperatures; they usually contain a large proportion of free fatty acids. The so-called "non-drying" oils are most valued as food, and of these the oil of the olive is especially esteemed. Of the "drying" oils (*i.e.* those that gradually harden into a resinous mass on exposure to air), that of the poppy is said to be most useful as food, and the most palatable.

Vegetable foods are, as a rule, particularly rich in *carbo-hydrates*, a numerous and important class of alimentary principles, which derive their name from the fact that they contain oxygen and hydrogen in the proportion to form water. Of these *starch* is the most important. It abounds in all plants, and especially in the seeds of the cerealia and leguminosæ, and in the potato and other tubers. By the action of certain reagents, and also by that of some of the digestive ferments, the insoluble starch is converted into soluble *dextrin*, and ultimately into grape sugar.

Similar properties are possessed by *inulin* and *lichenin* (from Iceland moss), and the various kinds of gum and mucin.

Cellulose, which exists in abundance in all plants, is closely allied to starch, but it is only capable of serving as human food when quite young and tender. It tends quickly to become "woody," and is then not only itself incapable of digestion by man, but it hinders the digestion of the other constituents associated with it.

Other important *carbo-hydrates* found in vegetables are the different kinds of sugar: they are not only nutritious in themselves, but they are most valuable from the property they possess of giving an agreeable flavour to other foods.

Grape sugar is found in the juices of most sweet fruits. *Cane* sugar is much sweeter and is found in the sugar-cane, certain species of maple, beet-root, etc. Fruit sugar, melitose, inosite, and mannite, are varieties of sugar possessing little importance as food; the same remark applies to *pectin* or fruit jelly, to the vegetable acids, and the glucosides.

The most important vegetable foods are derived from those plants which produce *farinaceous* seeds, *i.e.* seeds yielding *meal* or *flour*. The seeds of the *cerealia*, one of the *grass* tribe, and of the *leguminosæ* or *pulse* tribe, are of the greatest value and usefulness in this respect.

To the former belong those well-known "grains," wheat, barley, oats, rye, maize, rice, etc.; and the latter include those familiar articles of food, peas, beans, lentils, etc.

The cerealia.—The seeds of the cereals are, of all the products of the vegetable kingdom, those best adapted for the food of the human race, and we accordingly find them almost universally spread over the surface of the globe. They contain a large quantity of nutritious substances condensed into a small space, and they are, therefore, convenient both for storage and transportation, and being dry they can be preserved for a long period without deterioration.

They are rich in nitrogenous substances, the various grains containing from 5 to 14 per cent.; rich also in starch and cellulose, and they contain small and varying amounts of gum, sugar, and fat.

They also contain a considerable proportion of mineral substances, chiefly in the form of phosphates of lime, magnesia, potash, and soda, together with small amounts of iron and silica. It must, however, be remembered that the chemical composition of these grains is influenced, to a certain extent, by the nature of the soil in which they are grown, and the manure with which it is dressed.

The seeds of the cereals, before being used for human food, are usually ground into *meal.* This process has for its object not only the reduction of the hard seeds to powder, but also the separation and removal of the outer indigestible tunic, composed of woody cellulose, by which the seed is enclosed. That portion of the seed, however, which is richest in gluten lies directly beneath the outer coat of cellulose; it is therefore practically impossible to completely remove this outer coat without at the same time removing a portion of the highly nutritious gluten-containing layers.

The following table (extracted from one by Bauer) exhibits the relative average composition of the more important cereal grains :—

	Nitrogenous Substances.	Fat.	Starch, Sugar, Gum, etc.	Cellulose.	Ash.	Water.
Wheat .	12·42	1·70	67·89	2·66	1·79	13·56
Rye .	11·43	1·71	67·83	2·01	1·77	15·26
Barley .	11·16	2·12	65·51	4·80	2·63	13·78
Oats .	11·73	6·04	55·43	10·83	3·05	12·72
Maize .	10·05	4·76	66·78	2·84	1·69	13·88
Rice .	7·81	0·69	76·40	0·78	1·09	13·23

Oats, it will be seen, are especially rich in fatty and mineral substances, and also in indigestible cellulose. Maize also is relatively rich in fat, but slightly deficient in salts. Barley contains more fat, more indigestible cellulose, and more salts than wheat, but less nitrogenous substances and less digestible carbo-hydrates. Rice is seen to be rich in starch, but defective in nitrogenous and, indeed, in all the other solid constituents.

The next table gives the composition of different kinds of *flour*, and shows also the difference in composition between the finely and the coarsely ground flours :—

	Nitrogenous Substances	Fat.	Starch, Sugar, Gum, etc.	Cellulose.	Ash.	Water.
Wheat, finely ground .	8·91	1·11	74·28	0·33	0·51	14·86
,, coarsely ,, .	11·27	1·22	73·65	0·84	0·84	12·18
Rye, finely ,, .	10·21	1·64	73·54	0·64	0·98	13·99
,, coarsely ,, .	11·06	2·09	67·78	2·61	1·69	14·77
Barley Meal . .	10·89	1·23	71·85	0·47	0·63	14·83
Pearl Barley . .	7·25	1·15	76·19	1·36	1·23	12·82
Oat Meal . . .	14·29	5·65	65·73	2·24	2·02	10·07
Maize Meal . . .	14·0	3·80	70·68		0·86	10·60
Rice (ground) . .	7·43	0·89	77·62			14·15

The ash consists of potash, soda, lime, magnesia, and iron-oxide in varying proportions, combined with chlorine, phosphoric, sulphuric, and silicic acids, the phosphates being greatly in excess.

We shall now consider the special properties of the various kinds of cereal grains commonly used as food.

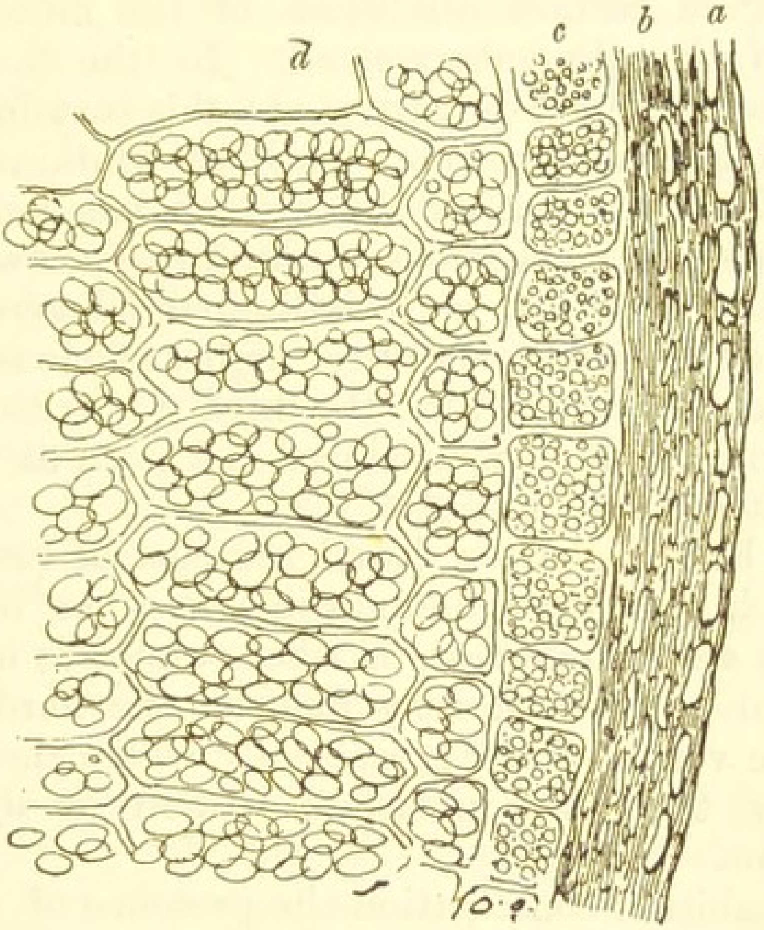
Wheat.—Wheat is the most largely consumed and extensively cultivated of all the cereal grains. It is rich in solids, and contains but little water; it therefore presents much nutriment in small bulk. The whole of the grain is digestible after its two outer coats have been removed. It yields a finer flour than other grains, and makes a *white* bread. The proportion of nitrogenous substances contained in it is large; as much as 14 to 15 per cent. in the hard wheats of Italy and Sicily. These consist of soluble albumen and gluten. Gluten really consists of four nitrogenous substances, which have been named gluten-casein, gliadin, gluten-fibrin, and mucedin. A nitrogenous substance, termed *cerealin*, regarded by some as merely a form of diastase, is also found in the inner envelope; it is capable of transforming starch into dextrin, sugar, and lactic acid. Wheat contains an abundance of starchy substances, from 60 to 90 per cent., consisting chiefly of starch, dextrin, and sugar. A small amount of cholesterin is found in wheat. It is rich in phosphates, especially in potassium and magnesium phosphate.

Its chief defects as a food are the small amount of fat (1·7 per cent.) it contains, and the absence of those salts of the vegetable acids which are converted in the system into carbonates.

The grain of wheat, free from the husk, is usually ground into flour before it is employed for food. The outer yellowish coat of the grain is known, when separated, as *bran*, and the inner white part as *flour*.

The usual yield is about 80 per cent. of flour, 16 of bran, and 4 of loss.

The flour is divided into different qualities, according to its fineness, the third or coarsest quality being known as *pollards* or *bran-flour.*



STRUCTURE OF GRAIN OF WHEAT (× 200).
a, Cells of the bran; *b*, cells of thin cuticle; *c*, gluten cells; *d*, starch cells.

The *hard* wheats yield a flour richer in gluten than the soft ones, and therefore more nutritious.

The gluten cells are especially accumulated in the inner portion of the cortical layer, which is richest also in fat and salts, and this part of the grain has, on that account, a high nutritive value.

The accompanying figure* illustrates these points in the structure of the wheat grain.

* From Landois' "Text-book of Human Physiology," 3rd edit., p. 351.

The use of "whole meal," containing all the constituents of the grain, has been advocated on account of the richness in nutritive constituents of the outer coats; but the bran-cells, it must be remembered, are exceedingly hard and indigestible, and may prove irritating in certain conditions of the mucous membrane of the alimentary canal. In the finest flour almost all the bran is separated; this certainly seems wasteful and undesirable, as bran contains 15 per cent. of nitrogenous substances, 3·5 per cent. of fat, and 5·7 of salts. Methods of grinding are now adopted so that the outer and more indigestible layers of bran —"the two or three outer and highly silicious layers" —can be separated from the highly nutritious inner tunic, and the flour so produced is known as "*decorticated* whole-wheat meal."

We have, however, found samples of bread made from such meal prove indigestible in some instances; and it is very important, if whole-wheat is used, that it should be ground *very fine*, as the harder outer coats are very irritating, especially where there is any tendency to gastro-intestinal catarrh or dysenteric conditions.

In habitual constipation the presence of the indigestible bran in the flour used for making bread often acts usefully as an intestinal stimulant.

The central white part of the grain is particularly rich in starch.

The various ways in which wheat-flour may be cooked into *bread* and other articles of diet will be described in the chapter on the "Cooking of Food."

A *granular* preparation of wheat is also made by a special manner of grinding, and known as "semolina" (Fr., *sémoule*). It is made from the inside of the grain of hard wheats, which are rich in gluten. It is used for making into puddings and adding to soups, etc. The *couscousou* of Algeria is also a granular preparation of wheat. *Macaroni*, *vermicelli*, and *pâte d'Italie* are made from hard Italian wheats rich in gluten.

Barley.—The meal of barley is very nutritious, and is largely used in fattening animals. The Greeks and Romans trained their athletes on barley (*hordearii*). It is rich in nitrogenous substances, which consist of gluten-casein, gluten-fibrin, mucedin, and albumen. It is especially rich in iron and phosphoric acid. It is not so well suited for making bread as wheat flour; the bread is heavier, less digestible, and is said to be rather laxative.

Scotch or *pot* barley consists of the grain without the husks. *Pearl* barley is merely the grain deprived of husk, and rounded and polished.

Barley bread is usually made of a mixture of wheat-flour with barley-meal.

Pearl barley is much used for making barley-water, a slightly nutritious beverage much used in sickness. Barley is largely used in the preparation of *malt*.

Oats.—Oatmeal is a highly nutritious food. As will be seen by reference to the preceding tables, both the grain and the meal are rich in nitrogenous substances and also in fat.

Oatmeal, according to Bauer's table, contains 14·29 per cent. of nitrogenous substances, and 5·65 per cent. of fats. It is therefore the richest of all the cereal meals in both these alimentary principles. Gluten-casein, or *avenin*, forms a considerable part of the nitrogenous constituents. This is closely related to the *legumin* of peas and beans. Dujardin-Beaumetz, who, in conjunction with M. Hardy, made an examination into the value of oatmeal as a food for growing children, has published the following analysis, which differs somewhat from that of Bauer, and gives a still larger percentage of fat:—

Water	8·7
Fats	7·5
Starch	64·0
Nitrogenous Substances	11·7
Salts	1·5
Cellulose, and other Substances	6·6

He attributes the fine muscular development of the Scottish Highlanders to their large consumption of oatmeal in childhood. The high nutritive value of oats, as a food for animals that are called upon to give out great muscular activity, is well known.

Sanson has separated a stimulating principle from oats, which he found especially abundant in black oats, and which he considers exerts an exciting influence on horses, lasting for about an hour after a feed of oats.

Oats contain a large proportion of indigestible cellulose; and owing to the absence of adhesive quality (such as is possessed by the gluten of wheat) in its nitrogenous constituents, it cannot be made into bread. It can, however, be made into "cakes," and as it is much more easily cooked than wheat or barley, it is for that reason found most valuable for making "porridge" and "gruel," the latter being a highly nutritious and agreeable beverage much valued by invalids.

It has been recommended as a food particularly suitable to soldiers during war, "because it contains much nutriment in small bulk; because it can be eaten for long periods with relish, and keeps unchanged for a long time." *

Groats is the grain freed from its integument, and, when crushed, forms "Embden groats," used for making gruel.

Oatmeal porridge is found to act as a slight laxative with some persons, and in some others it causes

* Parkes's "Hygiène," 6th edit., by Du Chaumont.

dyspeptic symptoms, which disappear on discontinuing its use.

Rye.—Rye is much consumed on the Continent, especially in parts of Russia and Germany. The grain, which has a close resemblance, in outward aspect, to wheat, is white internally, but brown on the outside, so that rye-meal makes a "black" bread. It is equal to wheat in nutritive value, but contains less vegetable fibrin and more casein and albumen. It also contains a peculiar odorous substance, and makes a sour-tasting, dark bread, which often disagrees with persons unaccustomed to its use and causes diarrhœa.

Rye is, of all the cereals, the grain most liable to be affected by "ergotism" due to the attack of a parasitic fungus. *Ergotised* or *spurred rye* causes, when taken as food, poisonous symptoms, the most serious of which are convulsions and gangrene.

Maize.—Maize is highly nutritious, and most analyses agree in attributing to it the largest proportion of fat of all the cereals; but, as will have been noticed, Bauer, in the tables given above, ascribes to oats a still larger proportion of fatty constituents.*

Maize (Indian corn) is now extensively cultivated in Europe, and its flour is largely substituted for that of wheat. It has, however, a peculiar flavour not approved of by many. In the green and succulent state the grains are cooked in North America as a fresh vegetable, like green peas.

Hominy is a preparation of maize. Owing to its deficiency in gluten, maize-meal is ill adapted for making bread unless mixed with some wheaten or rye flour; but it is often made into cakes, like oatmeal, which are palatable and nutritious, such as the

* The older tables of Letheby, quoted by Pavy, give to maize-meal 8·1 per cent. of fatty matter, and to oatmeal 5·6; and those of Payen 8·8, as compared with 5·5.

"hoe-cake" of the United States. *Polenta*, so largely consumed by the poorer classes in Italy, is composed of maize-meal. *Maizena*, or *corn-flour*, is prepared from the meal of maize by treating it with a weak solution of caustic soda, which removes its peculiar unpleasant flavour, but at the same time deprives it of some of its nutritive qualities.

On account of the large amount of fat contained in maize it is apt, if kept long, to acquire an unpleasant rancid taste. Maize is used largely for feeding and fattening animals, for which purpose it is especially suitable, because of its richness both in fat and nitrogenous substances.

Rice.—Rice, largely cultivated in the East, and forming the staple food of many Oriental peoples, is a grain of much less nutrient value than the preceding. It is comparatively poor in nitrogenous substances, the amount, however, varying considerably in different specimens, from 3 to 7·5 per cent. It is also very poor in fat and in salts; its chief constituent is starch, which exists in rice in a very digestible form. In the prepared state it also contains very little of the indigestible *cellulose*, a circumstance which adds to its value as a food. It has some analogy in composition with the potato.

Rice as ordinarily met with has had the husk removed, and been "whitened," *i.e.* the inner cuticle or red skin has been removed by passing it through a machine for the purpose.

Rice is too poor in nitrogenous, fatty, and mineral substances to be a suitable food by itself; it would have to be taken in too large quantities, and much of the starch it contains would therefore be wasted. But it is a very valuable food when mixed in proper proportions with other alimentary substances richer in fat and albuminates.

The ready digestibility of its starch granules renders it a very suitable food for persons with an irritable intestinal mucous membrane.

It cannot, by itself, be made into bread, but it is often mixed with wheat flour to make a very white bread, and it is frequently made into cakes with the help of adhesive substances.

It should not be boiled, but thoroughly *steamed* when cooked by itself, as boiling removes some of the small amount of nitrogenous and saline matters it contains, and so further lessens its food value.

The following table taken from the sixth edition of Parkes's "Hygiène," gives the comparative richness of the preceding *grains* in the various alimentary principles :—

Nitrogenous Substances.	Fat.	Starch, etc.	Salts.
Wheat.	{ Maize.	Rice.	Barley.
Barley.	{ Oats.	Maize.	Oats.
Rye.	Barley.	Wheat.	Wheat.
Oats.	Rye.	Rye.	Rye.
Maize.	Wheat.	Oats.	Maize.
Rice.	Rice.	Barley.	Rice.

Millet, sorghum or durrha, buckwheat.— A few other grains of subordinate value, such as those just-named, are employed as food in different countries.

Millet (*Panicum miliaceum* and other genera of grasses) belongs to the Cerealia ; it is largely consumed on the West Coast of Africa, in Algeria, in some parts of China, India, and the South of Europe.

The composition of millet is thus given by König (excluding *cellulose*) : Water, 12·3 ; albuminates, 11·3 ; fats, 3·6 ; carbo-hydrates, 67·3 ; salts, 2·3. The ash contains much silica and phosphates. As might be inferred from its composition it makes a good nutritious bread.

Durrha or *sorghum* belongs to a different tribe of grasses to the foregoing (*Sorghum vulgare*), but has much the same properties. It is ground and made into bread in India, China, and other countries.

Buckwheat (*Fagopyrum esculentum*) is not a cereal, but belongs to the natural order of *Polygonaceæ*. It has been introduced into Europe from Central Asia, and is known in France as *sarazain* or *blé noir*. The composition of buckwheat-meal, as given by Bauer, is as follows:—Water, 14·27; nitrogenous substances, 9·28; fat, 1·89; starch, cellulose, etc., 70·68; ash, 0·86. It makes a fairly nutritious and palatable bread, largely consumed in Brittany. Cakes made of buckwheat are also popular in Holland and the United States. In England it is largely grown for feeding pheasants and other game.

The **Leguminosæ** or pulses.—The ripe seeds of many of the leguminosa, such as beans, peas, and lentils, surpass all other farinaceous seeds in the large amount of nitrogenous substances they contain. This occurs chiefly in the form of vegetable casein or *legumin,* but they also contain, in addition, a little albumen and other proteids, together with much starch. By their richness in albuminates they greatly excel the cereals in actual nutritive constituents. Lentils, for example, contain about double the amount of nitrogenous substances that ordinary wheat does. These leguminous seeds are therefore the best suited by their composition to replace animal food.

Peas and beans contain much sulphur and phosphorus in combination with legumin; they are richer also than the cereal grains in potash and lime, but poorer in phosphoric acid and magnesia.

Owing to the large proportion of albuminates they contain they form a valuable addition to other food stuffs containing much starch or fatty matter; and in combination with rice they form the staple food of many Indian races. Eaten also with animal fat (bacon and beans) they constitute a highly nourishing food. They are especially useful when much exercise is taken; and both men and animals can subsist upon them alone for long periods.

Their defects as compared with the cereals are their relative indigestibility, their unsuitability to bread-making, and their less agreeable taste. "About 6·5 per cent. of the ingested pea passes out unchanged, and starch cells giving a blue reaction with iodine are found in the fæces; much flatus is also produced by the hydrogen sulphide formed from the legumin." (*Parkes.*)

The following table shows the mean composition of the pulses as compared with that of wheat (*Bauer*):—

	Water.	Nitrogenous Substances.	Fat.	Starch, etc.	Cellulose.	Ash.
Wheat .	13·56	12·42	1·70	67·89	2·66	1·79
Beans .	13·60	23·12	2·28	53·63	3·84	3·53
Peas .	14·31	22·63	1·72	53·24	5·45	2·65
Lentils .	12 51	24·81	1·85	54·78	3·58	2·47

Landois' estimate differs somewhat from the preceding.* "Peas," he says, "contain 18·02 proteids and 34·81 starch; beans 28·54 and 37·50; lentils 29·31 and 40;" and he adds, "on account of the large amount of proteids they contain, they are admirably adapted as food for the poorer classes."

Beans.—There are several varieties of beans used as food: there is the common horse bean, grown in the fields, and the Windsor or broad bean grown in gardens; the latter contains more starch, less cellulose, and rather more fat than the former. Then there is

* "Physiology," 3rd edition, p. 351.

the common haricot or French bean and the scarlet runner, both used, when fresh, as green vegetables, the seeds and pods being cooked together. The dried seeds of the former, known as *haricots blancs*, are largely consumed on the Continent as a table vegetable, and afford a very nutritious and palatable food. They contain, according to Payen, 25·5 per cent. of nitrogenous substances, 55·7 starch, etc., 2·9 cellulose, 2·8 fat, 3·2 ash, and 9·9 water.

Peas.—Of peas there are also several varieties: the common field pea is grown as food for cattle, and the garden pea (*Pisum sativum*) is eaten both as a fresh and dry vegetable. Dried peas contain rather less nitrogenous and fatty matter than beans, and rather more cellulose.

Lentils.—Lentils have of late years become a popular food in Britain, and are now largely imported from Egypt. This is the most nutritious of all the pulses, and contains the largest proportion of nitrogenous substances. It has the further advantage of being remarkably rich in iron—its ash containing as much as 2 per cent. of the oxide—and also in phosphate of lime; and it has a further advantage, especially over peas, in the absence of sulphur, and there is therefore not the same objectionable tendency to the liberation of hydrogen sulphide in the alimentary canal. It makes an excellent soup, and it will, no doubt, take the place, more and more, of pea-meal for this purpose.

Revalenta-arabica, revalesciere, ervalenta, are the names of a highly nutritious food which has long been sold as especially suited to invalids. It appears to be largely composed of lentil flour mixed with pea-, bean-, and maize-meal, to which oat- and barley-meal are occasionally added. It probably is also exposed to the heat of an oven, and so made more digestible.

Professor Beneke has suggested, as an excellent food for invalids, fine lentil flour combined with a certain proportion of rye flour, so as to increase the relative amount of starch.

It is necessary to bear in mind that the dry leguminous seeds require careful and thorough cooking. It is best to soak them for some time in cold rain water, and then boil them slowly in water free from chalk, as lime salts form insoluble compounds with legumin.

Roots and tubers.—The various roots and tubers employed as food are valuable chiefly on account of the amount of starch they contain; they are vastly inferior in nutritive value to the cereals and pulses, as they contain a relatively large amount of water and a comparatively small proportion of albuminates. Many contain a considerable quantity of sugar as well as starch, and also some *pectin* or vegetable jelly. Some contain vegetable acids, chiefly combined with potash, and these salts give them their well-known and important anti-scorbutic properties.

The **potato.**—This tuber, or swollen underground stem of the *Solanum tuberosum*, is the most important of these foods. It is a very productive vegetable, and therefore well repays cultivation, and when cooked forms a palatable and easily digested food. It is not, however, fit to be made the exclusive food of a people, as was the case some years ago in Ireland, when it was calculated that the potato formed from three-fourths to four-fifths of the entire food of the Irish people, and that an adult Irishman consumed 10½ lb. of potatoes daily, or 3½ lb. to each meal.

Since the outbreak of the potato disease, and the famine in Ireland which followed as a consequence, Indian corn has been largely cultivated in its place.

The average percentage composition of the potato

(König) is: Water, 75·77; nitrogenous substances, 1·79; fat, 0·16; starch, 20·56; cellulose, 0·75; ash, 0·97; asparagin and amidic acid are found amongst the nitrogenous constituents. The juice of the potato is acid, and contains vegetable acids combined with potash, soda, and lime; these give it its anti-scorbutic properties. The ash yields phosphoric and sulphuric acids, chlorine, silica, together with potash, soda, lime, magnesia, and oxide of iron.

It will thus be seen that the potato is chiefly remarkable for the large percentage of *starch* it contains, while it is poor in nitrogenous constituents, and contains scarcely any fat. Starch is largely extracted from potatoes for commercial purposes.

It has already been said that owing to its poorness in albuminates the potato is unfit to form an exclusive food, but it is a most valuable adjunct to other foods richer in nitrogenous substances, such as meat and fish; while, taken with butter-milk, which contains a large quantity of the nitrogenous substance casein, it composes a good, sufficient, and cheap food.

The starch of the potato has the advantage of being very digestible; its granules are contained in the cells of the cellular tissue of the tuber, surrounded by the acid albuminous juices. In cooking the albuminous juices are coagulated, the starch granules absorb the watery part of the juices, swell up, and break down the containing cells, so that the potato assumes a loose "mealy" or "floury" appearance. If this change does not take place the potato is close, waxy, and watery.

To avoid the loss of salts potatoes are best cooked in their skins, and steaming is the best method of cooking them, as they then lose none of their salts.

Although the potato is easily digested when "mealy" or "floury," it is not so when close and watery and should not then be eaten by persons with feeble digestions. The value of the potato as a preventive of scurvy has been referred to; and it is therefore a useful vegetable to be taken on long sea voyages.

The quality and flavour of potatoes vary greatly with soil and season; those are best that are grown on sandy or readily permeable soils. They are injured by long *keeping*, by *frost*, etc.

The **sweet potato,** from the *Batatas edulis*, has a tuber rich in starch (16 per cent.) and sugar (10 per cent.), and used to be eaten, like the ordinary potato, in Europe before the introduction of the latter. It becomes mealy when boiled, and is a wholesome and useful food, but too sweet to eat with meat as a vegetable. It is largely eaten by the poorer classes in some parts of America, and also in the south of France and Spain.

The **yam,** the large tuber of the *Dioscorea batatas* and other species, is a good substitute for the potato, as it cooks "mealy," and forms a wholesome and agreeable food. It contains a large amount of starch, and has not the objection of being sweet like the sweet potato. It is largely consumed in some tropical countries, and is also cultivated in parts of Europe.

The **Jerusalem artichoke** is a well-known edible tuber, grown in most vegetable gardens in England. It has a sweet taste and remains watery after cooking, and does not become mealy like the potato; this is owing to its not containing starch. It is less digestible than the potato, and contains but very little nutritive substances, and is, therefore, practically of little importance as a food. It contains 14 per cent. of sugar, about 3 per cent. of nitrogenous substances, and about 2 per cent. of inulin, a principle isomeric with starch.

Arrowroot, derived from the tuber of the *Maranta arundinacea*, is a pure form of starch, highly valued as an easily-digested carbo-hydrate. It is cultivated in the West Indies and other tropical countries. That imported from Bermuda is considered the best. Its "quality is judged of by its whiteness, by the grains being aggregated into little lumps, and by the jelly being readily made, and being firm, colourless, transparent, and good-tasted. The jelly remains firm for three or four days without turning thin or sour; whereas potato-flour jelly in twelve hours becomes thin and acescent. Under the microscope the starch-grains are easily identified," * and any adulteration with sago, tapioca, or potato-starch can thus be detected.

Arrowroot is simply a pure starchy food, and is valuable as a bland unirritating carbo-hydrate for invalids. It is usefully mixed with clear meat soups and extracts.

Tous les mois is another pure form of starch, derived from the tuberous *root* of the *Canna edulis*, grown in the West Indies. It is of the same value and use as arrowroot. Its starch granules have beautifully marked and distinct concentric lines, and exceed those of all other starches in size.

Tapioca, also a pure starch, is obtained from the tuberous roots of the *Manihot utilissima*, cultivated in Africa, India, and other hot countries. Its starch grains are small, with a central hilum, and three or more often adhere together into compound grains.

It is an agreeable and easily-digested carbo-hydrate, beneficial both for invalids and the healthy. It is usefully added to meat soups and broths, or made into puddings with milk.

Sago is another starch, obtained from the pith of the stems of several species of palm. It is usually met with in the "granulated" form or "pearl sago," small spherical grains prepared by mixing sago-flour

* Parkes.

with water into a paste, and then granulating. It is used like tapioca for making light puddings and for adding to soups, and is a useful and easily-digested food for invalids and dyspeptics.

Salep, consisting chiefly of starch and mucilaginous matter, is derived from the tubercles of several species of orchids, and is imported into England from the East. It possesses nutritive and soothing properties.

The following "roots" are of a more *succulent* nature, and are commonly used as *fresh* vegetables.

The **carrot** is the root of the wild *Daucus carota* improved by cultivation. When young it forms a useful and wholesome food, and is at Vichy regularly served at breakfast to the invalids who are taking the waters there. It contains a large proportion of water, 85 to 88 per cent., and about 8 per cent. of carbo-hydrates, including a variable quantity of sugar, 1 per cent. of salts, and rather more than 1 per cent. of albuminates.

The **parsnip** is much less frequently eaten than the carrot, which it closely resembles in food properties and composition, containing like it a considerable amount of sugar. A wine is sometimes made from parsnips.

The **turnip** is one of the cabbage tribe. It is a very popular vegetable, and the roots are largely cultivated as food for cattle. Its nutritive value is small, on account of the large proportion of water, 91 per cent., it contains. It contains about 6 per cent. of carbo-hydrates (starch, sugar, etc.), and about 1 per cent. of nitrogenous substances. It would probably be more popular as a vegetable on account of its agreeable flavour were it not for its tendency to cause flatulence.

Beetroot is a most valuable vegetable. It is extensively cultivated as food for cattle, and for the extraction of sugar. It is largely employed in salads, alone or with other vegetables, and unless tough and stringy is not indigestible. It contains about 87 per cent. of water, 9 of carbo-hydrates, 1½ of nitrogenous substances, and 1 of salts.

The **radish** resembles the *turnip* somewhat in composition and flavour; it is, however, more pungent, and is eaten rather for its agreeable flavour and its anti-scorbutic properties than as a food.

Salsify is rarely eaten in England. It resembles the parsnip somewhat in taste, and is a wholesome vegetable.

Green vegetables.—The various green, fresh, and succulent vegetables that are commonly regarded as suitable articles of food, such as the several members of the cabbage tribe, spinach, lettuce, asparagus, and others which will be presently enumerated, are valuable not so much on account of the nutritious principles they contain, which are in small amount, but because of the important inorganic salts they supply, especially the salts of potash, and because of the agreeable flavour possessed by many, and the wholesome variety and relish they give to our food. Their anti-scorbutic properties are highly important. They contain a very large amount of water, often as much or more than 90 per cent. The amount of nitrogenous substances they contain is small, varying from about 1½ to 4 per cent.

They contain a variety of non-nitrogenous substances, including cellulose, chlorophyll (the green colouring matter), small quantities of sugar, gum, pectin, fat, and vegetable acids. Many also contain essential oils or other flavouring matters, which impart to them agreeable tastes and odours, and make them useful as condiments.

When they are old and stringy or woody, their cellulose offers great resistance to digestion, and they are quite unsuited to persons of feeble digestive powers. On the other hand, the indigestible residue left by all green vegetables affords a useful and wholesome stimulus to intestinal contraction, and promotes regular action of the bowels.

By well-known arts of cultivation, the succulency and digestibility of many of these vegetables are greatly increased, especially by partial exclusion of light, and their value as articles of diet thereby greatly enhanced.

The cruciferous, or *cabbage*, tribe, is remarkable for the number of edible plants it contains. The natural order of the Cruciferæ is said not to possess a single poisonous plant, a botanical fact of great importance to those who happen to be in search of edible vegetables in a strange or unknown country. *Cabbages* (white and red), *greens*, *savoys*, *Brussels sprouts*, *cauliflower*, and *broccoli* are familiar examples. These contain a large proportion of sulphur, and therefore give rise during decomposition to a very disagreeable odour, and tend to occasion flatulence.

Sauer-kraut is a preparation of cabbage leaves, which are subject to pressure between layers of salt and allowed to undergo acid fermentation.

Cauliflower and **broccoli** consist of the *inflorescence* of the plant altered by cultivation. It is one of the most delicate and digestible of the cabbage tribe.

Seakale, which is grown excluded from light, and thereby *blanched*, is also delicate, nutritious, and easy of digestion.

Spinach is a wholesome and popular vegetable, and when properly cooked—*i.e.* made into a *purée*—is free from irritating properties. As it is, however, almost wholly indigestible, it acts as a useful aperient, and is for that reason prescribed as a remedy for habitual constipation. Hence also its reputation for "clearing the complexion." There exists a very old French proverb to this effect :—

> "Par l'espinard et le porreau,
> Florit le lys clair de la peau."

Sorrel is used largely in France, much in the same way as spinach is used in Great Britain. It is peculiar in having an acid taste, due to the presence of acid oxalates, and on that account it is considered as prejudicial to those who have any tendency to gout or gravel.

Celery is esteemed for its agreeable aromatic flavour, and is eaten both raw and cooked ; in the latter form it is wholesome and digestible. It is by some regarded as aphrodisiac as well as carminative.

It also has a popular reputation as being a cure for rheumatism if cooked and eaten freely. "The celery should be cut into bits, and boiled in water until soft and the water should be drunk by the patient. Put new milk, with a little flour and nutmeg, into a saucepan, with the boiled celery, serve it warm with pieces of toast, eat it with potatoes, and the painful ailment will yield. The proper way to eat celery is to have it cooked as a vegetable after the manner above described." *

The **green artichoke,** a species of cultivated thistle, is of little importance as an article of food, it is considered rather as an agreeable delicacy, easy of digestion. It is said to contain some tannin as well as mucilaginous substances.

Asparagus.—This, one of the *Liliaceæ,* is a popular and delicate vegetable. It contains a peculiar crystalline principle *asparagin,* which possesses diuretic properties, and imparts a peculiar disagreeable odour

* *Garden Advertiser.*

to the urine. It has been reputed to act as a cardiac sedative, and to quiet palpitations; it has also been credited with aphrodisiac properties.

Lettuce, endive, watercress, mustard and cress, are salad vegetables, and are generally eaten raw. They are cooling, anti-scorbutic, and wholesome, and easy of digestion when the digestive organs are sound.

The **onion** is valuable both as a condiment and a vegetable. In the young green state it is added to salads to give them pungency, and the mature bulb is also extensively used for flavouring purposes. The larger species grown in hotter countries, as in Spain and Portugal, are of much milder flavour, and are eaten as an ordinary vegetable; they are wholesome and slightly laxative.

The **vegetable marrow,** although of delicate flavour and digestion, has very little nutritive value on account of the very large proportion of water it contains.

The **tomato,** largely used in salads and for the preparation of soups and sauces, is refreshing and appetising, and is valuable chiefly for its pleasant acid flavour. It is forbidden by many physicians to all those who have a tendency to gout or gravel, on account of its containing oxalic acid.

The **cucumber** is used chiefly as a salad, and young cucumbers (gherkins) are pickled in vinegar. They have an agreeable refreshing flavour, but the cucumber eaten raw is liable to cause gastric disturbance in persons of feeble digestion.

The following tables (after König) give 1st, the average composition of the chief succulent roots and green vegetables; also that of the *French bean* when eaten as a fresh vegetable, the pods and seeds together: and 2nd, the constituents of the ash of certain of these:—

	Carrots.	Turnips	Beet-root.	Celery.	Onions.	Cab-bage.	Cauli-flower.	Brus-sels Sprouts.	Spinach	Let-tuce.	Aspar-agus.	French Beans.
Water	88·32	91·24	87·07	84·09	85·99	89·97	90·39	85·63	90·26	94·33	93·32	88·36
Nitrogenous Matters	1·04	0·96	1·37	1·48	1·68	1·89	2·53	4·83	3·15	1·41	1·98	2·77
Fat	0·21	0·16	0·03	0·39	0·10	0·20	0·38	0·46	0·54	0·31	0·28	0·14
Sugar	1·90	4·08	0·54	0·77	2·78	2·29	1·27	—	0·08	—	0·40	1·20
Other non-Nitrogenous Extractives	7·17	1·90	9·02	11·03	8·04	2·58	3·74	6·22	3·26	2·19	2·34	6·82
Cellulose	0·95	0·91	1·05	1·40	0·71	1·84	0·87	1·57	0·77	0·73	1·14	1·14
Ash	0·71	0·75	0·92	0·84	0·70	1·23	0·82	1·29	1·94	1·03	0·54	0·57

CONSTITUENTS OF THE ASH OF

	Carrot.	Turnip.	Celery.	Onion.	Asparagus.	Cabbage.	Spinach.	Lettuce.
Potash	35·21	45·40	43·19	25·05	31·03	37·82	16·56	37·63
Soda	22·07	9·84	—	3·18	11·59	14·42	35·29	7·54
Lime	11·42	10·60	13·11	21·97	10·48	9·36	11·87	14·68
Magnesia	4·73	3·69	5·82	5·29	4·90	3·52	6·38	6·19
Iron Oxide	1·03	0·81	1·41	4·53	2·99	0·15	3·35	5·31
Phosphoric Acid	12·16	12·71	12·83	15·03	20·12	12·30	10·25	9·19
Sulphuric Acid	6·72	11·19	5·58	5·46	6·36	15·46	6·87	3·76
Silica	2·47	1·87	3·85	16·72	6·60	—	4·52	8·14
Chlorine	5·19	5·07	15·87	2·77	—	6·97	6·29	7·65

Edible fungi.—Many species of fungi are suitable for food, but in England three only are commonly eaten—namely, the **mushroom,** the **truffle,** and the **morelle.**

Their chemical composition indicates a richness in nutritive, and especially in nitrogenous, substances, which should render them of considerable value as foods were they easy of digestion, but it seems doubtful if they are utilised in the alimentary canal. Some of them contain mannite and grape sugar amongst their non-nitrogenous constituents.

Mushrooms are largely consumed in England, but chiefly on account of their agreeable flavour; and they are eaten either alone or cooked with other kinds of food. They have the property of causing toxic symptoms, in certain persons, in the form of severe gastro-intestinal disturbance.

The *morelle* is usually imported from the Continent, and is employed chiefly for flavouring other dishes.

The *truffle* is esteemed a great delicacy, and is much employed in cooking, for its exquisite flavour. The black variety is the most highly valued, and those obtained from the oak-forests of Périgord in France are considered of the choicest flavour. They must be regarded as very indigestible vegetables.

The following is the chemical composition of the mushroom, truffle, and morelle as given by König. The ash is particularly rich in potash and phosphoric acid:—

	Mushroom.	Truffle.	Morelle.
Water	91·11	72·8	90·0
Nitrogenous Substances	2·57	8·91	3·48
Fat	0·13	0·62	0·24
Grape Sugar and 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

Bauer mentions that **Iceland moss** is used as a food in the Arctic regions, and that after removal of its bitter constituents by repeated washings, a pleasant-tasting bread is made of it, which has been recommended by Senator as a substitute for ordinary bread in diabetes.

Fruits.—A great variety of fruits, both in the fresh and dried state, are consumed as articles of food or as flavouring agents and luxuries.

The following are the principal varieties made use of in Great Britain, some being of native growth and others imported.

1. The apple, pear and quince.
2. The orange, lemon, lime, and shaddock.
3. The plum, peach, apricot, cherry, olive, date (stone fruits).
4. The grape, gooseberry, currant, cranberry, barberry.
5. The strawberry, raspberry, blackberry, mulberry.
6. Melon, pine-apple, fig, banana.

The following table gives the average composition of some of the most important of these (after Bauer) :—

	Apple.	Pear.	Peach.	Grape.	Strawberry.	Currants.	Oranges Pulp only.
Water .	83·58	83·03	80·03	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

The following gives the composition of certain dried fruits :—

	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	31·22	54·26	49·79
Other Non-nitrogenous Matters	17·0	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

The analysis of the ash shows these fruits generally to be particularly rich in potash salts. The apple and the strawberry are rich also in soda salts, especially the strawberry. They also contain salts of lime, magnesia, and iron.

It will be seen from the above tables that these fruits possess but a low nutritive value, as they contain a very large proportion of water, and of their solids only a very small proportion consists of nitrogenous matters. Their chief food value is in the sugar which they contain. This, in some, is considerable. They also contain important salts of vegetable acids (malates, citrates, tartrates) as well as some free acid.

They therefore possess valuable *anti-scorbutic* properties. As their salts are chiefly combinations of vegetable acids with alkalies, and as these become converted into carbonates in the system, they impart alkalinity to the urine, and they are, on that account, valuable in gouty states with a tendency to the deposition of acid urates.

Many contain small quantities of fat, and waxy and colouring matters. Their agreeable aroma is due to the presence of essential oils and compound ethers. They all contain varying amounts of indigestible cellulose and *pectin* or vegetable jelly. Malic acid is found in apples, pears, peaches, apricots, gooseberries, and currants: tartaric acid in grapes; and citric acid in lemons, oranges, etc.

When taken in moderate quantity these fruits are useful additions to the dietary: they are cooling and refreshing, of agreeable flavour, and tend to promote intestinal action, and to correct tendencies to constipation. Taken in excess, or when immature, or overripe, they are apt to set up gastro-intestinal irritation, often of a severe form.

Most of these fruits are so well known that any detailed descriptions of them would be redundant.

The **apple** when cooked, and of good quality, is easy of digestion, cooling, and slightly laxative. The best quality of pears, when ripe, are better suited for being eaten *raw* than apples, as their flesh is soft and "melts in the mouth."

Oranges are especially valuable for invalids; when ripe and well selected they are pleasant and refreshing, and very grateful for allaying thirst in feverish conditions.

The **lemon** and its congeners the lime and shaddock are important as yielding a useful anti-scorbutic juice, and for giving an agreeable pungency and flavour to insipid and tasteless foods.

Plums should be avoided in the unripe and overripe states, and they are more apt than other fruits to prove indigestible and irritating, and to cause diarrhœa. Dried plums (prunes) are often judiciously added to the daily dietary to remedy habitual constipation.

Peaches and nectarines are particularly delicate-flavoured and refreshing. Owing to the small quantity of sugar they contain, and their soft and delicate flesh (when ripe) they are well suited to the gouty and diabetic.

Currants, gooseberries, bilberries, and raspberries are remarkable for the amount of *free* acid they contain, which makes them very refreshing, and their juices form an agreeable addition to effervescing water. The **mulberry** is also very refreshing, and has slightly laxative properties.

The **strawberry** is one of the most popular of fruits, and is very wholesome when taken in moderation. It is considered to be a useful food for the gouty on account of its richness in alkaline salts (potash, soda, and lime) and its cooling, diuretic, and laxative qualities. French authors maintain that its flavour is enhanced by the addition of some acid juice, such as orange or lemon juice, or a few drops of good vinegar.

The **grape** is a very important fruit, on account of its richness in sugar, both in the fresh and dried (raisins) form. It is very digestible when fully ripe, and most acceptable to invalids. Its properties will be fully discussed in connection with the grape cure.

The **melon** is perhaps the most watery of all the fruits, containing, as it does, more than 95 per cent. of water; notwithstanding this it is apt to prove very indigestible, and to give rise to gastric disturbance.

Figs both in the green and dried state contain much sugar, and also a rather large proportion of nitrogenous matters, so that they are more nutritious than most fruits; in large quantities they are apt to prove aperient.

The **date** is also a highly nutritious fruit, and forms an important food for the Arabs.

The **banana and plantain** are also nutritious fruits, as they contain much sugar and a certain proportion of nitrogenous matters.

Saccharine Substances.

Grape sugar is largely present in all sweet fruits, and all starchy foods in the processes of digestion become converted into grape sugar or into maltose before assimilation. A form of sugar, lactose, is also present in considerable quantity in that typical food —milk. But the importance of sugar as an alimentary principle has already been shown, and it is more in its character as a flavouring agent, and as a pleasing addition to food, that we must now regard it. Sugar is not only a food, it is also a very largely adopted luxury, on account of its agreeably sweet taste. As a food, owing to its ready solubility, it needs no previous digestion; indeed, grape sugar has been termed a "pre-digested" carbo-hydrate. It is, however, especially when mixed with other food, apt to give rise to acidity and flatulence in some dyspeptic persons. It appears, in such cases, to promote acid fermentation in the alimentary canal.

Sugar is very largely used in the preservation of fruit, etc., on account of its antiseptic properties.

Cane, or crystalline, sugar is the kind generally used for addition to other foods. It is obtained chiefly from the sugar-cane or from beetroot; other plants, however, yield it, as certain species of maple, etc.

Grape sugar or glucose crystallises less readily, and is inferior in sweetening power. It is usually prepared from starch.

Cane sugar, after extraction, usually undergoes an elaborate refining process, by means of which the impurities are separated and nearly pure cane sugar is produced.

Molasses and treacle are more or less fluid residues left after separation of the crystallisable substances in the preparation of cane sugar.

Honey is a concentrated solution of sugar, mixed with a certain amount of wax, gum, and odorous and colouring substances. It contains a crystallisable and a non-crystallisable sugar — the former resembles glucose.

Before the discovery of sugar, honey used to be largely employed as a sweetening agent, and it has the same food properties and value as sugar.

CHAPTER V.

BEVERAGES.

Water.—All beverages contain water in certain proportions, and, as may be seen by reference to the various analyses of solid foods, water enters also largely into their composition. The body is itself composed to a great extent of water, certainly more than 70 per cent. Everything that is carried into the circulating fluids of the body, or that is eliminated from them, is conveyed by the agency of water. As a solvent it is indispensable in all the functional activities of the body. The consumption daily of a certain amount of water is thus an absolute necessity. Much of this is, of course, taken into the body combined with the solids of the food, but a certain quantity is required in the fluid form, and this is supplied by our various beverages. One of the best ways of supplying water to the body is by drinking it in its pure state, when its important solvent properties can be completely utilised.

The quantity of water needed daily must necessarily depend on the amount of the loss of this fluid which takes place by the lungs, skin, and kidneys, and this will be largely determined by the amount of work or exercise performed by the body, as well as by the temperature to which it is exposed. The quantity required daily must also vary much with the kind of food which enters into our diet; the drier the solids we eat the more water we shall need, the more succulent they are the less we shall require. It has been estimated that on an average an adult will require daily from $2\frac{1}{2}$ to 4 pints of water, or some beverage consisting almost entirely of water.

The *purer* the water obtained for drinking purposes the better; most, however, of so-called drinking waters as derived either directly from springs or from wells and rivers, contain dissolved gases and mineral substances. These often improve the flavour of the water, and give it a pleasant freshness, but an excess of mineral ingredients detracts seriously from its solvent properties.

Rain water is the purest form of *natural* water, and resembles distilled water, except that it contains whatever soluble constituents exist in the atmosphere through which it has fallen, so that traces of ammonia and nitric acid are generally to be found in it. If used for drinking purposes it needs to be collected with great care, as it is apt to dissolve any soluble substances with which it comes in contact. It must therefore not be received in leaden cisterns.

Distilled water is now largely used at sea, as most passenger ships are provided with condensing apparatus. When aërated it is a pleasant, wholesome beverage.

It is not needful, in this place, to insist on the importance, which is now generally recognised, of ascertaining that the water we use for drinking purposes is free from all organic impurity; most spring waters, however, although quite pure in this sense, contain a variable quantity of mineral constituents, especially of salts of lime, and these, if abundant, may detract from the value of the water for drinking and domestic purposes. Such water may cause digestive disturbance, or promote constipation, or may intensify any tendency that exists to calculous disorders. *Boiling* the water has the effect of greatly diminishing the hardness due to the presence of earthy carbonates, and so rendering it more suitable as a beverage.

Water which is not quite pure may be rendered much purer by suitable filtration.

Water, then, is an indispensable beverage; as a solvent agent it is needed in all the important chemical changes connected with nutrition; it is a valuable diuretic, it is absorbed rapidly and eliminated rapidly. It has been justly said that the use of an abundance of water as a beverage promotes a sort of "washing" of the various tissues of the body; that when taken at the end of stomach digestion it carries undigested substances out of the stomach into the small intestine. It has been contended by some that the mineral substances found in spring and river water may usefully supply some of the salts required for the construction and repair of the tissues, and that the existence of lime salts in such water is not altogether disadvantageous. This may possibly be the case with young growing subjects.

Iced water, taken in small quantities, is refreshing and cooling, and stimulates the digestive functions, but it is injurious when taken in great amount. Of the useful refrigerating action of cold water as a beverage in acute diseases, we shall speak hereafter.

Tea, coffee, and cocoa.—These aromatic and popular beverages, although differing considerably from one another in their common physical characters, agree in containing alkaloids which are either identical or closely related. Tea and coffee contain alkaloids, *thein* and *caffein*, which are identical, and cocoa contains an alkaloid *theobromin* which is closely allied to these.

There is a great resemblance in the general effects of tea and coffee, as might be concluded from the fact that they contain the same alkaloid, while the difference in their effects is probably due to the different aromatic principles or essential oils they contain, and to the greater amount of tannin in tea.

Cocoa, however, differs greatly in its properties and effects, as well as in its composition, from tea and coffee. We shall consider each of these beverages separately; and first, with regard to

Tea.—A great many varieties of tea are now imported into Britain from India and Ceylon, besides the older kinds grown in China.

The average composition of dry tea is stated by Bauer to be as follows :—

Thein	1·35
Other Nitrogenous Combinations .	9·44
Non-nitrogenous Extractives . .	19·20
Ash	3·65
Total of Matters soluble in Water .	33·64 per cent.

In Parkes's "Manual" the composition of dry tea is thus given :—"About 1·8 per cent. of thein, 2·6 of albumen, 9·7 of dextrin, 22 of cellulose, 15·0 of tannin, 20·0 of extractives, 5·4 of ash, as well as other matters, such as oil, wax, and resin."

The thein is combined with tannic acid. Some of the best teas yield a much larger proportion of thein than others. *Green* tea is somewhat richer than *black* in thein, ethereal oil, and tannic acid, and indeed in all the soluble constituents, by about 5 per cent.

The *ash* contains potash, soda, magnesia, phosphoric acid, chlorine, carbonic acid, iron, and silica. The principal constituents, and those which give it its characteristic properties, are thein, an aromatic volatile oil, and tannic acid ; of the last it contains, as stated above, about 15 per cent.

The difference between *green* and *black* tea is simply dependent on differences in the time of gathering the leaves, and their mode of treatment. The *green* is prepared from younger leaves, which are roasted in pans soon after gathering. Of China teas, *Young Hyson* is considered the finest kind of *green*, and *Souchong* and *Pekoe* of *black* tea. Some teas are "scented" in China by mixing the leaves with odorous flowers, such as orange-blossom, jasmine, roses, etc.

With regard to the amount of tannin contained in different varieties of tea, Dr. Hale White has made some important observations.* He submitted three samples of unblended tea—(1) the finest Assam, (2) the finest China, and (3) common Congou—to experiment, with the view of ascertaining the percentage of tannin yielded by each of them after short and long infusion, with the following result:—

	Percentage of Tannin.		
	(1)	(2)	(3)
Infusion for 3 minutes yielded	11·30	7·77	9·37
,, ,, 15 ,, ,,	17·73	7·97	11·15

The most noteworthy results of this experiment are (1st) that the finest Indian tea, when infused for fifteen minutes, yields nearly two and a half times as much tannin as the best China tea; and (2nd) as to the length of time of the infusion, we find that with the best China tea there is scarcely an appreciable difference between an infusion of three minutes and one of fifteen minutes. This result is therefore strikingly corroborative of Sir William Roberts's statement, that owing to the great solubility of tannin in hot water it is impossible to avoid the extraction of a great amount of tannin, even by the shortest infusion. It is only in the case of a tea so rich in tannin, as some of the Indian teas (No. 1), that prolonged infusion makes any considerable difference in the amount of tannin extracted.

It should be noted that these experiments of Dr. White also confirm the impression which most discriminating tea-drinkers must have received, that Indian teas, on account of the great amount of tannin they contain, are much more prone to cause gastric

* *British Medical Journal*, Jan. 12, 1889.

and nervous disorders in sensitive persons than the best China teas; and that cheap teas are much more likely to prove injurious than costly ones. Sample No. 2 was worth retail about five shillings a pound.

In making an infusion of tea the water should be boiling, for delicacy of flavour it should be neither too hard nor too soft, but for economical purposes the softer the water the better.

Parkes suggests that as water containing much lime or iron will not make good tea, such water should be well boiled for fifteen to twenty minutes with a little carbonate of soda before it is used for making tea, and Sir William Roberts also advocates the addition of carbonate of soda to tea for other reasons, as will be immediately mentioned.

Soft water extracts more of the soluble principles of the leaves, and makes a darker infusion, but some think that the infusion is, on that account, of less delicate flavour. The infusion should not be for more than three or four minutes. Longer infusion lessens the aroma and extracts too much of the soluble matters, thereby diminishing the delicacy of flavour of the beverage.

As to the effects of tea as an article of diet much difference of opinion exists, and especially as to the relative value of tea and coffee. It should be recognised that there often exist great individual peculiarities with regard to the effects of these beverages, and hence the conflict of opinion on this point.

Pavy refers to tea as "not heating to the system, nor oppressive to the stomach" like coffee; there are other physicians who consider coffee much more digestible than tea.

Tea appears to act as a stimulant and restorative to the nervous system. It removes fatigue, rouses and clears the mind, and promotes intellectual energy. It diminishes the tendency to sleep, and this effect may be carried to the extent of producing sleeplessness. When taken, as it usually is, hot, the warmth of the infusion no doubt aids its stimulating influence. It increases the action of the skin, and has been said to cause constipation, but it certainly, at times, appears to have the opposite effect, and a cup of hot tea will often accelerate the action of aperients. It deadens the sensation of hunger, and increases the power of fasting. It will cool the body when hot—probably by promoting the action of the skin—and it warms the body when cold. It will often relieve headache, and proves a useful antidote to alcoholic intoxication, and especially to that mental torpor which even small quantities of alcohol will produce in certain persons. *Green* tea possesses more active properties than *black*, and is more likely to be over-exciting to the nervous system.

There can be no doubt that for most persons tea, taken in moderation, proves an agreeable, refreshing, and wholesome beverage. It has been found a most useful article of diet for soldiers, increasing remarkably the power of enduring great fatigue, especially in hot climates. When milk and sugar are added to tea it becomes a nutritious and useful food.

On the other hand, it is quite certain that tea taken in excess, and in some constitutions, may become very injurious. It will not infrequently excite and maintain most troublesome gastric catarrh, the only remedy for which is an entire abstinence from tea for a considerable period. It is often also the cause of troublesome cardiac palpitations, together with muscular tremors, and general nervous agitation. We have noticed that tea will often commence somewhat suddenly to disagree with a person, and excite dyspeptic symptoms, coincidently with the occurrence of nervous worry, and that after the cause of nervous anxiety has passed away tea may again be taken, in moderation, with impunity. In irritable states of the stomach tea is also apt to disagree, especially if the coarser teas containing much tannin are taken ; these, when taken in large quantity during or too soon after a meal, will disturb, and often seriously hinder, the digestive process.

The ordinary strength of tea, according to Sir W. Roberts,* is 4 to 5 per cent., "that is four or five parts of the dry leaf to a hundred parts of boiling water. Strong tea runs up to about 7 per cent., and weak tea goes down to 2 per cent." This excellent observer found that tea exerted an inhibitory or retarding effect on salivary and peptic digestion, and he concludes that this effect is due to the influence of the tannin it contains. He points out that this cannot be avoided by brief instead of protracted infusion : "Tea infused for two minutes was not found sensibly inferior in its retarding power on salivary digestion to tea infused for thirty minutes." The best way to minimise the inhibitory effect of tea on digestion is to make it very weak and use it very sparingly, and to drink it after and not with a meal. Adding a little carbonate of soda—10 grains to 1 ounce of the dry tea-leaf—had the effect of entirely removing this retarding effect on digestion.

Coffee.—Coffee is an agreeable aromatic beverage prepared from the seeds, after they have been roasted, found within the fruit of the *Coffea arabica*.

The choicest coffee is Mocha or Arabian coffee. It was introduced into Europe in the seventeenth century, about the same time that tea was also introduced. In roasting, the coffee berries are exposed to a temperature of 200° Cent. or more ; during the process they assume a dark brown colour, the sugar in the berry is converted into caramel, and volatile aromatic empyreumatic products are developed which give to coffee its aroma.

* "Lectures on Dietetics and Dyspepsia."

At the same time certain gases are formed which swell up the seeds, so that they increase in bulk while they lose in weight.

Coffee should be roasted only a short time before being used, as owing to the volatile nature of the aroma it rapidly deteriorates by keeping; for the same reason the roasted berries should not be ground till immediately before the infusion is made.

The composition of unroasted coffee is stated by Parkes to be 34 per cent. of cellulose, 10 to 13 per cent. of fat, 15·5 per cent. of sugar, dextrin, and vegetable acid, and 10 per cent. of legumin, also a solid acid, small quantities of aromatic oil, and the alkaloid caffein. The chief ingredients of the ash are potash and phosphoric acid.

According to König 21 to 37 per cent. of solids are extracted from roasted coffee by infusion; or on an average—

Caffein	1·74
Oil	5·18
Non-nitrogenous Extractives	14·52
Ash	4·06
Total Matters soluble in Water	25·5 per cent.

The chief constituents, then, of coffee are a *volatile oil*, developed by roasting, to which it owes its aroma; *tannin* (less than in tea) in a modified form, *caffeo-tannic* and caffeic acids; and *caffein*, an alkaloid identical with thein.

It has been suggested that the ethereal oils developed during the roasting of coffee are more concerned than the caffein it contains in imparting to it its characteristic properties.

It is a curious fact that in Europe we make an *infusion* of coffee, in the East they make a *decoction;* the latter Dujardin-Beaumetz says preserves its nutritive and tonic properties, while it gets rid of its exciting ones.

The value of coffee, as a beverage, is greatly detracted from in Great Britain by the singular want of care and skill so widely manifested in its preparation.

Coffee should be made perfectly fresh, from freshly ground and freshly roasted seeds: as *all* the soluble substances are not extracted by infusing alone, it is desirable, on economical grounds, that a mixed infusion and decoction should be made in the following manner:—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 its 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.

The effects of coffee on the system are those of a decided stimulant to the nervous centres. It has been termed in France *une boisson intellectuelle*, on account of its stimulating action on the brain. It lessens the need for sleep after exertion, and diminishes the sense of fatigue; indeed, it would appear to have the power of augmenting the functional activity of the muscles. It has also a decidedly stimulating effect on the heart; in small quantities it quickens its action, but in large quantities it slows it, and when taken in *excessive* amount it will often sensibly disturb the rhythm of this organ and cause intermission.* It increases the secretion of the kidneys and of the skin, and in some persons it will stimulate the peristaltic movement of the intestine, and so act as an aperient.

* The author has seen several instances of this toxic effect of coffee when taken inadvertently in excess.

It will sometimes disturb the digestion in dyspeptic persons, and give rise to heartburn, and this is more likely to occur when very strong coffee is taken immediately after a full meal. Other toxic symptoms occasionally occur from taking coffee in excess, or in *too strong* infusion, such as muscular tremor, nervous anxiety and dread of impending danger, as well as palpitation, cardiac intermissions, and an uncomfortable feeling referred to the cardiac region.

Although coffee can exert no direct nutritive action in the system, and it has been shown that its use tends to increase rather than diminish (as had been stated) the excretion of urea, yet its influence in sustaining the human body under fatigue and privation is very remarkable. Parkes bears strong testimony to its great value in the diet of the soldier: "Not only is it invigorating without producing subsequent collapse, but the hot infusion is almost equally serviceable against both cold and heat; in the one case the warmth of the infusion, in the other the action on the skin, being useful, while in both cases the nervous stimulation is very desirable." It has been said to afford some protection against malaria.

When coffee is taken, as it usually is, together with milk and sugar, as *café au lait*, it then contains a considerable amount of nutritive substances, and forms a highly sustaining food.

The valuable properties possessed by coffee are occasionally utilised in the treatment of disease, as an antidote, for instance, in opium poisoning and alcoholic intoxication. It is also given as a cardiac tonic in heart disease, as a diuretic in dropsies and urinary disorders, and as a nervine in migrain and asthma.

Germain Sée * draws an interesting comparison between the action of coffee and alcohol:—

"Alcohol," he says, "is a real *moyen d'épargne*,

* "Du Régime Alimentaire. Des Boissons."

i.e. it diminishes the organic waste, as is evidenced by the diminished excretion of urea by the kidneys, as well as of carbonic acid by the lungs. Coffee does nothing of the kind; it maintains the *statu quo*, or it may accelerate retrograde metamorphosis, in consequence of its active stimulation of the functions causing increased tissue change.

"Alcohol excites in a fugitive fashion the peripheral circulation. Coffee imparts new energy to the heart and blood-vessels.

"Coffee increases the temperature: alcohol diminishes it (in large doses).

"The muscular system and muscular energy are marvellously roused by coffee, and a man fatigued or over-worked can find no more wholesome support: whereas alcohol produces on the muscles a dubious passing excitement, and in the end a degeneration of all the organs of human activity."

He concludes by pointing out that so far as the nervous system is concerned, coffee is an antidote to alcohol. This is probably why it has become the custom to take coffee after dinner and the wine-drinking which usually accompanies that meal.

Sir W. Roberts' experiments showed that coffee exerted very little retarding influence on salivary digestion, as compared with tea, and this he accounted for by the fact that in coffee tannin "is replaced by a modification of that substance called caffeo-tannic acid." Coffee, however, was found to exercise a greater retarding influence on *stomach* digestion than tea, on account of its being taken in much stronger percentage infusion. "Strong coffee, the *café noir* of France, is seen to have a very powerful inhibitory effect;" * hence it should not be taken after a meal by dyspeptic persons.

Cocoa or **cacao.**—Cocoa is widely removed by its composition and character from tea and coffee. It,

* "Dietetics and Dyspepsia."

however, contains, as has been stated, an alkaloid closely allied to caffein, viz. theobromine. Cocoa is obtained from the seeds of an exotic tree, the *Theobroma cacao.* The seeds are extracted from a pulpy fruit in which they are embedded. These, consisting of kernel and husk, are roasted, after the manner of coffee berries, to develop aroma. The *kernels* of the roasted seeds, when coarsely crushed, form "cocoa nibs." A decoction of the nibs is made by boiling gently in water for a couple of hours, and then pouring the dark brown decoction off the undissolved residue. This is, however, very unlike the preparations of cocoa commonly used; these consist usually of the *kernels* ground to a paste, and mixed with other saccharine or starchy substances; one of the objects of such admixture being to lessen the relative proportion of fat in the cocoa. When starchy substances are used for this purpose, the cocoa requires boiling, but when sugar only is used, it can be prepared by the simple addition of boiling water or milk.

Chocolate is manufactured cocoa—the best kinds from carefully selected and skilfully prepared seeds. Sugar and flavouring substances are added in the manufacture.

The composition of cocoa, besides theobromine, of which it contains about 1·5 per cent., includes a small quantity of a volatile oil, to which it owes its aroma, and which is developed in roasting; a large amount of fat, known as *cacao butter*, amounting to 45 or 50 per cent.; about 15 to 18 per cent. of albuminous substances; and a small quantity of starch, about 15 per cent. The ash is rich in potassium phosphate.

It will be seen from this analysis that cocoa is a highly nutritious food, containing a considerable amount of albuminates and hydro-carbons, and a certain proportion of carbo-hydrates and salts. It resembles milk somewhat, as approaching in composition to a complete food. Its defect is the large amount of fat it contains, which renders it prone to disagree with persons of delicate digestions. It is the avowed object of the best preparations of cocoa to diminish the relative amount of fat by the addition of other suitable substances, or to promote its digestibility by the admixture of some alkali.

Cocoa and chocolate present a convenient and palatable form of a highly nourishing food, and in South America cocoa and maize cakes are carried by travellers because they provide an agreeable kind of food in small bulk.

It will be seen that it is only the decoction of the nibs that can really be likened to tea or coffee as a beverage; the other forms of cocoa containing a large proportion of nutritious solids.

Chocolate is largely used in France to mix with various medicaments, in order to dilute them, or to disguise their taste and make them agreeable to the palate.

The following table, adapted from König, gives the average composition of cacao beans (kernels) and the best kind of chocolate :—

	Cacao Beans.	Chocolate.
Water	3·25	1·53
Nitrogenous Substances . .	14·76	5·06
Fat	49·00	15·25
Starch	13·31	—
Sugar	—	63·81
Other Non-nitrogenous Matters	12·35	11·03
Woody Fibre	3·68	1·15
Ash	3·65	2·15

Maté or Paraguay tea is prepared from the dried leaves of the *Ilex paraguayensis,* belonging to the holly tribe. It contains *thein*, and its infusion is largely consumed in South America as a dietetic beverage.

Chicory is prepared from the root of the wild endive (*Cichorium intybus*) by roasting like coffee, and then reducing to powder. It contains an aromatic volatile oil which is considered by some to give off an aroma like that of coffee, and its infusion is said to be drunk pure in some parts of the Continent. In Great Britain it has been used either as an addition to or an adulteration of coffee. Added to coffee in small quantity it is thought by some to increase its flavour, as it certainly does its colour.

Alcoholic Beverages.

The term "alcoholic beverages" comprises a great variety of familiar drinks, into the composition of which alcohol enters in widely varying proportions: the so-called "ardent spirits" and spirituous liquors may contain as much as 50 per cent., or even more, of alcohol, while the lighter wines scarcely contain 10 per cent., and the weaker kinds of beer not even 5 per cent. Before considering the dietetic properties of these various alcoholic beverages, it will be convenient to describe briefly what is known practically of the effects of alcohol on the human body. A great conflict of opinion is always maintained in connection with the subject, and this is, indeed, likely to be the case so long as prejudice and dogmatic enthusiasm are allowed to take so large a part in the discussion of a scientific question.

It is now generally admitted that only a portion of the alcohol taken into the body is eliminated as such; a portion, no doubt, especially when taken in large quantity, escapes in the urine and breath; but a portion, some maintain a considerable portion, disappears in the body. What becomes of this? It is burnt or transformed within the body in the same manner as any other food of similar chemical composition: this is the answer given by many experimenters, and it is the one supported by Dujardin-Beaumetz * as the result of his own recent experiments. "In the blood," he says, "you bring together two bodies, one alcohol, eager for oxygen, the other hæmoglobin, ready to give up that oxygen under the feeblest influence, even that of an inert gas, and you imagine that no exchange takes place between these two bodies; such changes do take place; alcohol, under the influence of hæmoglobin, is transformed into acetic acid. A portion of the alcohol ingested undergoes combustion at the expense of the oxygen of the hæmo-globin of the blood globules. When alcohol is introduced into the economy in non-intoxicating doses, it is in part oxidised, and transformed, first, into acetic acid, then into alkaline acetates, and finally into carbonates. Alcohol, then, is a food, *un aliment d'épargne*, which instead of promoting combustion [of the tissues], on the contrary retards it by withdrawing a certain quantity of oxygen from the blood corpuscles. It is to this action on the blood globules that it owes its power of lowering the temperature of the body, especially notable when toxic doses are administered. In such instances the alcohol is no longer consumed, but it destroys the blood corpuscles and dissolves the oxyhæmoglobin. That portion, however, of the ingested alcohol which does not undergo combustion, acts directly on the cerebro-spinal nervous system, giving rise to the phenomena of intoxication, of sleep, and of vaso-motor changes varying according to the amount of alcohol ingested. These three properties of alcohol, alimentary, anti-thermic, and toxic, render alcoholic beverages most powerful remedies in febrile diseases." This opinion has the merit of clearness and definiteness, and is founded on the results of careful experiment.

* "L'Hygiène Alimentaire. Des Boissons."

Germain Sée,* while he admits that only a small portion of the alcohol taken into the body is eliminated, maintains, however, that it is not oxidised or consumed in the body. What, then, becomes of it? The answer he offers to the question appears wholly inadequate. "One word," he says, "is enough to characterise the destiny and the action of alcohol in the organism; it acts the part of a *moyen d'épargne*, a genuine moderator of retrograde metamorphosis."

This is one of those explanations which explain nothing, not uncommon in the writings of this author. It does not tell us what becomes of the alcohol that *disappears* in the body; it is simply an evasion of the difficulty. "Alcohol checks oxidation," he continues; "alcohol, like the fats, diminishes the production of urea, and, as a consequence, the body-weight increases, and even moderate drinkers tend to become corpulent." His conclusion is that alcohol is not really a food, but that its function is to moderate retrograde metamorphosis; to temporarily check the incessant waste of the tissues. This is what he means by a *moyen d'épargne.* He considers it of value also as a nervo-muscular stimulant, and as aiding, in a certain degree, the digestive functions.

Bauer † is disposed to explain its favourable effects solely on the ground of its exciting and stimulating properties, and he considers its nutritive properties to be insignificant.

Pavy ‡ considers the weight of evidence to be in favour of its being regarded as a *food*, and that when taken in moderate quantities the greater part is utilised in the system, and only a small portion is eliminated.

What it is important to note, with regard to its stimulating effects, is that they are *temporary*, and

* "Du Régime Alimentaire. Des Boissons Alcooliques."
† "Dietary of the Sick."
‡ "A Treatise on Food and Dietetics."

quickly give place to a sedative, and in some persons, even in moderate quantities, to a depressing effect. It produces, then, *temporary* stimulating effects on the nervous and circulatory systems; there is, for a time, mental exhilaration and a more rapid flow of ideas, while there is also quickened action of the heart and increased fulness of the pulse. This is followed by a *sedative* effect on the nervous system, often of very great value. It has also the effect of causing dilatation of the peripheral blood-vessels, in consequence of which the face flushes, and there is a subjective feeling of warmth following its use.

In small quantities, by stimulating the secretion of the gastric juice, it promotes appetite, but in large quantities it has the opposite effect, and is, as will presently be seen, a *retarder* of digestion.

In its action on the nervous system small quantities exhilarate, large quantities (after a brief period of excitement) are sedative and narcotic.

It is most important to remember that the effects of alcohol vary greatly in different individuals, and that what may only be sufficient to produce a pleasant exhilaration in one person, will cause toxic depressing effects in another.

Indeed, it is mainly on account of the remarkable difference in its effects on different persons that so much misapprehension exists as to its true character.

Alcohol is a useful food and an agreeable stimulant, or a narcotic poison, according to the dose in which it is taken, or the susceptibilities and tissue reactions of the individuals to whom it may be administered.

Experiments as to the effect of alcohol in health have generally been made with too large doses, so that they have only furnished information, valuable certainly so far as it goes, of the effects of alcohol *in excess.* For instance, to test the effect of alcohol on muscular exertion by giving a man four ounces of brandy every four hours (!) * was useless for the purpose of elucidating the physiological effects of moderate doses of alcohol. This was a poisonous dose, and antecedently to its administration it might naturally have been expected to produce toxic effects, and therefore to embarrass rather than promote muscular exertion.

Experience has taught us that for temperate healthy persons, unaccustomed to the free use of alcohol, *one* ounce of brandy or whisky, freely diluted, is as much as should be taken at a time, if it is desired to avoid any of its depressing and toxic effects; and experiments undertaken with the object of testing the physiological action of alcohol in moderation should be restricted to doses of this amount. It is indeed pointed out, in the last edition of Parkes's "Hygiene," that "one to one and a half fluid ounces of absolute alcohol in twenty-four hours is the maximum amount which a healthy man should take;" whether in the form of ardent spirits, wine, or beer, and with this opinion we are entirely in accord.

That alcohol taken in small quantities improves the appetite and beneficially increases the circulatory activity, is almost universally admitted. Of its value as a sedative to the nervous system in certain diseased conditions, there is also nearly a general acknowledgment; as to its influence on the work of the body, physical and mental, it would seem, when taken in the moderate quantity above stated, to be helpful under many circumstances. Taken in larger quantity it would seem, on the contrary, to be almost invariably hurtful; women seem more susceptible of its injurious effects than men, and should take it with even greater moderation, and healthy children should do without it altogether.

* Experiment quoted in Parkes's "Hygiène."

Alcohol taken in excess is known to lead to very serious morbid changes in nearly all the organs of the body. Chronic inflammatory and degenerative changes of a granular, fibroid, and fatty nature attack the stomach, liver, lungs, kidneys, the brain and its membranes, and especially the blood-vessels. This, however, is not the place to discuss the many and serious morbid conditions which are produced by the excessive use of alcohol.

With regard to the influence of alcoholic beverages on the digestive processes, Sir William Roberts has made some valuable experiments, and the conclusions he has arrived at with regard to spirits may be thus briefly summarised.

With respect to ardent spirits, such as brandy, Scotch whisky, and gin, he found that these spirits used in moderation, and well diluted, promote rather than retard salivary digestion; that they increase the salivary secretions.

"The common practice of adding a tablespoonful of brandy to a basin of arrowroot or sago gruel therefore promotes its digestion."

With regard to peptic digestion, it was found that with 10 per cent. and under of proof spirit, there was no appreciable retardation, and only a slight retardation with 20 per cent., but with large percentages it was very different, and with 50 per cent. the digestive ferment was almost paralysed.

In the proportions in which these spirits are usually employed dietetically, not only do they not appreciably retard digestion, but they "act as pure stimulants to gastric digestion, causing an increased flow of gastric juice and stimulating the muscular contractions of the stomach, and so accelerating the speed of the digestive process in the stomach."

It will be necessary, in the next place, to consider the properties of the various beverages containing alcohol which are in common use.

Spirits.—The various "ardent spirits" are obtained by distillation from fermented liquids, and their odour and flavour depend on the nature and source of the fluid from which they are distilled. They are usually met with in commerce of about the strength of *proof spirit*, *i.e.* 49 parts of alcohol to 51 of water, and having a specific gravity of 0·920 at 60° Fahr. When they contain a larger proportion of alcohol their specific gravity is lowered, and they are then said to be so many degrees *over-proof;* whereas, if they contain a smaller quantity of alcohol their specific gravity is raised, and they are said to be so many degrees *under-proof.*

Practically, these distilled spirits, when pure, may be looked upon merely as mixtures of alcohol and water; the differences in their flavours and odours depend on the presence of various ethers, or of volatile oils, derived from the various fermented fluids from which they are distilled, or purposely added. Some are sweetened by added sugar, and some are intentionally coloured by the addition of colouring substances.

Brandy, rum, whisky, and gin are the spirits most in vogue in Great Britain.

Brandy, cognac, or **eau de vie,** when of the best quality, is distilled from wine or fermented grapes. There is, however, a great quantity of *eau de vie* fabricated in France, of an inferior quality, from potato-spirit or grain-spirit, *i.e.* spirit distilled chiefly from rice, maize, etc.

The quality of brandy depends on the kind of wine from which it is distilled; the finest quality comes from the white wines of the Charentes. The colour of brandy is due to its being kept in an oak cask, from which also it extracts some tannin. Caramel is used to colour the inferior kinds. Its aroma and flavour are due to the presence of volatile ethers, which pass over during distillation. Brandy improves in flavour by keeping, while it loses in strength. On an average it contains about 42 per cent. of alcohol. Dietetically it is highly valued, when of good quality, for its delicacy of flavour and its purity as a spirit.

Rum is distilled, in the West Indies especially, from the fermented products of the sugar cane. When new it is of somewhat coarse flavour, which becomes greatly refined by age. It is the spirit usually served out in the British army and navy. It is of about the same strength as brandy.

Whisky is extensively distilled in Scotland and Ireland from malted grain, usually barley. The smoky flavour is due to the *peat* and *turf* fires used in drying the grain. A certain amount of age is necessary to render whisky wholesome. It may be used in the same manner as brandy, and is more likely to be obtained *pure* than that spirit.

Gin and **Hollands** are corn-spirits, distilled from the unmalted grain. It is necessary in this case that the first distillation should be purified by re-distillation. Gin is flavoured subsequently by the addition of juniper and other flavouring agents; it is also sweetened by the addition of sugar, so that gin may be obtained either "dry" or "sweet." Dry Plymouth gin is one of the most wholesome kinds. It is more diuretic than other spirits on account of the juniper it contains.

Arrack is a spirit distilled from a fermented infusion of rice.

Kirsch, or **Kirsch-wasser,** is a spirit largely drunk in Germany and on the Continent. It is distilled from cherries.

Spirits distilled from grain or from the potato are apt to be contaminated with *amylic* and other alcohols of injurious quality. As amylic alcohol, or *fusel-oil*, is less volatile than ordinary or ethylic alcohol, by re-distillation the latter can be separated from the former, which is left behind in the still.

Dujardin-Beaumetz * has shown that the toxic character of alcohols increases with their atomic weights, and each of the alcohols in the following series presents more and more poisonous properties as its atomic weight increases :—

Ethylic Alcohol	C_2H_6O
Propylic ,, ...	C_3H_8O
Butylic ,, ...	$C_4H_{10}O$
Amylic ,, ...	$C_5H_{12}O$

The higher the alcohol in the series the more toxic it becomes.

Brandy distilled from wine contains only very small quantities of these toxic alcohols, but *eau de vie* distilled from potatoes or from grain contains a much larger quantity of propylic, butylic, and amylic alcohol. The same author also points out that since the ravages of the phylloxera it has been difficult in France to obtain genuine *cognac*, except at a very high price, and he names 20 francs the litre. A spirit distilled from grain and from beetroot has largely taken the place of that which used to be obtained from wine. He mentions that in 1875 France produced 348,723 hectolitres of genuine eau de vie (distilled from wine) ; whereas in 1879-80 these figures had fallen to 4,929 ; and in 1882-3 to 13,073 ; and in 1884-5 they had improved to 24,899. It is instructive to compare these figures with the 2,000,000 hectolitres of alcohol annually consumed in France.

As to the influence on the digestive processes of the various spirits in common use, Sir W. Roberts found *gin* preferable to either brandy or whisky ; in

* "L'Hygiène Alimentaire. Des Boissons."

his experiments he noticed that brandy and Scotch whisky interfered with the digestive processes, "precipitated the starch more readily," altogether out of proportion to the amount of alcohol they contained, and brandy was worse than whisky; and this circumstance appears to be due to certain ethers and volatile oils in them; and brandy contains a trace of tannin, which has an intensely retarding influence on salivary digestion.

Little need be said of the various alcoholic *liqueurs* in ordinary use. They owe their sweetness to added sugar, and their characteristic flavours to various aromatic substances. *Curaçoa* is flavoured with orange peel; *Noyeau* with the kernels of the peach and apricot; *Maraschino* with a flavour derived from cherries; *Kümmel* with cumin and carraway seeds; *Anisette* with aniseed and coriander.

Chartreuse and *Benedictine*, etc., are distilled from a mixture of various aromatic substances.

Absinthe is bitter, being flavoured with wormwood. It is usually taken mixed with water, before a meal, to stimulate appetite.

Kümmel is considered by some authors to be the most wholesome of these liqueurs.

Wines.—We have seen that alcohol and the ardent spirits are obtained by distillation from saccharine fluids that have undergone fermentation. The juices of all saccharine fluids can be made to undergo the alcoholic fermentation. This is usually set up by the agency of the yeast fungus, which causes the sugar to break up into ethylic alcohol and carbonic acid.

The most ancient and popular of these fermented drinks are those which have been obtained, since the earliest times, from the juice of the grape; and it is to the fermented juice of the grape that the term "wine" usually applies. This term is, however, also applied to the fermented juice of other saccharine fruits, as that of the orange, elder, gooseberry, currant, etc.

The characters and properties of wines are determined not only by the variety of the vine on which the grapes are grown, but also by circumstances of soil, of climate, of season as influenced by weather, of degrees of ripeness when the grapes are gathered, and of modes of manufacture and preparation.

"In the manufacture of *white* wines, the grape juice, after having been left for several days in contact with the crushed skins, in order that the soluble constituents of these may be extracted, is pressed out, and the *must* (the name given to the expressed juice) so obtained is submitted to fermentation, which sets up of itself on mere exposure to air by means of the yeast germs everywhere present. To make a *red* wine, the juice of *black* grapes is fermented together with the skins and stones (and sometimes the stalks), and the colouring matters as well as the tannin contained in these are dissolved out into the wine." *

König gives the following as the average percentage composition of grape *must* :—

Water	74·49
Nitrogenous Substances	0·28
Sugar	19·71
Acid	0·64
Other Non-nitrogenous Substances	4·48
Ash	0·40

Great fluctuations are observed in the proportions of sugar and acid as determined by the circumstances mentioned above. Even in the same localities, difference of season will cause the sugar to vary from 12 to 24 per cent.; and the acid from 0·5 to 1·2 per cent.

The ash consists chiefly of potash and phosphoric acid. The *must*, of course, undergoes great changes

* Bauer.

in composition during the processes of fermentation and preparation. The sugar is, in great part, converted into alcohol, glycerin and succinic acid being at the same time formed. The fermentation, however, in many wines is arrested before the whole of the sugar has been exhausted, and the proportion of sugar thus left in the wine gives it one of its distinctive characters.

The tannin which gives astringency to wine is found only in any considerable amount in *red* wines, and is derived from the stones, the skins, and the stalks. The *aroma* of wines is usually developed during fermentation and after it has been in bottle; but in some instances, as in the Muscat, it depends on the grape itself.

The chief acids of *must* are malic and tartaric. Malic acid is found principally in the unripe grape. They both diminish in amount as the fruit ripens, while the proportion of sugar at the same time increases.

Good wine should not contain more than 0·5 per cent. of tartaric acid. Owing to the variability of climate and seasons in the north of Europe, and the consequent imperfect ripening of the grape in certain years, the Rhenish and Moselle wines are apt at times to contain an excess of acid.

The amount of sugar in wine depends much on climate, the grapes grown in hot climates containing much more saccharine matter than those grown in colder regions. It also depends on the degree of ripeness of the fruit when gathered, and so also upon the season, for in cold, wet seasons the grapes will not ripen thoroughly, and will therefore contain less sugar. The amount of sugar will vary in different wines from 10 to 30 per cent. In order to make good wine the *must* should contain not less than 20 per cent. of sugar. Warm and dry summers are advantageous, and influence favourably the wine produced. In the preparation of some of the richest and choicest wines, such as Château d'Yquem and Tokay, only fully ripe, or even over ripe, grapes rich in saccharine substances are selected.

The colour and astringency are extracted from the skins and stalks during fermentation, to a great extent by the combined action of the alcohol generated during this process and the acids; at the same time the exhausted organic ferment, with other organic substances and "cream of tartar," are deposited as *lees.*

Certain wines are "fortified" by the addition of spirit, especially the wines grown in hot countries, as in Spain, Portugal, Madeira, etc. The spirit is added for the purpose of checking fermentation before all the saccharine matter is exhausted. Such wines possess much "body" and "fruitiness" on account of the amount of saccharine and extractive matters retained in them. In cooler climates, as in France and Germany, the fermentation, which proceeds more slowly, is allowed to terminate spontaneously, and the saccharine matter is almost wholly exhausted. Such wines are "drier," mature more rapidly, and acquire a finer aroma or bouquet. This bouquet or aroma depends upon the ethereal products formed by a combination of free acid with alcohol, and therefore appears more constantly in the acid wines of the north.

The *cream of tartar* thrown down in the *lees* is deposited in proportion as the alcohol is formed, as it is very sparingly soluble in spirit. A further deposit of this insoluble salt takes place after the wine has been drawn off into casks; it then assumes a crystalline form, and is known as "argol." The *fining* of wine consists in adding to it white of egg, isinglass, or some similar substances, which, being coagulated and precipitated by the action of the wine, entangles and carries down with it the suspended organic and other impurities. The wine is thus rendered clear, bright, and durable.

Plastering is the term applied to the practice that prevails in Spain, Portugal, and the south of France, of either dusting plaster of Paris (sulphate of lime) over the grapes before they are crushed, or adding it to the *must.* This leads to the deposition of the greater part of the natural tartaric acid in combination with lime, and to the substitution of sulphate of potash in its place, an altogether undesirable change so far as wholesomeness is concerned, but the keeping properties of the wine are probably improved.

In the preparation of sparkling wines like champagne, a second fermentation is set up by the addition of syrup, and some of the carbonic acid is prevented from escaping, so that an effervescing character is given to the wine, while a special flavour is imparted by the addition of "liqueur."

Little that is of practical value can be learnt from the *minute chemical analysis* of a wine; the palate and the stomach are the most reliable tests of its quality and wholesomeness.

Dujardin-Beaumetz well remarks that "it is a profound error to regard wine as merely a mixture of water and alcohol. It is a complete, living whole . . a living being" of very complex constitution. "It has," he goes on to say, "its youth, its maturity, and its old age. Some growths, like those of Burgundy, have a short life and a precocious old age; others, like Bordeaux, have a much longer life, and are even made to travel to hasten their maturity. They have also their diseases, diseases which result most commonly from bad manufacture or faulty fermentation giving rise to the presence of impure products." Besides water and alcohol, wines contain glycerin, sugar, tannin, essential oils, ethers, colouring matters and extractives, acids, and salts; and a wine will contain these constituents in different proportions in different periods of its existence.

The proportion of *alcohol* in wines varies from 6 to 25 per cent.; and it is stated that a natural wine derived from the normal fermentation of the grape cannot yield more than 17 per cent., and that any amount beyond this must be added. It is said that a pipe of 115 gallons of port wine has never less than 3 gallons of brandy added to it, and some of the richer wines have as much as 13 to 15 gallons added; and that to 108 gallons of sherry, there are added 6 to 8 gallons of brandy. Some of the finest wines do not contain more than 6 to 10 per cent. of alcohol.*

The following table of the average percentage by volume of alcohol in some of the best-known wines is collated from the tables published by Bauer, Dujardin-Beaumetz, and Parkes:—

	Per cent. of Alcohol.
Sherry	22·90
Port	21·91
Marsala	20·44
Madeira	19·11
Tokay	12·74
Graves	12·30
Champagne (Sparkling)	11·75
Rudesheimer	11·60
Zeltinger	11·20
Ruster	11·08
Macon, Volnay } Burgundies	11·00
Johannisberg	10·00
Voslauer	9·89
Larose	9·85
S. Julien	9·28
Leoville	9·10
Château Margaux	8·75
,, Lafitte	8·73
Chablis	7·88

* Parkes's "Hygiène," 6th edit., edited by Du Chaumont.

It is only in the sweet liqueur-like wines and in those to which *sugar* is added in the manufacture, that this substance exists in any considerable amount. According to Bauer, *Ruster* contains 21·74 per cent. of sugar, *Tokay* 14·99, *Malaga* 16·57, *Champagne* 11·53, *Sparkling Hock* 8·49, *Port* 6·42, *Marsala* 3·48, *Madeira* 3·46, *Sherry* 1·88.

In the Rhenish and Moselle wines there is but a very small quantity of sugar. In *Johannisberg* only 0·42 per cent., in *Rudesheimer* 0·39, in *Zeltinger* 0·13, and in *Stein-Reisling* 0·01.

In Clarets and Burgundies it is either absent, or present in very small quantity.

The amount of *tannin* found in different wines varies greatly. As it is derived chiefly from the coloured skin of the grape, it is absent, or in very small quantity, in white wines. New ports contain it in greatest quantity. On keeping, the tannin becomes deposited in combination with cream of tartar and colouring and extractive matters, and forms what is known as the "crust."

Most wines contain some *free acid*, as well as the acid bitartrate of potash. The free acid is chiefly *tartaric*, with smaller quantities of malic and acetic acids. The white wines contain most free acid, the Rhenish and Moselle wines from 1·14 per cent. (Marschberg) to 0·33 (Rudesheimer), Champagne 0·58, port and sherry about 0·45, clarets about 0·60.

The *bouquet* and aroma of wines depend chiefly on the presence of compound *ethers* and volatile oils. The ethers, the chief of which is termed *œnanthic* ether, are developed in the wine as it ages, and become especially noticeable after it has been long in bottle. They are formed by the reaction of the acids in the wine on the alcohol, and are therefore more remarkable in the more acid wines as in those of the Rhine and Moselle.

These, then, the *alcohol*, the *sugar*, the *tannin*, the *free acid*, and the *ethers*, are the chief constituents of wine from a dietetic point of view.

Some authors divide wines into four classes :—(1) *Spirituous* or *liqueur* wines ; (2) *red* or astringent wines ; (3) *white* or acid wines ; and (4) *sparkling* wines.*

The liqueur, or *spirituous* wines, such as Sherry, Port, Madeira, Marsala, Malaga, etc., are wines which contain more than 15 per cent. of alcohol. They are called *dry* when nearly all the sugar of the grape is converted into alcohol, as in dry sherries ; and *saccharine* when the fermentation is arrested before all the sugar has been exhausted, as in Malaga, fruity Ports, etc. Some of these are termed in French, *vins cuits*, or "cooked wines," because the fermentation is arrested, and the saccharine matters retained by heating them to a certain temperature. Most of them contain added alcohol. They are usually drunk only in small quantities, as dessert wines, or for the sake of their alcoholic strength and stimulating power in debilitated and diseased states, and especially (port) in convalescence from acute exhausting diseases.

The *red* wines are most of them slightly astringent and tonic from the tannin they contain. There is a great variety of these wines imported into Great Britain from France, Spain, Italy, Germany, Hungary, Greece, Australia, and other countries. The most esteemed and useful are the French wines—the clarets or Bordeaux wines and the Burgundies.

The chief drawback to their use now is that the cheaper kinds are so largely adulterated in France that, as they are imported into Great Britain, they are often mixtures of various worthless and injurious wines artificially coloured.

Sound, well-made clarets and Burgundies are amongst the most wholesome of wines taken in

* Dujardin-Beaumetz. "Des Boissons," op. cit.

moderation and somewhat diluted with water, as is usual in France.

The Burgundies contain more alcohol than the Bordeaux wines, and are considered more "heady," but they are valuable when a somewhat stronger and more tonic wine is needed.

The red Hungarian wines, such as Carlowitz and Ofner, form good substitutes for French wines.

The *white* or *acid* wines contain less tannin and more free acid than the preceding. They are somewhat more diuretic, and are wholesome and refreshing, especially when diluted with some alkaline water, which removes the excess of acidity without injury to the other qualities of the wine. Most of these wines are grown in northern countries, and come from the banks of the Rhine and Moselle. France also has several white wines, such as Barsac, Vin de Grave, and the Sauternes, from the Bordeaux district; and Chablis, from Burgundy. Many of the Sauternes, however, are strong saccharine wines, and cannot be said to resemble greatly the white acid wines of the north. Some also of the white Hungarian wines, as Ruster, are rich in saccharine constituents.

The type of *sparkling* wines is Champagne. This wine, when pure and sound, is most valuable as a rapidly-acting restorative and stimulant, and is often of great service from its power of allaying irritability of the stomach by means of the carbonic acid it contains.

With regard to the influence of wines on the digestive processes, Sir W. Roberts has made some instructive observations. He found that even very small quantities of the stronger and lighter wines—sherry, hock, claret, and port—exercised a powerful retarding influence on salivary digestion. He considers this to be wholly due to the *acid*—not the alcohol—they contain; for if this acid be neutralised, by mixing with the wine some alkaline water, the disturbing effect on salivary digestion is completely removed. "The use of 'alkaline table waters' as an addition to wines is," Sir W. Roberts observes,* "highly commendable," as they "greatly mitigate or wholly obviate the retarding influence of these wines on the digestion of starch."

It was also found that they likewise retarded peptic digestion to an extent altogether out of proportion to the quantity of alcohol they contained. Port and sherry exercised a great retarding effect. "Even in the proportion of 20 per cent., sherry trebled the time in which digestion was completed." This, then, is a most unsuitable wine for persons of feeble digestive powers.

With hock, claret, and champagne, it was also ascertained that this retarding effect on digestion was out of proportion to the alcohol contained in them; but champagne was found to have "a markedly less retarding effect than hock and claret;" indeed, in the proportion of 10 per cent., champagne had a distinct, though slight, accelerating effect, and this superiority of champagne appears to be due to the "mechanical effects of its effervescing qualities." The final conclusion arrived at by Sir W. Roberts is that, while large quantities of these wines exercise a considerable retarding effect on peptic digestion, *small* quantities do not produce any appreciable retarding effect, but act as pure stimulants; that *sparkling* wines impede digestion less than the *still* ones, and, when taken in moderate quantity, "act not only as stimulants to the secretion of gastric juice, and to the muscular activity of the viscus, but may, at the same time, slightly accelerate the speed of the chemical process in the stomach."

In the dietetic use of wines, as the author has elsewhere observed,† those wines agree best and are

* "Dietetics and Dyspepsia."

† "Food Accessories: their Influence on Digestion."—*Nineteenth Century*, February, 1886.

most useful which are absorbed and eliminated from the system *with the greatest rapidity*, as tested by the increase of the renal secretion, and he has been led to the practical conclusion that this is the best criterion of the suitability of any particular wine to any particular constitution. If the effect of different wines on notoriously gouty persons be carefully observed, it will be found that some can drink champagne (in moderation, of course) with impunity, especially if a small quantity of an effervescing alkaline water be added to it, while claret will at once provoke some manifestations of gout; others who are unable to drink champagne without provoking a gouty paroxysm, will often be able to drink a mature, fine, soft claret with advantage; others will support hock well, and a few can drink fine sherries and ports in small quantities; but in all it will be found that the test of the suitability of the particular wine to the particular constitution is its susceptibility to rapid elimination, and *vice versâ*.

Cider and perry.—These fermented beverages, obtained respectively from the saccharine juices of the apple and the pear, have much in common with "wines;" and, indeed, in Germany cider is known as "apple-wine." They are usually made in districts where those fruits abound.

Their "alcoholic" strength varies. In England and in Germany it has been estimated at from 5 to 9 per cent.; but some of the sweet ciders of France do not contain even 2 per cent. of alcohol. They contain also acids, chiefly *malic*, extractives, and salts. The alkaline salts, malates, carbonates, and phosphates impart diuretic properties, and those of potash some slight aperient effects.

It has been suggested by Denis-Dumont, of Caen, that the diuretic properties of cider render it a useful beverage for the gouty and those who suffer from uric acid deposits. Made into "cup" with soda-water, it is, no doubt, a refreshing and wholesome beverage; but as it is apt to undergo acetous fermentation, care must be taken that it is "sound," or it may give rise to colic and diarrhœa.

Beer.—This popular and ancient beverage is, as is well known, a fermented infusion of malt flavoured with the bitter extractive of the hop.

In the process of "malting," barley is caused to germinate under the influence of warmth and moisture; a ferment *diastase* is developed during germination, and this ferment converts the starch of the grain into dextrin and sugar; it is thus rendered capable of yielding a saccharine infusion suitable for alcoholic fermentation. The malt must be dried, and this drying is effected at different temperatures. When dried at a comparatively low temperature, *e.g.* below 140° F., a pale malt is produced which is used in brewing ale. Malt dried at a higher temperature and so blackened and burnt is used for brewing porter and stout.

It is unnecessary here to describe the process of brewing. It is sufficient to say that the infusion of malt is termed "wort," and contains in solution sugar, dextrin, albuminates, diastase, and salts. To this "sweet wort" hops in suitable quantity are added, the liquid is then boiled, cooled, and placed in vats for fermentation with yeast. The alcoholic strength of the beer depends on whether a *strong* or *weak wort* is used. The more concentrated the wort the stronger will be the beer brewed from it. In the preparation of beer other starch-containing substances capable of being converted into sugar by the action of diastase may be used, such as wheat, rice, and potatoes. Alcohol and carbonic acid are formed during the fermentation of the wort. The greater part of the latter escapes, but enough is retained to give an agreeable flavour to the beverage. There are other details necessary to be attended to in the preparation of the various kinds of beer with which we are not concerned.

The chemical composition of beer is somewhat complex; besides *water* and *alcohol*, it contains sugar, dextrin, albuminates, aromatic, bitter and colouring matter, salts, and a varying amount of acetic and carbonic acid.

The following analysis of German beers is adopted from König :—

	Water.	Carbonic Acid.	Alcohol.	Albumen.	Extractives.	Ash.
Mild (Winter) Beer	91·81	0·23	3·21	0·81	4·99	0·20
,, (Summer) ,,	90·71	0·22	3·68	0·49	5·61	0·22
Strong (double) ,,	88·72	0·25	4·07	0·71	7·23	0·27
Porter . . .	88·52	0·21	5·16	0·73	6·32	0·27

By keeping the amount of alcohol gradually increases and that of extractives diminishes; "old ales" are therefore, as a rule, *strong* ales. The colour of beer depends on the temperature at which the malt is dried, also the longer the wort is boiled the darker it becomes.

The average percentage amount of alcohol, extractives, and ash in various well-known beers is thus given by Dujardin-Beaumetz after Girard and Pabst.*

	Alcohol.	Extractives.	Ash.
English Beer (for exportation) . .	7·3	5·9	0·35
London Porter	5·2	6·4	0·32
Strasburg Beer	4·7	4·65	0·32
Bavarian ,, ...	4·5	7·2	0·29
Saxony ,, ...	3·7	5·8	0·25
Bohemian ,, ...	3·6	4·7	0·20
Vienna ,, ...	3·5	6·1	0·20

* "L'Hygiène Alimentaire. Des Boissons."

The amount of alcohol by volume in different beers may vary by as much as from 1 to 10 per cent. Scotch (Edinburgh) ale contains as much as 8·5 per cent. of alcohol. The free acidity (chiefly acetic acid with small quantities of lactic, malic and gallic acids) ranges from 18 to 45 grains per pint. Most beers contain a small amount of albuminous substances, not more on an average than 0·5 per cent. The salts consist of earthy phosphates and alkaline chlorides and phosphates. Some of the dark beers and porters contain caramel. Free carbonic acid exists in beer in about the proportion of $1\frac{3}{4}$ cubic inch per ounce.

It has been calculated that on an average a pint (20 oz.) of beer contains—

Alcohol	1 oz.
Extractives—Dextrine, Sugar . .	1·2 oz.
Free Acid	25 grains.
Salts	13 grains.*

The peculiar aromatic and bitter flavour of beer is due to the hop extractives it contains.

The extractive matters derived from the malt, and consisting chiefly of sugar and other carbo-hydrates, vary from 5 to nearly 15 per cent., and are most abundant in stout, porter, and sweet ales, and least so in light, bitter beer.

Beer is not merely a tonic and stimulating alcoholic beverage, it also contains a certain amount of nutriment in the form of extractives, chiefly carbo-hydrates, with a small quantity of albuminates; so that, when taken habitually, it tends to induce a state of fulness and plethora of the system, and a disposition to grow fat. It has been suggested that this is to some extent due to its exercising a slight interference with the metabolism both of the fatty and nitrogenous tissues. Dujardin - Beaumetz considers that it assists the

* Parkes's "Hygiène," 6th edition.

digestion of alimentary carbo-hydrates through the influence of a certain amount of diastase in it. Light beers in which the bitter principles predominate and the extractives are small in amount, no doubt act as stomachics and tonics.

It has been remarked that great beer-drinkers are subject to heaviness and drowsiness, and these effects are referred to the narcotic principles in the hops (*lupulin*); but Ranke has suggested that it is caused in part by the potash salts in it. It is believed that the habitual excessive consumption of beer may interfere with due oxidation and elimination to such an extent as to lead to the accumulation in the system of imperfectly oxidised products such as oxalic and uric acids, and so engender biliousness and goutiness. To avoid such possible evils the quantity consumed daily should not exceed a pint of the stronger beers or two pints of the weaker ones. Porter appears to be easier of digestion than beer.

Sir William Roberts' observations on the effects of beer on salivary and peptic digestion showed that "malt liquors hamper salivary digestion exactly in proportion to their degree of acidity. Sound English beers have not nearly so much acidity as wines, and they interfere comparatively little with the digestion of starch; but 'turned' beer is highly inhibitory." With respect to peptic digestion malt liquors exerted a retarding effect "altogether out of proportion to their percentage of alcohol." In large quantities they are powerful retarders of stomach digestion, in particular of farinaceous foods. "But in more moderate quantities—a tumbler or so—especially of the lighter beers," they assist digestion, and this is particularly the case when the beer is "well up," *i.e.* when it contains a considerable amount of free carbonic acid.

CONDIMENTS.

Condiments are employed for the purpose of giving flavour and relish to food, to excite appetite and to promote digestion. They greatly increase the pleasures of feeding, and by their stimulating properties they promote the digestive secretions and excite the muscular contractions of the alimentary canal. Many are distinctly antiseptic and carminative.

The most important and most extensively used is *common salt.* Sir William Roberts asks the question, "Why do we use so much salt with our food? Animals in a state of nature require none." He concludes that it is because in our elaborate methods of cooking and preparing food they are deprived of most of their saline ingredients. "Salt must therefore be supplied artificially to make up the defect, and to restore to the food so treated that sapidity and salinity of which it has in part been deprived." Besides giving relish to food, salt aids digestion by promoting the secretion of gastric juice, and thereby furthering the solution of albuminous substances. According to Voit, the presence of salt favours the disintegration of albumen in the body, and accelerates the interchange of juices and augments the renal secretion.

Vinegar is also an important condiment extensively used to give an acidulous flavour to many articles of food, and also, for its antiseptic properties, to preserve food. Sir William Roberts found that it had a very powerful retarding effect on salivary digestion, and he cautions persons with weak digestion to be very sparing in its use. Bauer also cautions against an excessive use of vinegar as it "leads to a high degree of anæmia and emaciation, since the acid lessens the alkalinity of the blood and the number of the blood-corpuscles." *

Many substances used as condiments contain small quantities of ethereal oils and other aromatic substances—as mustard, pepper, horse-radish, ginger, nutmeg, cinnamon, cloves, allspice, saffron, vanilla, mint, thyme, fennel, sage, parsley, garlic, etc., etc.

Many of these, by conferring agreeable flavours and by their warm carminative properties, promote appetite and assist digestion; but their excessive use is calculated to excite irritation and disorder of the digestive organs.

* "Dietary of the Sick."

CHAPTER VI.

THE ANNEXATION OF FOOD: ITS DIGESTION, ASSIMILATION, AND UTILISATION.

In this chapter we shall proceed to consider the preparations and transformations which the different varieties of alimentary substances must undergo within the body in order that they may be assimilated, annexed, or otherwise utilised according to their several functions in nutrition.

The first change which the food experiences in order to fit it for annexation and utilisation is in the mouth, where it undergoes mechanical subdivision in the process of mastication, as well as admixture with the secretion of the salivary and other glands of the mouth. The mechanical division which the food undergoes in the mouth is an exceedingly important preparatory step to the further action of the digestive juices upon it, as it multiplies the surfaces of contact and increases its permeability to the digestive fluids. By simultaneous commingling with the frothy saliva a certain amount of air is blended with the food, which also renders it lighter and more porous and more accessible to the gastric and intestinal juices.

Admixture with the saliva is also attended by a chemical action on the carbo-hydrates or starchy food substances. Through the agency of a diastasic ferment contained in the saliva, to which the name of *ptyalin* is given, the insoluble starch is converted into soluble dextrin, and subsequently into *maltose*, a form of sugar which is distinguished from grape-sugar by containing one molecule less of water. In the small intestines the maltose is converted into glucose.

Ptyalin belongs to the group of unorganised ferments, and, even when present only in very minute quantity, it causes starch to take up the elements of water and become soluble, undergoing itself no essential change in the process. Saliva acts but slowly on raw, unboiled starch, because the starch-grains consist of *granulose*, or starch enclosed in coats of cellulose, and cellulose appears to be unaffected by saliva. When the starch is boiled, the starch-grains swell up, the cellulose envelopes are ruptured, and thus the diastasic action of the *ptyalin* can take effect. Hence the necessity of thoroughly boiling all starchy food or raising it to a high temperature.

During the early months of infant life the salivary glands are very imperfectly developed, and it is not, therefore, advisable to give starchy food to young infants. Saliva acts best in an exactly neutral medium; but it also acts in an alkaline and even in a slightly acid fluid. Its action is, however, arrested or prevented by a strong acid; so that when the contents of the stomach are decidedly acid, and especially when it contains free hydrochloric acid, the action of the saliva on starch is arrested when the food reaches that organ. If the acidity be neutralised, the action is resumed.

Bauer suggests that the chemical action of saliva in digestion is infinitely less than might at first sight be supposed, as the food remains so short a time in the mouth, and the transformation of starch into sugar is arrested by the acid gastric juice, and that its chief use is to soften, moisten, and aid in the mechanical subdivision of the food-mass, and also, by covering it with mucus, to enable it to be easily swallowed. Substances soluble in water are dissolved by the saliva, and sapid matters are thus brought into contact with the end-organs of the nerves of taste.

Sir William Roberts observes with regard to salivary digestion that, as the time for it is brief, "to be of any avail the action must be rapid." He thinks that "the exceptional richness in diastase of human saliva" is remarkable, and that it has "special relation to the habit man has acquired of cooking his food. Salivary diastase is powerless on raw starch, but it acts energetically on starch which has been changed to a state of jelly or mucilage by previous boiling or baking. And if we consider how large a part of our food consists of bread and other cooked farinaceous articles, the importance of an exceptional salivary power will at once appear." The initial act is the transformation of this "solid or semi-solid coherent starch-jelly into a running liquid. Such articles as bread, pastry, and doughy puddings are altered considerably even by a brief contact with saliva. Their texture is rendered loose and more penetrable, and this change greatly facilitates the subsequent task of the gastric juice."*

In febrile and other morbid states the saliva may assume an acid instead of the normal alkaline reaction. This is due to fermentative changes set up by low organisms in the mouth. The salivary secretion is often also diminished, and the mouth becomes "dry and parched;" or the mucus becomes viscid and tenacious and the mouth "clammy." This condition is favourable to the development of acid and fœtid decompositions.

The conclusions deduced by Sir William Roberts, from his experiments on the influence of certain familiar "food accessories" on salivary digestion, may be suitably summarised here. First, with regard to ardent spirits, such as whisky, gin, and brandy, he found, when used with moderation and well diluted, that they promoted, rather than retarded, salivary digestion by causing an increased flow of saliva. "The common practice of adding a tablespoonful

* "Dietetics and Dyspepsia."

of brandy to a basin of arrowroot or sago-gruel, therefore, promotes its digestion." But the proportion must not exceed 5 per cent., and gin seems to be preferable to either brandy or whisky. In whisky and brandy there are certain ethers and volatile oils, and in the latter a trace of tannin, and these appear to exert an intensely retarding influence on salivary digestion. And the *stronger* mixtures of all these decidedly retard salivary digestion. With regard to wines, it was found that even small quantities of such wines as sherry, hock, claret, and port exercised a powerful retarding influence on salivary digestion, due, *not* to the alcohol, but to the *acid* they contain; for when this was neutralised by the addition of some alkaline effervescing water, the disturbing effect on salivary digestion was completely removed. The influence of acids in arresting or retarding salivary digestion is important in connection with the dietetic use of vinegar, pickles, salads, etc. In the case of vinegar, it was found that 1 part in 5,000 sensibly retarded this process; so that when acid salads are taken together with bread, the effect of the acid is to prevent any salivary digestion of the bread. As to malt liquors, if they are free from acidity they interfere but little with salivary digestion; but it is otherwise if they are acid. Pure water charged with carbonic acid exercised a considerable retarding influence on salivary digestion; but if it contains an alkaline carbonate, the presence of the alkali removes this retarding effect. Tea was also found to exert a powerful retarding influence on salivary digestion, due to the tannin it contains; coffee and cocoa a comparatively feeble one.

The food when it reaches the stomach encounters the acid gastric juice, and by the agency of this digestive fluid the insoluble albuminates become converted into soluble *peptones*. This change is effected by the agency of a "hydrolytic" ferment, termed *pepsin*, which the gastric juice contains, together with free *hydrochloric acid*. The acidity of the gastric juice is, in health, not so great as is generally believed; indeed, its acid reaction is but slight, as the hydrochloric acid it contains enters into combination, for the time being, with pepsin and albuminates, and then no longer gives an acid reaction. The amount of free hydrochloric acid in gastric juice has been estimated at 0·2 to 0·3 parts in 1,000.* (*Landois.*) *Lactic acid* is also found in gastric juice, but this arises from the fermentation of carbo-hydrates; for there are two other ferments yielded by the gastric juice—a *lactic acid ferment* and a *milk-curdling ferment*.

The carbo-hydrates undergo still further conversion into *dextrin* in the stomach through the continued action of the saliva swallowed, but whether their conversion into sugar is or is not arrested in the stomach is as yet undetermined. The finely divided mixture of food and gastric juice found in the stomach is spoken of as *chyme*. The action of gastric juice on albuminates is first to cause them to swell up, and finally to more or less completely dissolve them. There would appear to be certain stages in this process. The large and complicated proteid molecule is split up by a process of hydration into simpler ones. The first stage is the formation of *syntonin* or *acid-albumen*, or *para-peptone*. This has the property of being soluble in acids, but it is again precipitated on neutralising the solution. The next step is the formation of *hemi-albumose* or *pro-peptone*. This is not coagulated by heat and is soluble in water. It is precipitated by nitric acid, but the precipitate is dissolved on heating and falls down again on cooling.

* Richet's estimate is much higher, viz. 0·17 per cent. "*Du Suc Gastrique.*"

Finally, by the continued action of the gastric juice, the pro-peptone passes into true *soluble peptone.* Its formation is due to the taking up of a molecule of water, under the influence of the hydrolytic ferment pepsin. The greater the amount of pepsin, within certain limits, the more rapidly does the solution take place. The pepsin suffers scarcely any change; it would seem, however, that some of it is used up in the process of digestion, but the chief loss is due to its passing, from time to time, with the chyme into the small intestine. The solution of albuminates can only be accelerated within narrow limits by increasing the proportion of pepsin in the digestive fluids, large additions having, apparently, no power of increasing the digestive activity.* Albuminous substances entering the stomach in solution are not first coagulated, as used to be taught, before they are converted into syntonin, except in the instance of casein, which is first coagulated and afterwards dissolved. It has been suggested that coagulated albumen may be regarded as the anhydride of the fluid form and the latter as the anhydride of peptone; this view, therefore, represents the peptones as the highest degree of hydration of the albuminates.

The true peptones have remarkable characters and properties by which they differ greatly from ordinary soluble albumen. They are not coagulated by heat, or by nitric acid, or by acetic acid, and potassium

* Sir William Roberts' observations on peptic digestion, *out of the body*, differ somewhat from this statement which is made on the authority both of Bauer and Landois. He says: "The speed of digestion is roughly proportionate to the amount of pepsin in the digesting mixture. The more pepsin, the greater is the speed of digestion—*without any limit on either side.* And we should probably see . . . if it were possible to arrange the experiment so as to eliminate all interfering conditions, the speed of peptic digestion would be found to be exactly proportional to the quantity of pepsin contained in the digesting mixture." ("Dietetics and Dyspepsia.")

ferro-cyanide. They diffuse easily through animal membranes. They have a cheesy taste, while albumen and albumose are tasteless.

The destination of the peptones, after absorption into the blood, is doubtless to replace the albuminous substances consumed in the organism.

Gelatin and gelatin-yielding substances are also digested by the gastric juice, and gelatin loses its property of solidifying in the cold.

The gelatin-peptones are quite different from the true peptones, although they share with them the properties of solubility in water and diffusibility through membrane.

It is interesting and important to notice the changes that milk undergoes in the stomach. On entering the stomach the casein coagulates and entangles with it some of the fat globules. The free hydrochloric acid, by neutralising the alkali which keeps the casein in solution in milk, is adequate to produce this effect, but the gastric juice contains also, besides pepsin, a *milk-curdling ferment* which precipitates casein either in neutral or alkaline solutions. It is this ferment, under the name of rennet (an infusion of the fourth stomach of the calf in brine), which is used to coagulate casein in the manufacture of cheese. The casein is in the stomach subsequently converted into syntonin, and finally into a true peptone.

There is also a *lactic acid ferment* in the stomach which changes a portion of the milk-sugar into lactic acid. A part of the milk-sugar is converted in the stomach and intestine into grape-sugar.

It is necessary for the proper performance of gastric digestion that the food should be kept for a considerable time in the stomach submitted to the sort of churning movement imparted to the food-mass by the contraction of its muscular walls. In this way the food is thoroughly mixed up with the gastric juice, the chyme being prevented from escaping into the duodenum by the contraction of the pylorus; this after three or four hours relaxes, and the acid chyme passes out of the stomach into the small intestine. Do fats undergo any change in the stomach? They are said to undergo partial decomposition with the formation of a small quantity of fatty acids which are of use in emulsifying the rest of the fat; but their real digestion takes place lower down in the alimentary canal.

Peptones can be produced outside the body by dissolving albuminous substances in artificial gastric juice. Such products often possess a disagreeable bitter taste, the cause of which is not thoroughly understood. It has been suggested that it is due to the formation of an alkaloid—of the nature of a *ptomaine*—developed during the decomposition of albuminous matter. These artificially-produced peptones have been regarded as calculated to render great service in invalid feeding. Whether they can fulfil all the functions in the body of albuminous substances, and contribute, like them, to the repair of the nitrogenous tissues, has been warmly discussed. It is admitted that there is no necessity that dissolved albuminous substances should be transformed into peptones in order to be absorbed; they can certainly be absorbed without undergoing such transformation.

It is also known that an increased secretion of urea appears after the administration of peptones, just as it does after the ingestion of unaltered albumen, and that the chemical composition of peptones differs little from that of ordinary albuminous bodies.

But Brucke has maintained, in opposition to those who assert that peptones perform all the functions of proteids, that the absorption of some unchanged albumen is necessary, and that only this is capable of forming *organic* albumen, and that the peptones after undergoing a re-conversion into albumen are wholly metabolised as such. This is the view to which Bauer seems to lean.* "An organism," he says, "could with peptones alone, and combined only with the necessary non-nitrogenous food stuffs, be kept alive only for a limited, albeit a fairly long space of time; but for its continued maintenance the addition of so much unaltered albumen as is necessary for the repair of the tissues would be required. At the same time it is not improbable that a given weight of peptone is perfectly equivalent for purposes of metabolism to an equal amount of albumen, so that its *albumen-sparing* action far exceeds that of gelatin.

"It is clear also that the peptones, even if in further researches they should be found not to be available for tissue formation, may yet be very valuable nutriments for the sick, being capable of replacing albuminous nutrition for months together, and presenting the manifest advantage of being easily and immediately absorbed. A relatively small addition to the food of unaltered albumen would be necessary in order to obviate the waste of albumen in the body as well as to attain an increase of weight. All clinical experience in peptone feeding in the past is capable of the same interpretation."

It is a curious and interesting circumstance that when peptones are injected into the general circulation they act as poisons, and this fact has naturally led to the inquiry why it is that, in health, the peptones in the intestine do not pass into the general circulation and exert their poisonous influence on the nervous system. To this inquiry no satisfactory answer can at present be given. As a rule, the peptones disappear from the portal blood before it reaches the general circulation; indeed, very little,

* "Dietary of the Sick."

if any, peptones can be found in it before it reaches the liver. Although it has not yet been discovered where the peptones undergo this remarkable change which renders them fit for appropriation as nutriment, it has been suggested that the liver may, to some extent, serve the purpose of preventing any peptones from reaching the general circulation which may have escaped transformation in the blood of the portal system.

Dujardin-Beaumetz calls attention to the difference observable in the various *peptones* that are found in commerce; "some are acid, some neutral; some are liquid, some solid; and their chemical reactions even are different." He regards the question of peptones as a "very complex" one. The dry peptones he considers preferable to the liquid ones. He calls attention to their disagreeable taste being objectionable to many invalids, and he suspects the more agreeable-tasting preparations of being largely adulterated with gelatin. Instead of promoting the secretion of gastric juice, he has found that they retard it. Their chief value is, he maintains, in rectal alimentation, and the following formula is the one he particularly recommends:—To a cup of milk add two or three table-spoonfuls of *liquid*, or two or three teaspoonfuls of dry peptone, the yolk of an egg, five drops of laudanum and seven grains of bicarbonate of soda if the peptone is acid, as the contents of the large intestine are alkaline or neutral, and never acid. Germain Sée also admits that peptonised enemata may prove valuable as a *temporary* expedient, but that it is impossible to rely upon them exclusively for more than two or three weeks, on account of the inevitable onset of diarrhœa.

Attempts have been made from time to time to estimate the relative digestibility of different kinds of foods in the stomach; but this is a question extremely difficult to resolve, as it is complicated by a variety of changing circumstances. The activity of the digestive organs is subject to great variations at different times and in different individuals. The various modes of cooking or otherwise preparing the food may cause it to offer very varying degrees of resistance to the action of the gastric juice at different periods. One of the most important conditions is, no doubt, the state of mechanical subdivision to which the food is reduced when it reaches the stomach. Fish and chicken (the more delicate parts, as, *e.g.* the breast) are more digestible than mutton, and mutton is more digestible than beef; and these differences are due to the different degrees of resistance their fibres offer to disintegration. The flaky muscular masses of the more digestible kinds of fish are made up of short fibres, easily torn apart and separated; the flesh of the chicken is composed of shorter and more delicate fibres than those of mutton, and mutton of shorter and smaller fibres than beef. The muscular fibres of different parts of an animal differ also greatly in their size and delicacy and mode of aggregation. The short and delicate-fibred muscles of the chicken's breast are more readily digested than the larger and tougher-fibred leg muscles. Dr. Beaumont's observations on the rate of digestion of various substances, as noted by him in the celebrated case of Alexis St. Martin, who was the subject of a gastric fistula, have been repeatedly quoted. His general conclusions were in accord with those of common experience. Animal foods were more easily digested than vegetable; the latter were often observed to leave the stomach in an undigested state. Fats were highly indigestible in the stomach. The digestibility of animal flesh was seen to be dependent, to a great extent, on its tenderness and facility of disintegration; game, for instance, was the most digestible of foods. Salt and vinegar appeared to promote digestion. The rapidity with which a meal was digested depended on the quantity as well as the quality of the food and the condition of the stomach at the time. Three and a half hours was the average time it took to digest a moderate meal of bread and meat. Saturation of the ingesta with fat materially interferes with the action of the gastric juice upon it. The tender cellulose of young vegetables is much more digestible than when it has been rendered woody by age. Cooked meat is more digestible than raw, the gastric juice penetrating with greater ease between the fibres. Hard-boiled eggs appear to offer mechanical conditions most unfavourable to the action of the gastric juice. Animal gelatin is very readily dissolved in the stomach.

The duration of gastric digestion appears to vary between very wide limits, and to depend on individual peculiarity and many other circumstances. The most common circumstances which retard gastric digestion are: excessive quantity of food, a catarrhal condition of the gastric mucous membrane, the presence of the febrile state, hyperæmia and anæmia of the mucous membrane of the stomach (both of which interfere with the free secretion of the gastric juice); certain morbid states of the nervous system also diminish the secretion of gastric juice. A deficiency of free acid seems even of more importance than a deficiency of pepsin; and it is probable that this is a common condition in cases of acute and chronic gastric catarrh. It is also noteworthy that, although the quantity of the normal acid needed for active digestion may be deficient, yet there may be sour eructations and other symptoms present pointing to the abnormal formation of *other* acids, due to abnormal fermentative processes.

Food, of course, may be abnormally retained in the stomach by any obstruction at the pylorus, or by defective propelling power in the stomach walls associated with dilatation of its cavity and a paretic condition of its muscular coats.

Sir William Roberts' experiments on the influence of certain food accessories on peptic digestion led him to the following conclusions. Ardent spirits retarded digestion according to their degree of concentration. With 10 per cent. and under of proof spirit there was no appreciable retardation, and only a slight retardation with 20 per cent.; but with large percentages it was very different, and with 50 per cent. the digestive ferment was almost paralysed. Wines and beer retard peptic digestion altogether out of proportion to the quantity of alcohol they contain. Port and sherry exercised a great retarding effect. Tea and coffee exercise a remarkably retarding effect on stomach digestion; strong coffee had a very powerful retarding effect. Beef-tea had a powerful retarding effect on peptic digestion, apparently due to the salts of the organic acids contained in it.*

The food, reduced to the condition of chyme, when it passes out of the stomach into the duodenum, encounters two other digestive fluids—the *bile* and the *pancreatic juice*. The acid chyme, meeting with these *alkaline* fluids, loses its acidity, and the further action of the pepsin on the albuminates is suspended. The pancreatic juice is one of the most important digestive fluids in the body, and it is the most energetic and general in its action of all the digestive juices, and contains no less than four hydrolytic ferments: (1) *Amylopsin*, which seems to be identical with the ptyalin of the saliva, but is much more energetic than it, and can transform *raw* as well as boiled starch into sugar. At the temperature of the

* *Vide* "Dietetics and Dyspepsia.

body the change is effected almost at once. Even cellulose is said to be dissolved by it, and gum changed into sugar. This ferment is absent, according to Korowin, from the pancreas of new-born children. (2) *Trypsin*,* which digests albuminates, changing them, first, into a globulin-like substance, then into pro-peptone or albumose, and finally into true peptone like the pepsin-peptones, and sometimes termed *tryptone*. Trypsin is destroyed when it encounters pepsin and hydrochloric acid together; so that it is useless administering trypsin by the mouth, as it would be destroyed in the stomach. (3) A *fat-splitting ferment, steapsin*. This causes neutral fats to appropriate a molecule of water and split into glycerin, and their corresponding fatty acids, as, *e.g.*:

$$\underbrace{(C_{57}H_{110}O_6)}_{\text{Tristearin.}} + \underbrace{3(H_2O)}_{\text{Water.}} = \underbrace{(C_3H_8O_3)}_{\text{Glycerine.}} + \underbrace{3(C_{18}H_{36}O_2)}_{\text{Stearic Acid.}}.$$

And (4) a *milk-curdling ferment*.

The pancreatic juice has the power of forming a *fine permanent emulsion* with fats. In this process the fats are subdivided into exceedingly minute particles, in which form they can be taken up by the lacteals. The fatty acid, set free by the fat-splitting ferment, enables the alkaline pancreatic juice to at once produce an emulsion, for the presence of a free fatty acid causes emulsification to take place very rapidly.

Putrefactive bacteria appear to find in the products of pancreatic digestion an extremely favourable soil for their development, and under certain circumstances, when pancreatic digestion is prolonged, will give rise to the production of most foul-smelling

* It is a remarkable circumstance that the juice of the green fruit of the papaya tree, or *Carica papaya*, possesses digestive properties, due to the presence of a peptonising ferment closely related to *trypsin*, and termed *caricin* or *papain*.

substances, the chief of which is *Indol* (C_8H_7N). This may readily be produced during pancreatic digestion out of the body; and the same thing, no doubt, occurs occasionally inside the body, and would frequently occur were it not for the antiseptic action of the bile. When, therefore, the flow of bile into the small intestine is for any reason hindered or interrupted, there is obvious danger of such putrefactive decomposition occurring; and since during putrefactive decomposition within the body poisonous organic alkaloids may be formed, there is the risk of actual poisoning by the absorption of such alkaloids from the alimentary canal.

It is seen, then, that the pancreatic juice exerts a solvent digestive action on all classes of alimentary substances, the albuminates, the carbo-hydrates, and the fats. Like the saliva, it converts starch into dextrin and sugar, and like the gastric juice, it converts insoluble albuminates into soluble peptones.

It has, however, been proved that the *bile* exerts an important influence in the absorption of fat, and that large quantities of fat can be absorbed without the presence of pancreatic juice in the bowel, provided only there be a free inflow of bile; but if bile be absent, then the absorption of fat is to a very great extent interfered with, notwithstanding the abundant presence of pancreatic juice; and so far from pancreatic juice being the sole agent in the digestion of fat (as was once taught), it is only when associated with bile that it is of any real value. "So far as we know at present," says Bauer, "the pancreatic juice alone, without the presence of the bile, can effect the absorption of but a fraction of the ingested fat; nevertheless, it is conceivable that the action of the bile in the assimilation of fat may be but imperfectly performed without the co-operation of the pancreatic juice. Perhaps the true state of the case may be, that while a moderate admixture of fat with the food may be absorbed by means of the bile alone, larger quantities cannot be without the aid of pancreatic juice at the same time."

The *bile* is, then, an important agent in the digestion and absorption of fat. It aids the pancreatic juice in emulsifying fat, and it has a remarkable power in facilitating the passage of fat through animal membrane. If bile be absent from the intestine, a large proportion of the fatty matters of the food pass away undigested in the evacuations. The whitish colour of the stools in cases of obstructive jaundice is not only connected with the absence of bile pigment, but is also due to the presence of a large quantity of undigested fat. Bile promotes the absorption of fats—1st, by emulsionising them, so that the fatty particles pass more readily into the lacteals; 2nd, by *moistening* or wetting both the fat granules and the pores of the intestinal *villi* so that they become easily permeable; it is found that fat filters through a membrane moistened with bile or bile-salts under less pressure than when moistened with water or saline solutions. It allows diffusion to take place between a watery fluid and a fatty fluid by acting as a sort of soap, so that the intervening membrane can be moistened by both fluids.

It is said (*Landois*) that bile also contains a *diastasic ferment* capable of transforming starch into sugar and also glycogen into sugar. Another function of the bile is that it stimulates the peristaltic movements of the muscular wall of the intestine, and so acts as a sort of natural aperient; this effect is also furthered by the amount of fluid it adds to the fæces. The bile acts also as an antiseptic, and prevents putrefactive changes in the intestine which the presence of the bacteria of putrefaction would otherwise bring about.

Throughout the whole of the intestinal canal, from the duodenum to the termination of the large intestine, the contents continue to present an alkaline reaction, and the action of the pancreatic ferments is maintained. Besides the bile and pancreatic juice, the food when it reaches the small intestine encounters also the so-called "*succus entericus*," or intestinal juice, secreted by the glands that are found embedded in the intestinal mucous membrane. These are mainly Brunner's glands which are confined to the upper part of the small intestine, and Lieberkuhn's follicles which are closely packed throughout the whole length of the small and large intestine.

Since in the small intestine the food encounters simultaneously so many digestive secretions, it is almost impossible to limit accurately the particular part that each one plays in the processes of digestion. Experiments made out of the body cannot be arranged under precisely the same conditions as those which obtain within the alimentary canal, and conclusions drawn exclusively from such observation are exposed to obvious sources of error.

The *succus entericus* is said to be able to convert maltose into grape-sugar, and so to continue the diastasic action of the saliva and pancreatic juice; it is also believed to be able to slowly peptonise fibrin. It is probable that portions of the food may continue to be dissolved in the lower half of the small intestine under the influence of the various digestive ferments that have been mixed with it. In the large intestine the digestive processes cease, and putrefactive changes alone continue; the absorption of fluid, however, goes on so that the contents of the large intestine increase in consistency as they advance along it.

The food has now been traced from its entrance into the mouth to its complete digestion in the small intestine; here the *dissolved* food substances pass into the blood-vessels and lymphatics, and so enter the general circulation. The peptones immediately on entering the blood-vessels appear to undergo certain changes. They are taken up, to a great extent, by the red blood-corpuscles, and by a process of dehydration are converted back again, so to speak, into a larger and more complex albuminous molecule, that of *globulin.* "The blood corpuscles thus form, as it were, a store of albuminous material, which they convey to all parts of the body, and give off where it is wanted." A portion, however, of the peptones appear to have another destination; they are converted in the liver, where they are arrested, into glycogen. In the liver also the sugar absorbed from the intestinal canal is dehydrated and converted likewise into glycogen. There it is stored up for a time, and given out as required by the organism. The liver, therefore, is a great storehouse of carbohydrates, and it serves them out to the economy as they are required.

The chief amount of the *fats* is absorbed in the form of a *milk-like emulsion*, and a small portion in the form of *soluble fat-soaps.* The fats themselves are not chemically changed, but remain as undecomposed neutral fats. The *villi* of the small intestine are the chief organs concerned in the absorption of the fatty emulsion, and in these the lacteal vessels originate which convey the *chyle*, containing the fatty granules, towards the thoracic duct on its way to join the general circulating fluid.

Sir W. Roberts' observations led him to the conclusion that the effects of food-accessories (for reasons he sets forth) on pancreatic digestion are practically *nil.* "In no case did I find evidence of the possibility of that embarrassment and arrest which occurred in the case of salivary and peptic digestion."*

* "Dietetics and Dyspepsia."

The *usefulness* of various articles of diet in nutrition must depend upon their *digestibility* and upon the proportion in which they can be and are dissolved and absorbed in the alimentary canal. The real nutritive value, therefore, of any food-stuff cannot be accurately determined simply by reference to its chemical composition, but can only be properly estimated by actual observation as to the extent to which it is appropriated by the organism. It must, at the same time, be remembered that there are limits to the digestive and absorptive capacities of the alimentary canal, which vary with regard to different forms of food, and that any overloading of the digestive organs with food-substances it cannot completely digest is most injurious.

In the case of a complex feeder like man it is undoubtedly extremely difficult to ascertain to what precise extent any particular component of his diet is utilisable; a certain amount of approximately accurate information can, however, be obtained in various ways which will afford considerable assistance in the solution of these questions.

It is well known how much the digestibility and full utilisation of the food of man depend on its being presented to him in sufficient variety, and that a monotonous sameness of dietary ends by becoming repulsive, and leads to actual derangement of the digestive organs. Particular methods of preparing and cooking food also greatly determine the extent of its utilisation. Individual peculiarities, habits, and various external circumstances, such as different climatic conditions, also influence the digestion and assimilation of different articles of diet.

One of the most marked and notable differences in the utilisation by man of habitual food-substances is that which is observed between animal and vegetable foods. The human digestive organs can assimilate vegetable foods far less completely than animal foods. The seeds of certain cereals when submitted to a special mode of preparation and cooking form the only exception to this rule.

This difference in the power of utilising animal and vegetable foods is well illustrated in the following table of Fr. Hofmann quoted by Bauer. It gives the percentage proportions *digested* and *undigested* of several animal and vegetable alimentary substances:—

Weight of Food.	Vegetable.		Animal.	
	Digested.	Un-digested.	Digested.	Un-digested.
Of 100 parts of Solids .	75·5	24·5	86·9	13·1
" " " " Albumen	46·6	53·4	81·2	18·8
" " " " Carbo-hydrates . . .	90·3	9·7	96·9	3·1

The reason of the great amount of waste which passes out of the body undigested in the case of many vegetable foods must not be looked for in any great loss of unassimilated starch; for large quantities of starch are wholly digested and absorbed in the human alimentary canal, if they are contained in foods, which in other respects favour the action of the digestive juices upon them. It has been found, for instance, that the carbo-hydrates in wheaten bread, in macaroni, in rice, etc., are utilised to within 0·8 to 1·6 per cent.; whereas as much as 8 to 18 per cent. of undigested residue passes out of the body from such foods as black bread, potatoes, and the like. Some of these latter set up acid fermentations in the alimentary canal, which excite active peristalsis in its walls and rapid expulsion of its contents. In many of the imperfectly digested vegetable foods the nutritive matters are enclosed in cell-walls of indigestible, or imperfectly, or very slowly digestible cellulose, and they are passed through the intestinal canal too rapidly for the digestive juices to penetrate them. Moreover, hard, ligneous substances, such as the bran of black and brown bread provoke, by mechanical irritation, active intestinal peristalsis. Indeed, it has been noticed that the addition of cellulose to a meat diet will cause an imperfect assimilation even of the flesh. It *must* also be noted that, as a rule, vegetable foods are, relatively to their nutritive value, more bulky than animal kinds, and, for that reason, tend to the evacuation of a greater amount of undigested residue, as they have to be ingested in greater relative quantity.

With respect to the utilisation of different *animal* and *vegetable* foods, some valuable experiments have been made by Rubner and are summarised by Bauer ("Dietary of the Sick"). It has been objected to these experimental observations that they were made with excessively large quantities of food, such as could not be taken habitually; but they nevertheless illustrate what they were intended to illustrate, and that is the *relative* proportions in which the several articles of food tested can be utilised in the organism.

It has long been well known that the flesh of animals can be utilised to a remarkable extent, and Rubner tested this fact upon himself by eating, for three consecutive days, large quantities of roast beef, with the following results:—

Total Amount Ingested.				Percentage Lost in Fæces.			
Dry Matters.	Nitrogen.	Fat.	Ash.	Dry Matters.	Nitrogen.	Fat.	Ash.
919	119·5	71·9	45·7	5·6	2·8	17·2	21·2
1100	146·3	62·6	55·9	4·7	2·5	21·1	15·0

Broken-down muscular fibres could be detected in the evacuations, which is not the case when smaller quantities of meat are taken and digestion is normal; so that, under the latter conditions, certainly a large percentage would be utilised.

With hard-boiled eggs the following results were obtained: in two days, 1,896 grammes of fresh eggs were eaten, representing 495 grammes of water-free (dry) food substance, and containing 41·5 grammes of nitrogen, 206·7 grammes of fat, and 20·9 grammes of ash. The percentage loss of each of these in the fæces was, of

Dry Food Substances	5·2 per cent.
Nitrogen	2.9 ,, ,,
Fat	5·0 ,, ,,
Ash	18·4 ,, ,,

showing that a very large percentage was utilised in the system.

The same observer's experiments with milk showed a very extensive utilisation of the organic constituents, although not so extensive as with the preceding substances, and there was especially a greater loss of salts, and particularly of lime salts.

One experiment lasted three days and three experiments one day each, during which an exclusively milk diet was taken. The following were the results obtained:—

Total Weight Ingested.

	Fresh Milk.	Dry Substance	Nitrogen.	Fat.	Sugar.	Ash.
1st Experiment (3 days)	7315	945	46·1	285·3	307·2	53·4
2nd ,, (1 day)	2050	265	12·9	79·9	86·1	15 0
3rd ,, ,, ,,	3075	397	19·4	119·9	129·1	22 4
4th ,, ,, ,,	4100	530	25·8	160·0	172·2	29 9

LOSS PER CENT. IN FÆCES.

	Dry Sub-stances.	Nitro-gen.	Fat.	Ash.
1st Experiment (3 days) .	7·8	6·5	3·3	48·8
2nd " (1 day) .	8·4	7·0	7·1	46·8
3rd " " " .	10·2	7·7	5·6	48·2
4th " " " .	9·4	12·0	4·6	44·5

It was also found that milk and cheese administered together were well assimilated.

As to the utilisation of vegetable foods, some of the most important series of experiments refer to the assimilation of various kinds of bread. The following table gives the results obtained by G. Mayer :—

INGESTED.

	Dry Sub-stances.	Nitrogen.	Ash.
1. White Wheaten Bread .	439·5	8·8	10·8
2. Munich Rye Bread . .	438·1	10·5	18·1
3. Pumper Nickel . . .	422·7	9·4	8·2
Loss per cent. in Fæces.			
1. White Bread . . .	5·6	19·9	30·2
2. Rye Bread . . .	10·1	22·2	30·5
3. Pumper Nickel . . .	19·3	42·3	96·6

The next table refers to the experiments of Rubner with the same object. In both series of experiments the important fact is established that the finer white kinds of bread are much more completely utilised in the organisms than the coarser brown or black (rye) kinds.

INGESTED.

	Dry Substance	Nitrogen.	Carbo-hydrates.	Ash.
White Bread (3 days)	1364	22·8	1173	29·9
" " " " .	2338	39·1	2010	51·2
Black Bread (2 days)	1529	26·61	1319	39·5
Percentage loss in Fæces.				
White Bread (3 days)	5·2	25·7	1·4	25·4
" " " " .	3·7	18·7	0·8	17·3
Black Bread (2 days)	15·0	32·0	10·9	36·0

Experiments with macaroni gave similar results to those with white bread. The percentage loss in the fæces in two series of experiments with macaroni was as follows:—

	I.	II.
Dry Substances . . .	4·3 per cent.	5·7 per cent.
Nitrogen	17·1 " "	11·2 " "
Carbo-hydrates . . .	1·2 " "	2·3 " "
Fat	5·7 " "	7·0 " "
Ash	24·1 " "	22·2 " "

Rice and maize were also found to be well assimilated by the human digestive organs, and the following table refers to two series of experiments by Rubner with *risotto* and *polenta*, together with Parmesan cheese :—

PERCENTAGE LOSS IN FÆCES.

	Risotto.	Polenta with Parmesan.
Dry Substances	4·1 per cent.	6·7 per cent.
Nitrogen	20·4 ,, ,,	15·5 ,, ,,
Fat	7·1 ,, ,,	17·5 ,, ,,
Carbo-hydrates	0·9 ,, ,,	3·2 ,, ,,
Ash	15·0 ,, ,,	30·0 ,, ,,

As to the utilisation of the leguminosæ, several experiments have been made by various observers as to the nutritive value of peas. It was immediately noticed that the mode of cooking exercised a great influence on the digestibility. When pea-meal was consumed for four consecutive days, prepared with milk, butter, and eggs; of a total of 875 grammes of dry substance ingested, containing 36·9 grammes of nitrogen, only 8·2 per cent. of this nitrogen was lost in the fæces. In a second experiment with *lentils, simply soaked in water and boiled,* 40·2 per cent. of the nitrogen was eliminated unused.*

In two series of experiments by Rubner on the digestibility of peas in the human subject, he administered in the first series only a moderate quantity, and in the second series an excessive quantity, with the following results:—

PERCENTAGE LOSS IN FÆCES.

	1st Series.	2nd Series.
Dry Substances . . .	9·1 per cent.	14·5 per cent.
Nitrogen	17·5 ,, ,,	27·8 ,, ,,
Carbo-hydrates	3·6 ,, ,,	7·0 ,, ,,
Ash	32·5 ,, ,,	38·9 ,, ,,

* Woroschiloff, Strümpell. Rubner.

These figures show that there is a far greater relative loss when large quantities are taken in the food than when small ones are used.

Experiments with regard to the utilisation of potatoes, carrots, and savoy cabbages, showed that it was defective.

Ingested.

	Dry Substance	Nitrogen.	Fat.	Carbo-hydrates.	Ash.
Potatoes . .	2993	34·37	430·3	2154·5	192·1
Carrots . . .	823	12·94	94·6	562·9	82·5
Savoy Cabbages.	1480	39·5	263·5		219·8
Percentage loss in Fæces.					
Potatoes . .	9·4	32·2	3·7	7·6	15·8
Carrots . .	20·7	39·0	6 4	18·2	33·8
Savoy Cabbages	14·9	18·5	6 1	15·4	19·3

Experiments as to the capacity of the human organs to digest cellulose were tested with celery, cabbage and carrots, and it was found that of *unlignified* cellulose from 47·3 to 62·7 per cent. could be digested.

The *absorption of fat* in the human organism was also tested by Rubner in a series of experiments, in which, besides bread and meat, large quantities of fat, bacon, and butter were administered. The following tables give the results obtained when variable quantities, from 100 grains up to the largest amount possible were consumed, together with bread and meat :—

INGESTED.

	Dry Substances	Nitrogen.	Fat.	Carbo-hydrates.	Ash.
Bacon, 100 grammes daily .	1090	47·3	198·0	519·2	47·0
" 200 " " .	1222	47·1	389·4	432·8	43·0
Butter, 200 " " .	1231	43·9	428·1	443·1	51·0
Greatest possible quantity of Fat	1562	46·7	701·0	468·7	54·9
Percentage loss in Fæces.					
Bacon, 100 grammes . .	8·5	12·1	17·4	1·6	28·5
" 200 " . .	9·2	14·0	7·8	6·2	25·1
Butter, 200 " . .	6·7	11·3	2·7	6·2	20·0
Greatest possible quantity .	10·5	9·2	12·2	6·8	27·7

Some interesting points in the assimilation of fats may be noticed in the results of these experiments. In the first place we notice that the whole amount of fat passed by the bowels was almost the same when 200 as when 100 grammes of bacon were consumed, and it was not until the daily consumption of fat exceeded 351 grammes, that the limit of perfect assimilation was surpassed. From this it may be concluded that the loss of fat in the process does not rise with the consumption of fat, but remains the same until a certain maximum is exceeded, and after that the proportion of fat assimilated rapidly declines. It is also shown that the utilisation of bacon is less than that of butter, a circumstance probably accounted for by the fact that in the latter the fat is not enclosed in cells. The utilisation of other foods is likewise influenced by these large quantities of fat, for that of the carbo-hydrates was less complete when large quantities, than when smaller amounts of fat were taken.

The utilisation and digestibility of different food-substances are, no doubt, greatly influenced by pathological conditions, as, for instance, in the febrile state, but accurate information resting on an experimental basis is much needed in this direction.

CHAPTER VII.

THE COOKING, PREPARATION, AND PRESERVATION OF FOOD.

MAN is the only animal that *cooks* his food, and although it is possible there may exist certain savage races that have no knowledge of cooking, it is certain that civilised man invariably cooks some portions of his food, and it would seem also to be certain that advances in civilisation are accompanied by proportionate progress in the culinary art.

Cooking answers most important purposes in connection with food. In the first place it improves or develops agreeable flavours in food, especially in animal foods, and thus renders them attractive and pleasant to the palate. By the action of a high temperature on meat, and the flesh of animals generally, agreeable gustatory properties are developed which they do not possess in the uncooked state, and they are thus rendered capable of giving pleasurable excitement to the sense of taste. Cooking thus increases the desire to take food. In the next place, it enables the food to be more readily masticated, and more easily digested. The mastication of animal food is greatly facilitated by cooking, for in the raw state it is tough and tenacious, and torn apart with difficulty; whereas after cooking the muscular fibres become more solid and firmer, while they lose much of their toughness, and are far more readily divided or torn apart by the teeth, while the fibrous tissue connecting them together is softened and gelatinised. The whole mass is thus rendered much less coherent and more susceptible of mechanical subdivision. The lessened cohesion and increased mechanical divisibility which cooking imparts to food, greatly favour its digestibility, by enabling the digestive juices to come into intimate contact with it, and to penetrate readily into its substance. Cooking thus leads to important mechanical and chemical changes in food, which greatly facilitate its digestion.

The exposure of food to a high temperature affords the further safeguard of destroying parasitic or other minute living creatures or germs which may accidentally be present in it. The effect of a certain degree of heat on animal flesh is that the albumen is coagulated, and the fibrous connective tissues are converted into gelatin. Nor is the warmth that cooking imparts to food a matter of indifference, for in many instances it promotes the digestive action of the stomach upon it, and increases its stimulating effects.

Boiling.—One of the simplest and most convenient modes of cooking animal food is that of boiling. One of the first effects of plunging meat into water is that some of the soluble constituents of the meat pass out into the water, a portion of the soluble albumen, of the extractives, and of the salts. To what extent these soluble constituents shall be extracted by the water, or be retained in the meat, will depend on the manner in which the process of boiling is carried out. In prolonged boiling more or less of the connective tissue is converted into gelatin, and is dissolved in the water; some of the fat, of course, melts at this high temperature and floats on the surface. The water in which the meat is boiled is termed *broth*, or, in French *bouillon*. As has just been said, when the object is to retain as much as possible of the soluble constituents in the meat, the process of boiling must be conducted differently to what it is when the contrary is desired, viz. to extract as much as possible of the nutritive constituents of the meat in the broth. In the first case, the meat, which should be in one large piece, is plunged into water which is already *boiling*, and it is then kept on the boil for about five minutes. By this means the albuminous matter in the external layers of the joint is rapidly coagulated, so as to form a protective layer on its surface ; this retains the juices and soluble constituents in the interior of the meat, and prevents their escape into the water. The meat is thus kept juicy and palatable throughout its interior, and the broth is thin and poor. After boiling briskly for five minutes, the cooking should be completed at a temperature of 160° to 170° F. If a lower temperature than this be employed, the albuminous matter in the interior will not be properly coagulated, and the joint will cut with a raw and uncooked appearance ; and if this temperature be much exceeded, the muscular fibre tends to shrink and become hard and indigestible. Most cooks employ too great heat in boiling, and so cause the meat to be hard and shrunken. Liebig recommended a temperature of 158° to 160° F., and Parkes says after the first five minutes of boiling "the heat can scarcely be too low," and he points out that the "temperature of coagulation of the albuminous substances differs in the different constituents ; one kind of albumen coagulates at as low a heat as 86° F., if the muscle serum be very acid ; another albumen coagulates at 113° F. ; a large quantity of albumen coagulates at 167°. The hæmato-globulin coagulates at 158° to 162°, below which temperature the meat will be underdone. In boiling, ammonium sulphide is evolved with odoriferous compounds, and an acid like acetic acid."

If, on the other hand, the object is to make a rich and nutritious broth, and therefore to extract as much as possible of the soluble constituents of the meat into the water, a different method is followed. The meat, cut into small pieces, is put into *cold* water, and the temperature should then be gradually raised to about 150° or 160°. Actual boiling should be avoided in making strong broth, in order to avoid the coagulation and precipitation of the albumen. But in the preparation of soups, prolonged boiling is needed in order to fully extract the gelatin. It is the gelatin, indeed, which forms the basis of soups, for the coagulated albumen floating in the fluid is usually removed by straining. Boiled in this manner the nutritive principles of the meat pass out as completely as possible into the water in which it is cooked, and impart to it the flavour and much of the nutritive qualities of the meat, while only a tough, tasteless, stringy solid residue is left. We thus see that either the joint must be sacrificed to the broth, or the broth must be sacrificed to the joint. Of course, inferior parts of meat, and bones, may be largely utilised when our object is simply to make strong broth or soup.

Parkes states that beef gives the weakest broth, containing in a pint about 150 grains of organic matter and 90 grains of salts. Mutton broth is a little stronger, and chicken broth strongest of all. About 82 per cent. of the salts of beef pass into the broth, *i.e.* all the chlorides and most of the phosphates. Broth can also be made without the application of heat by digesting half a pound of finely-minced beef with a pint of water, to which four drops of hydrochloric acid have been added. This is richer in soluble albumen than when heat is employed. By using rather more hydrochloric acid, but no salt, heat can be applied up to 130° F., and by this method nearly 50 per cent. of the meat can be obtained in the broth. (*Parkes.*)

The effect, then, of boiling on the joint (cooked for its own sake, and not for the broth) is to coagulate the albumen, to loosen the muscular fibres, and to abstract a portion of the water and some of the soluble extractives. There is, therefore, a considerable loss of weight in the process of boiling, variously estimated at from 20 to 30 and even 40 per cent.

The clear broth, after skimming from it the melted fat, together with the coagulated albumen which collects on the surface with the fat, contains very little nutritive substances. It contains the salts of flesh, some gelatin and soluble extractives, and forms a fluid stimulating to the digestive organs, although not actually and directly nutritious. According to Bauer, 500 grammes of meat will suffice to prepare a litre of strong broth, which should be flavoured with a few aromatic vegetables.

Roasting.—This method of cooking retains the nutritive juices and the extractives more completely than boiling. In order to retain the juices as much as possible, the joint should be at first exposed to a strong heat, and afterwards cooked very slowly. By this method the surface-layers are at once coagulated, water is evaporated, and a sort of crust is formed, which presents a barrier to the subsequent escape of the juices of the meat. The joint is removed to a greater distance from the fire, and the lower temperature is allowed to penetrate slowly to the interior. By this means the albumen and the coloured juices of the flesh are slowly coagulated without any great shrinking and hardening of the muscular fibre. A certain amount of the meat juice, however, escapes during roasting, and this, together with the melted fat, forms the "gravy," to which some gelatin becomes added when the high temperature is long maintained. Continual basting with the melted fat is an important part of the process, as it tends to diffuse the heat uniformly over the joint, and to prevent scorching and too great hardening of the surface.

As the surface becomes browned by the influence of a higher temperature, several new odorous and sapid substances are developed, which give to roast meat its characteristic odour and taste. If too strong a heat is employed, the fat is apt to undergo decomposition, and fatty acids are developed, attended with the disengagement of volatile products having a most penetrating and disagreeable odour, and often proving irritating to the digestive organs. If the temperature of the interior of the joint does not rise above 130° F., it remains reddish, blood-tinged, and "underdone." For beef, mutton, and game this temperature is sufficient, and gives the tenderest meat and the best-flavoured; but for veal and poultry a higher temperature—158° to 160° F.—is needed. The colouring-matter of the blood, as we have seen, coagulates at this point. If the temperature is allowed to exceed this, the muscular fibre becomes hard and tasteless. In roasting small joints, in order to keep them juicy and savoury and "underdone" throughout, they must be put for a short time in *very hot fat*, as in cooking steaks; so, also, in order to avoid the formation of a hard, dry crust on lean meat, it should be freely basted with added fat. The loss of weight in roasting is due chiefly to loss of water, and is estimated variously by different writers. Bauer puts it at a much lower percentage than that by boiling, viz. 20 to 24 per cent.; Parkes gives 20 to 35 per cent.—about the same as in boiling; Pavy, quoting Letheby, gives the loss by roasting as much greater; but probably much depends on the *method* of roasting.

The loss in *baking* is said to be rather less.

In other methods of cooking meat, the changes it undergoes are essentially the same as in boiling and roasting. One of the most popular is

Stewing.—In this process the meat is usually cut up into small or moderately-sized portions, and placed in just enough water to cover it. It is then allowed to simmer gently for a considerable time.

The meat should be cooked slowly; and the water should not be allowed to boil, for if boiling occur, the meat will become tough and hard. Much of the nutritive matters of the meat pass out into the surrounding liquid, which becomes thick, rich, and greasy, to which sliced vegetables and other flavouring ingredients are usually added. When properly stewed, the texture of the meat becomes greatly loosened, so that it breaks down readily under pressure, and should be thus rendered easy of digestion; but the other substances and the sauces so frequently added to stews often interfere greatly with their digestibility; and it is probable that when, as is not uncommon, the stewed substances are kept for a very long time at a high temperature, toxic products may be developed by decomposition of some of the albuminates. Stewing is an economical method of cooking meat, as the loss is much less than in boiling or roasting, viz. about 20 per cent., and is chiefly due to the water evaporated. The whole of the stew is eaten—meat, vegetables, and gravy—so that there is no loss of nutritive constituents. When this process is applied to previously-cooked meat it is termed a "hash." In this the meat is often hard, dry, and tasteless.

Braising.—Sir Henry Thompson has called attention to the neglect in England of the method of "braising" in cooking. He refers to it as a valuable process in the preparation of animal food, and as "superior in some respects to that which the term 'stewing' denotes. In braising, the meat is just covered with a strong liquor of vegetable and animal juices (technically called *braise* or *mirepoix*) in a closely covered vessel, from which as little evaporation as possible is permitted, and is exposed for a considerable time to a surrounding heat just short of boiling. By this treatment tough, fibrous flesh, even if old, whether of poultry, of cattle, or meat unduly fresh, such as it is difficult to avoid during the summer heats in town, is made tender and easily digestible. Moreover, it becomes impregnated with the odour and flavour of fresh vegetables and sweet herbs, while the liquor itself, slowly reduced in the process, furnishes the most appropriate, fragrant, and delicious sauce with which to surround the portion when served at table. Thus also meats which are dry, or with little natural flavour, as veal, become saturated with juices, and combined with sapid substances, which render the food succulent and delicious to the palate. Small portions sufficing for a single meal, however small the family, can be thus dealt with. . . The first principle essential to a braise is that the meat so to be treated must be very slowly cooked in a closely covered vessel, and with a small quantity of liquid. The second principle is that the meat shall be impregnated in this process with the flavour of vegetables, herbs, etc., and of some spices and, if desired, with wine. This is to be done by placing in the braise-pot around the meat slices of ham or bacon, cut carrots, parsnips, turnips, onions, various herbs, a bay-leaf, cloves, and other spices, and a little wine; together with a small quantity of good meat stock. . . The third principle is not generally considered absolutely essential to the process, although it is undoubtedly the last refinement necessary to produce a first-rate braise. It is that of partially browning or half roasting the portion also, and this may be accomplished in two ways. The legitimate or original way of doing this is to have well-fitted to the braise-pot a sunk copper or iron cover, in which some hot coals or charcoal are placed, in order to transmit downwards a scorching heat to the top of the portion which is uncovered by the liquid in the pot below. In this case it is usual to cover the portions, especially of a fowl, with a piece of white paper, which serves to shield a delicate morsel from a too fierce heat. The other and inferior way is to very lightly roast the meat before putting it into the pot to braise, and so dispense with the coals on the cover; but this hardens it and prevents the juices penetrating." *

Broiling or grilling is the same as roasting, only it is applied to smaller portions of meat, and is therefore a much more rapid process, and a far larger surface is exposed to the direct action of a high temperature. In order to preserve the juices within the meat the same principle must be applied as in roasting. It is a method which develops the flavour of the meat very completely, and has the further advantage of being rapid and convenient.

The flavour of *baked* meat is inferior to that of meat roasted before an open fire, for when cooked at a high temperature in a confined space the volatile fatty acids generated in the process are unable to escape, and they are therefore retained in contact with the joint, which acquires a rich, strong flavour, and is unsuited for the consumption of persons of delicate digestions.

Frying is also a mode of cooking meat ill suited for the purpose of increasing its digestibility. Usually the meat, cut into thin slices, is put into boiling oil or fat with which it becomes more or less saturated, and is thus rendered somewhat impermeable to the digestive juices. Fatty acids developed during the action of a high temperature on the fat are also apt to remain in contact with the meat, and to lead to disturbance of the digestive process, attended with the formation of irritating acid substances in the stomach.†

* "Food and Feeding."

† Some critical remarks on the process of frying, by Sir Henry Thompson, may be studied with advantage.

"The art of frying," he says, "is little understood, and the

Whatever method of cooking meat be adopted, one great rule should always be attended to, viz. to cook the meat slowly and with as little heat as possible, so that the loss may be chiefly due to the water evaporated.* Too great heat is commonly employed in cooking on a large scale, and the meat, instead of being juicy and full of flavour, is often sodden and tasteless, and the muscular fibres hard, shrunken, and indigestible.

In cooking salt meat, which is invariably *boiled*, the heat should be applied very slowly and for a long time ; the addition of a little vinegar is said to have a useful softening effect.

Fish is cooked for the same purpose as meat, and is usually either boiled, grilled, or fried. It is most easily digested when boiled ; the next best method is grilling. Fish requires to be *thoroughly* boiled so that it can readily be detached from the bones ; but it requires a shorter time than meat. The harder the water in which it is boiled the firmer is the flesh of the fish. Fish boiled in sea-water, or in water to which salt has been added, is firmer and of finer

omelette is almost entirely neglected by our countrymen. The products of our frying-pan are often greasy, and therefore for many persons indigestible, the shallow form of the pan being unsuited for the process of boiling in oil—that is, at a heat of nearly 500° F. This high temperature produces results which are equivalent indeed to quick roasting, when the article to be cooked is immersed in the boiling fat. Frying, as generally conducted, is rather a combination of broiling and toasting or scorching ; and the use of the deep pan of boiling oil or dripping, which is essential to the right performance of the process, and especially preventing greasiness, is a rare exception and not the rule in ordinary kitchens. The principle on which success depends is, that at the moment of contact with the almost boiling oil, a thin film of every part of the surface of the fish or other object to be fried is coagulated, so that the juices with their flavours, etc., are at once locked up within, and no quality can escape. The bath of oil should therefore be in quantity sufficient, and also be hot enough to effect this result in an instant ; after which, and during the few minutes requisite to cook the interior, the heat is often slightly lowered with advantage."

* Parkes states that the loss to the soldier from cutting up, from bone and from cooking, amounts to 6 or 7 out of 12 oz.

flavour than when boiled in soft water, because of the solvent effect of the latter.

Fish fried in fat is not a suitable food for persons of delicate digestion.

The preparation and nutritive value of soups, broths, and the various meat extracts, will be more conveniently considered hereafter.

The *Cooking of Vegetable Foods* must next be considered. Many vegetable substances used for food by man are absolutely inedible in the raw, unprepared condition, while others are rendered more palatable and digestible by cooking processes. Mechanical subdivision and the action of a high temperature are the chief processes applied to the preparation of vegetable foods. By these processes the vegetable structures are softened and the intercellular substance loosened, so that they are more readily amenable to the processes of mastication; by rupture of the cell walls, the nutritive cell contents are set free, while by the action of heat on the starch granules, the principal alimentary constituent in vegetable tissues, important physical changes occur which greatly aid the digestion of starch. Heat causes the starch granule to swell up, its outer envelope is ruptured, and its contents are set free, so that they can be readily acted on by the digestive secretions. Unless submitted to this influence, the outer envelope of the starch granule offers great resistance to the action of the digestive juices on its contents. Besides this action on the starch granules, cooking, as in the case of animal food, coagulates any soluble albuminous substances in the vegetable tissues or juices; and in boiling, the soluble, gummy, saccharine, colouring and saline matters are, of course, to a great extent extracted in the water.

Undoubtedly, *Bread-making* is one of the most important cooking processes that are applied to the preparation of human food, and it is practised amongst all civilised nations.

The art of bread-making consists in converting flour or meal into a firm and *porous* substance, which can be readily masticated, and which, while it retains a certain amount of water, is not noticeably moist or sticky.

The first step in this process is the formation of a *dough* or paste by mixing the flour with a certain quantity of water and *kneading* this together by the hands or by machinery. The next step is to impart the necessary property of porosity by intimately mixing carbonic acid with the dough, either by generating it within its substance, or forcing it in from without.

The first of these methods may be effected either by fermentation or by the use of so-called "baking powders"; and the second by Dauglish's process for forcing carbonic acid into the dough by pressure. Owing to the tenacity of the gluten of the meal, the vesicles of gas are held together, and a light, spongy mass is formed. It is then exposed, in suitable portions, to the heat of the oven, and by the process of *baking* it is solidified and converted into a firm and permanently porous *bread*.

Leavened bread is the term applied to bread in which the carbonic acid has been generated by *fermentation*. The ferment used is either *yeast* or *leaven*, that is, old dough in a state of fermentation. The yeast fungus, *Torula* or *Saccharomycetes cerevisiæ*, is the active agent in either case. This converts the sugar in the dough into alcohol and carbonic acid. It is usual in making bread by fermentation to mix a certain quantity of the flour with the ferment, some salt and lukewarm water. These are kneaded into a stiff paste or dough, which is placed aside in a warm situation for an hour or two. The mass gradually swells up, from the evolution of carbonic acid gas, or, as the baker terms it, the *sponge* rises. When the sponge is in active fermentation it is thoroughly kneaded with the remainder of the flour, salt and water, and again set aside for a few hours in a warm situation. Fermentation extends throughout the whole, and, at the proper moment, the dough is made into loaves and introduced into the oven. Herein constitutes one of the chief points in the baker's art. Unless fermentation has been allowed to proceed far enough, a heavy loaf is the result; and if allowed to proceed too far, an objectionable quality is given to the bread by the commencement of another—an *acid* fermentation. This is said to be more likely to occur, with the formation of acetic, butyric and lactic acids, when "leaven" has been used as the ferment, and that bread so made has, as a rule, a more or less sour taste. "Time also must not be allowed for the dough to sink before being made into loaves and baked. Under the influence of the heat of the oven an expansion of the entangled vesicles of gas ensues, and occasions a considerable further rising of dough; and with the subsequent setting of the substance of the loaf a permanently vesiculated mass is formed." (*Pavy.*) The alcohol is driven off by the heat of the oven in baking. The best-flavoured bread is said to be that made with brewer's yeast.

The necessary porosity may also be given to the dough by the use of *baking powder* for the evolution of carbonic acid gas. Borwick's baking powder consists of a mixture of carbonate of soda and tartaric acid; and Liebig's, which is by some considered more wholesome, of a mixture of the acid phosphate of calcium with carbonate of soda and chloride of potassium; or carbonate of ammonia may be mixed with the dough, and hydrochloric acid added. The bread thus made has a less agreeable taste than that made by fermentation, and it is a process rarely employed by bakers.

Dauglish's process, which is now largely carried out by the Aërated Bread Company, consists in forcing carbonic acid through the dough by pressure, and it claims as one of its recommendations that the manipulation of the dough by the hands of the baker is avoided. It is also considered to have the advantage over fermentation, that it is impossible for the conversion of starch into dextrin, sugar, and lactic acid to go too far. About twenty cubic feet of carbonic acid, derived from chalk and sulphuric acid, are used for 280 pounds of flour, and about eleven cubic feet are actually incorporated with the flour. It is said to keep sweet and good much longer than fermented bread, but it has a peculiar taste, and lacks the pleasant flavour of the best fermented bread; moreover, it is always drier, and in keeping even for a short time becomes very hard and brittle. Salt is usually added to bread to improve its flavour and appearance, giving it greater whiteness and firmness.

Bauer asserts that owing to "the more intense heat the changes in the constituents of the flour are carried farther in the crust than in the crumb," and that there are developed in the crust "along with dextrin and sugar certain specific sapid substances;" and he states that, "among other differences, there is always somewhat less nitrogenous matter in the crust than in the crumb." This is wholly at variance with Dujardin-Beaumetz's contention that "the crust is much more nourishing than the crumb"—a contention which he bases on the following analysis by Barral, showing the difference in the composition of the two.

	Crust.	Crumb.
Water	17·15	44·45
Insoluble nitrogenous substances (gluten, etc.)	7·30	5·92
Soluble " "	5·70	0·75
Soluble carbo-hydrates (dextrin, sugar, etc.)	4·88	3·79
Starch	62·58	43·55
Fats	1·18	0·70
Mineral substances	1·21	0·84

The effect of the heat applied in baking, on the constituents of the flour, is to increase their digestibility, the nitrogenous constituents are changed, the starch granules are ruptured, and a portion of the starch is converted into dextrin and grape sugar.

Bread varies much both in its digestibility and nutritive properties, just as it differs also in its physical appearance and chemical composition. These differences depend partly on the mode of preparation and partly on the kind of meal employed.

Badly-made bread is often the cause of dyspepsia; the fermentative changes continue in the stomach with generation of carbonic acid gas, and consequent flatulence, heartburn, and acid eructations. This has been attributed to the use of unwholesome yeast; and it has been urged in favour of aërated bread made by the Dauglish method that it is free from such risks; but bread may certainly be badly made, and on that account indigestible, without the fault being necessarily in the yeast. It is undoubtedly a great drawback to the use of the coarser meals and of whole meal for making bread that such bread is often indigestible and heavy, and productive of dyspepsia in some persons of feeble digestion. This is probably, in great measure, due to the diminished porosity of such bread, for it seems to resist aëration and vesiculation to the same degree as is common in the best qualities of white bread. Bauer observes of bread made of coarse, adhesive meal:—"Such adhesive breads are very imperfectly utilised by the human organs of digestion, since the irritation they cause to the mucous membrane of the alimentary canal leads to a rapid progress and early evacuation of its contents"—a property, however, often "usefully employed to overcome habitual sluggishness of the bowels."

Dujardin-Beaumetz also protests against the common error that the coarser kinds of household bread are more nutritious than the very fine white "fancy" breads (*pains de luxe*).

In the first place, it must be remembered that such bread is prepared and baked with unusual care and skill, and is thoroughly aërated and light, and thereby rendered more easy of digestion. In the second place, it would seem to be richer in nitrogenous constituents. The following figures, comparing the percentage proportion of nitrogen in three qualities of bread—seconds, firsts, and "fancy" bread—are quoted by Dujardin-Beaumetz from Violet ("Sur le Pain"):—

PERCENTAGE OF NITROGEN.

	Seconds.	Firsts.	"Fancy."
1st specimen	0·92	1·18	1·39
2nd ,, ...	1·05	1·36	2·06
3rd ,, ...	0·99	1·02	1·25
Average . .	0·99	1·19	1·57

The composition of some different kinds of bread is thus given by Bauer: * in 100 parts—

	Water.	Nitrogenous Matters.	Fat.	Sugar.	Non-nitrogenous Matters.	Woody Fibre.	Ash.
Fine Wheaten Bread .	38·51	6·82	0·77	2·37	40·97	0·38	1·18
English ,, ,, .	37·00	8·10	1·60	3·6	47·40	—	2·30
Coarse ,, ,, .	41·02	6·23	0·22	2·13	48·69	0·62	1·09
Rye Bread . .	44·02	6·09	0·48	2·54	45·33	0·30	1·31

* Abstracted from a larger table in his "Dietary of the Sick."

A great deal has been written, without very much reflection and without any very great regard to accuracy, about the evils attending the separation of the "bran," or outer coat of wheat, from the flour of which bread is made. It has been urged that not only is this practice very wasteful, but that it leads to the loss in the bread made from such flour of much of the most important nutritive constituents of the grain; and, indeed, it is admitted that the bran is rich in nitrogenous (15 per cent.), fatty (3·5 per cent.), and mineral substances (6·7 per cent., chiefly phosphates). But, as has been pointed out by Parkes and others, if the "bran" is used, much of it is probably entirely undigested, and it can therefore yield but little nutriment, and that, unless ground *very fine*, the outer envelopes of the grain are very irritating, and especially unsuited to sick persons with any tendency to intestinal irritation; indeed, according to Parkes, "dysenteries have been found most intractable merely from attention not being directed to this simple point." The method, now extensively adopted, of *decorticating* the grain—that is, of removing the two or three outer highly silicious envelopes and leaving the fourth or inner envelope—has certainly more to recommend it, and it no doubt yields a meal very suitable for bread-making, especially for young and growing persons with sound and active digestions; but we have seen some—otherwise very pleasant—bread made from such decorticated whole-wheat meal 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 white flour. Pavy also urges, with much cogency, that "if bread were our sole article of sustenance, the rejection of the principles contained in the outer part of the grain would be a serious error in dietetics; but if other food be taken which furnishes a free supply of them, as is actually the case with a mixed diet, there is nothing to condemn as erroneous. It must not be considered, because we do not consume the bran and the pollard of the meal ourselves, that their constituents are thereby wasted or lost to us. Employed, as such articles are, as food for other animals, we may, in reality, although indirectly, get their elements in association with other matter. Looked at in this way, it being granted that animal food is taken, we are at liberty, if our inclination so dispose us, without incurring any charge of wastefulness, to select one part of the grain for ourselves, and allow the other to pass to the lower animals."

Sir Henry Thompson advocates strongly that the bread of the labourer should be made from entire wheat meal; "but it should not be so coarsely ground as that commonly sold in London as 'whole meal.' This coarse meal does not readily produce light, agreeable bread when made in the form of ordinary loaves: a solid mass of this meal, 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. Consequently the form of a flat cake, resembling that of the ordinary tea-cake, is preferable, since it admits of the right amount of heat operating equally throughout the mass. The following recipe will be found successful, probably after a trial or two, in producing excellent, light, friable, and most palatable bread:—To 2 lb. of coarsely-ground or crushed whole wheat-meal, add half-a-pound of fine flour and a sufficient quantity of baking powder and salt; when these are well mixed, rub in about 2 oz. of butter, and make into dough with half milk and water, with skimmed milk (warm), or with all milk, if preferred.

Make into flat cakes like 'tea-cakes,' and bake without delay in a quick oven, leaving them afterwards to finish thoroughly at a lower temperature. The butter and milk supply fatty matter, in which the wheat is somewhat deficient. A palatable addition is made, in my opinion, by exchanging the half-a-pound of flour ordered in the foregoing recipe for the same quantity of medium-fine Scotch oatmeal. The change adds to the brittleness and lightness of the product."

The *baking powder* is made by mixing well together—Tartaric acid, 2 oz.; bicarbonate of soda, 3 oz.; common arrowroot, 3 oz. Keep perfectly dry in a wide-mouthed bottle.

The advantages of bread as an article of diet are familiar to every one. It contains a large amount of albuminates and carbo-hydrates; the nitrogen is in the proportion of 1 to 21 of the carbon, so that the addition of some nitrogen would be necessary to make it a perfect food. It is deficient in fat and, if the outer coverings of the grain are entirely removed, in mineral substances. But man never tires of its use, probably because of the great variety of its constituents.

A further cooking of bread in the form of *toasting* is often resorted to, and it appears to increase its digestibility; there is a further loss of water, and the surfaces are scorched, and the bread is made firmer and crisper. It should be toasted in slices *thin enough* to be made crisp all through; when they are thick the central part becomes soft like *new* bread. New bread is well known to be less digestible than stale; the former being soft and moist is more difficult of mastication and insalivation, as it tends to clog together in heavy adhesive masses which are not porous enough to allow of the free access of the digestive juices. Bread, when stale, has the peculiar property of becoming soft and like new bread on re-baking or exposing for a short time to a high temperature; this has been accounted for on the hypothesis that when bread gets dry by keeping, the water enters into chemical combination with the solid constituents, for if it were due to evaporation of the contained water, it would be impossible to make it appear fresh and new by reheating.

Wheat flour, and the meal of other cereals, is also cooked in various other ways besides being made into bread. *Biscuit*, as the name signifies, is made of dough which is baked much longer, and is harder and drier than ordinary bread, so that it can be preserved for a much longer time. In the French army, besides the *pain de munition*, or ordinary bread, which is reckoned to keep from five to eight days, according to the season, they have when on active service *pain biscuité*, which will keep forty to fifty days. They have also *pain demi biscuité*, which can be preserved twenty to thirty days.

The simplest kind of biscuit is made of flour and water only, or a very little butter is added to prevent it from becoming too dry and hard. Such is the ordinary "ship" or sailor's biscuit. The advantages of biscuit of this kind are that it contains but little water, and is therefore, bulk for bulk, more nutritious than bread, three-quarters of a pound of biscuit being equivalent to one pound of bread; it occupies less space, and is more transportable. Its disadvantages are, that it tends, by keeping, to get very hard and dry, and to become, after long restriction to its use, unpalatable and indigestible, and it is found better for the health of troops to issue a bread ration whenever possible, and to use biscuit only when bread cannot be procured. Parkes calls attention to the value of "unfermented cakes" made simply with water and salt, as a substitute for biscuit in war time. They are palatable, nutritious, and readily made; and he thinks every soldier should be taught to make them. "The Australian damper is simply made by digging a hole in the ground, filling it with a wood fire, and when the fire has thoroughly burnt up, removing it, placing the dough on a large stone, covering it with a tin plate, and heaping the hot ashes round and over it. In a campaign every soldier, if he could get flour and wood, would soon learn to bake a cake for himself. The only point of manipulation which requires practice is not to have the heat too great; if it be above 212°, too much of the starch is changed into dextrine, and the cake is tough. Exposed to greater heat and well dried, the unfermented cakes become biscuit."

Various other kinds of biscuit are prepared in which sugar, eggs, milk, etc., enter as constituents, and sometimes baking powder or carbonate of ammonia (on account of its volatility) is added to the dough to give them porosity and lightness.

Puddings, pastry, sweet cakes, etc., are made of flour mixed with butter, eggs, sugar, and other substances. These are cooked at a high temperature, being usually baked or boiled, and the flour undergoes similar changes to those which occur in making bread. They are, however, generally rich, and apt to cause stomach disturbances, especially in the dyspeptic. Pastry is especially unwholesome on account of the changes which the heat of the oven causes in the fats mixed with it; and boiled pudding or paste is indigestible because it usually forms a solid tenacious mass, not porous like bread, and penetrated with difficulty by the digestive fluids.

Macaroni, Vermicelli, Pâte d'Italie, etc., are all preparations of flour usually made from hard Italian wheat, rich in gluten. A stiff paste is made with flour and hot water, and this is pressed through holes in metal plates, or stamped into various forms, heat being applied at the same time. They have the advantage of keeping well and being very nutritious in small bulk, and so are convenient for transport.

Of *macaroni* Sir H. Thompson observes:—"It is certainly to be lamented that so little use is made in our country of Italian pastes. Macaroni in all its forms is, in fact, an aliment of very high nutritious power, being formed chiefly of gluten, the most valuable part of the wheat from which the starch has been removed. 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 mid-day meals. . . Macaroni might with advantage be prepared at restaurants as a staple dish in two or three forms, since it sustains the power without taxing too much the digestion. One of the best forms for serving it is that known as *macaroni à l'Italienne*, a simple and excellent mode of preparing which is as follows:—Place in a quart stewpan a pint and a half of boiling water; throw in 4 oz. of macaroni; season with salt and pepper, and boil gently for twenty minutes. Strain completely from the water in the colander, wipe out the stewpan, and put back into it the macaroni, with a quarter of a pint of good stock; let it simmer gently until all the liquid is absorbed by the macaroni, a process requiring about twenty minutes. Grate and mix together an ounce of Parmesan and an ounce of Gruyère or good English cheese. Half of this quantity is to be put into the stewpan, stirring the cheese into the macaroni over the fire. When this quantity is dissolved, add the rest of the cheese, together with rather more than half an ounce of butter, and stir until all is melted. Season and serve on a hot deep dish." Milk may be used instead of stock.

Many kinds of farinaceous foods are prepared by boiling with milk, eggs, etc., and served in semi-fluid form easy of digestion, and very suitable for invalids, young children, and persons of delicate digestion. Oatmeal gruel, rice-milk, and milk puddings made with sago, arrowroot, tapioca, macaroni, etc., afford very useful foods, especially appropriate to states of convalescence, and as a transition from fluid to solid foods.

Rice requires to be cooked carefully, or the grains remain hard and indigestible; thorough steaming, so that the starch granules shall be completely swollen, is the best process to adopt.

Peas and *beans* also require thorough boiling, slowly, and for a long time, in order to be made digestible. If old, no amount of boiling will soften them, they must then be soaked in cold water for twenty-four hours, crushed and stewed.

The *potato*, a vegetable rich in starch, also requires careful cooking. Steaming is the best method, as there is then no loss of salts, but the heat should be moderate. If boiled, it should be in their skins to prevent the loss of salts, and the boiling must be thorough or the starch granules will remain indigestible; and also *slow*, otherwise the cellulose and albuminates will be hard.

"*Mashed* potatoes" is a useful method of serving this vegetable, as it effectually gets rid of the hard indigestible masses into which a badly cooked or imperfectly masticated potato is apt to reach the stomach.

Most *fresh green* vegetables and edible *roots* are boiled in water according to definite culinary rules, and their digestibility and wholesomeness depend greatly on their being well and carefully cooked. They should be selected young and tender, and boiled sufficiently to acquire the necessary softness. Their digestibility is greatly increased, and their irritating properties avoided by reducing them into the form of *purées* whenever this is possible.

Vegetables of the cabbage tribe give a peculiarly disagreeable odour to the water, "green-water," in which they are boiled, so that they must be boiled alone and the water thrown away. *Salads* are prepared both with cooked and uncooked vegetables, and are usually "dressed" with a mixture of oil, vinegar, and other condiments. They are useful for stimulating appetite, and giving relish to other food, but they do not constitute suitable food for invalids as they are somewhat difficult of digestion.

Many fruits are also submitted to a cooking process, in order to soften them and make them more easy of digestion.

The preservation of food.—Various means have at all times been adopted by the human race to prevent or retard the decomposition of food substances, so as to render them transportable from place to place, or to store them up when procurable in abundance, for use in periods of scarcity, or to preserve them from one season to another.

By the application of the various means available for preserving foods, the produce of different countries becomes interchangeable, and the over-abundance of one region supplies the deficiencies of another; and, indeed, a great part of the world's commerce consists in the transport of food supplies between distant countries. Foods that contain very little water, such as various cereal grains and the pulses, only require to be kept dry and clean, in order to remain sound and in a good state of preservation for long periods, but all kinds of food, both animal and vegetable, into the composition of which water enters largely, can only be prevented from undergoing decomposition for any considerable time by special methods of preservation. These methods are mainly four in number :—

1. The method of *drying* food, or getting rid of the greater part of the water contained in it.
2. The exclusion of atmospheric air; or, what amounts to the same thing, covering the food with an impermeable coating.
3. Exposure to cold.
4. Treatment with antiseptic chemical agents.

Some of these methods are frequently combined. Drying by exposure to the air is a very ancient and primitive method of preserving animal food, and is practised largely in savage or half-civilised communities. In countries where the air is dry and pure, and the solar radiation intense, it is a ready and convenient method; the meat is simply cut into slices and exposed to the air. The Kaffirs thus preserve large masses of beef that have been sun-dried. The Egyptians also preserve meat by exposing it to the sun and north wind.

Charqui is the name given in South America to strips and slices of beef, freed from fat and dried rapidly by sun heat, and sprinkled with maize. *Tasajos* is also a preserved meat prepared in South America, by cutting it in thin slices, then dipping it in brine and partially drying. *Pemmican*, a food used by Arctic travellers, consists of a mixture of the best beef and fat dried together, and is very nutritious, but costly. Sugar is sometimes added to it, as well as raisins and currants, which increases its value when fresh vegetables are not procurable.

Meat may also be dried at a very low heat; it gets very hard from having lost the greater part of its water, and requires careful cooking.

There is a preparation of dried meat by M'Call, of London, which retains 12 per cent. of water, and is flavoured with pepper and salt. It is sold in 4 oz. packets, and is said to be very good and nutritious.

The French use powdered dried meat largely for adding to invalids' foods. *La poudre de viande Rousseau* is one of the most popular; it is said to keep for any length of time, to be of an agreeable odour and taste, and to be readily digested.

Another dry food in vogue in Paris is the *Aliment complet Adriam*, which professes to be a "complete" food, and to contain in a dry form and in small volume, roast meat, toasted bread, milk, sugar, steam-cooked vegetables, and malt. It is stated to have an agreeable flavour, and it is intended to take the place of powdered meat.

Hassall's flour of meat is analogous to these preparations. It is said by Parkes to be composed of good fresh meat, freed from visible fat, and carefully dried at a very low temperature, and pulverised by machinery, so as to form a very fine, smooth powder. This is mixed with about 8 per cent. of arrowroot, $2\frac{1}{2}$ per cent. of sugar, and 3 per cent. of a mixture of salt, pepper, spices, and colouring matter. The object of the arrowroot is to assist its suspension in water. It keeps well in tins, but it should not be exposed to the air for long at a time.

Bread is also preserved by drying; the "pain biscuité" of the French army is bread dried by heat, and bread from which the water has been partially pressed out by hydraulic pressure will keep good for years. *Potatoes*, too, are preserved by drying. They are either in slices or granulated. This preparation is easily cooked (should be steamed, after soaking in cold water) and very palatable. Analyses made by Professors Attfield and De Chaumont showed that one pound of preserved potatoes contained the solid matter of three and a half pounds of ordinary fresh potatoes.

Other *vegetables* can be dried and compressed, such as peas, cauliflower, carrots, etc., and so successfully that those of Masson and Challot, if properly cooked, are almost equal to fresh vegetables. They must be cooked very slowly. Professor Attfield's analysis showed that dried compressed cabbage contained the solids of seven times its weight of fresh cabbage, and the mixed vegetables five and a half times the solids of the fresh vegetables. The experience of the American war showed that as anti-scorbutics they were much better than nothing, but inferior, however, to fresh vegetables. Vegetables preserved in bulk, without drying, are much better as food, and as antiscorbutics.

Milk can also be preserved by *drying*, and is sold as a powder.

Eggs can be dried, but the yolk does not keep well. Mixed with flour, ground rice, etc., both yolk and white can be dried and preserved.

The *drying of fruits* is a very well-known means of preserving them.

A combination of drying, salting, and smoking is a very common domestic method of preserving several kinds of animal food.

2. The *exclusion of air* is another largely employed method of preserving food. The immersion of fish (previously somewhat salted) in oil, the covering potted meats with a layer of melted fat, are familiar illustrations of this process. By simply exposing the surface of meat to a strong heat, so as to coagulate the outside albuminous layers, it can be, on this principle, kept for some time.

Any means by which foods can be covered with an impermeable coating, and so protected from the action of the air, will usually preserve them for a long time; in this way by coating eggs with a solution of bees' wax in warm olive oil (one-third of bees' wax to two-thirds of olive oil) they may be preserved for two years. Eggs are also preserved by packing in sawdust or salt, or by covering them with gum, butter, or oil, indeed anything which excludes air. A modification of this method is one described by Parkes. "Meat being cut into smaller portions and placed in a large vessel, heat should be applied, and while hot, the mouth of the vessel should be closed tightly with well-washed and dried cotton-wool; the air is filtered, and partially freed from germs." Covering the whole surface of meat with a coating of paraffin, or embedding it in powdered charcoal, is also a preservative measure representing applications of this method. Tinned and bottled provisions are all preserved on the principle of the exclusion of air. The food to be preserved having been introduced into a suitable vessel, heat is applied so as to generate steam, in order to drive out the air, the opening of the vessel is then closed and made air-tight.

What is known as Appert's process consists simply in the complete exclusion of air. McCall's process consists in partial exclusion of air, and acting on the residue by sodium sulphite; this latter process avoids the application of so high a temperature as is needed in the former. Another method is to draw off the air and substitute a mixture of nitrogen and a little sulphurous acid in its place. Meat, fruit, vegetables, and all kinds of provisions may be preserved for a great length of time by application of this method. Milk may be kept in the same way, but the butter is apt to separate, and this may be prevented by concentrating the milk and adding some sugar. It is usual to add about 80 grammes of cane sugar to one litre of milk, and evaporate the whole to one-fifth of its volume, and it is sealed up while hot in air-tight tins; when given to children a suitable proportion is first dissolved in cold water and then boiled. By Loefflund's process it is preserved *unsweetened*.

3. Another method is the application of *cold.* It is a well-known domestic expedient to keep perishable food substances on ice, and fish is invariably packed in ice to convey it to market, and to preserve it fresh until cooked. In ice, meat can be preserved for an unlimited period, and the supposed tendency to rapid decomposition after thawing appears to have been exaggerated. It is, however, certain that frozen meat loses about 10 per cent. more in cooking than freshly-killed meat. Large quantities of meat are now imported from America and Australia in refrigerating chambers. The refrigerating chamber is now an essential part of the equipment of ocean-going steamers, and thanks to it passengers can now be provided with fresh provisions all through the voyage.

"The refrigerating apparatus plays an important part in passenger economy on board the ships of the Orient line.* In specially constructed chambers, meat and vegetables can be kept for any length of time without damage, and the passengers of all classes have fresh food at all times without the disagreeable odours which used to accompany the livestock pens in use before the chambers were fitted. The principle on which the freezing chamber is contrived is one of the most curious examples of the application of a scientific theory to a practical purpose. To endeavour to explain it in unscientific language, let us state what has long been known, that a certain quantity of heat, a quantity perhaps not to be felt, is in all air. This heat keeps the air at a certain bulk, and the more heat there is the more the air expands. This is, of course, within the experience of every one. To make use of the fact for refrigerating purposes, air is pumped into a chamber, and so compressed. The temperature of the

* "The Orient Guide." Description of freezing machines by Mr. Andrew Brown, the Orient Company's Superintendent Engineer.

compressed air rises. The latent heat, that is, becomes active. This is got rid of by circulating cold water through it; the water of the sea is cold enough; and the compressed air parts with its heat to the water. It is then liberated, but to attain its ordinary volume or bulk it must have back the heat it has parted with to the water. It tries to get heat from everything it comes in contact with. Any particles of moisture it encounters fall in snow before its chilly breath. When meat and vegetables are placed before it, any heat they contain is taken from them, and they become frozen. This is the principle of the refrigerator; and its application, with the help of an engine to compress the air and work the circulating pump, is merely a matter of detail.

"The water of the sea, at its ordinary temperature, is found quite cold enough for the purpose, and cold is generated artificially with as much ease and exactness as heat. The freezing chamber can, at will, be cooled down to any point that may be required. The compression and expansion of the air are effected by machinery. In the earlier refrigerating apparatus for producing cold, salts were used, and in conjunction with water and acids, were circulated through pipes in the storage chambers; but these methods have been entirely discarded in favour of freezing by cold air, which, besides being less costly, is much more easily adapted for use on shipboard.

"Before the air is in a suitable condition to be discharged from the machine into the chambers, it has its heat subtracted from it during four successive stages. In the first of these it is drawn from the atmosphere into the compressing cylinders, where it is compressed to one-fiftieth of its original volume, being at the same time cooled by jets of water playing into the cylinders. At this pressure it is led to a water tower, where it is mixed with water from a spray, which further reduces it in temperature, after which the moisture which it has acquired is taken from it in a series of drying pipes, surrounded by air returning from the chambers. The compressed air thus cooled and free from moisture, goes then to the expansion cylinders, where it gives out during expansion part of the work expended in compressing it, in helping to drive the machine. It is then in a condition to enter the storage chambers at a temperature of about 80 degrees below zero Fahr., or about 120 degrees of frost, and entirely free from moisture.

"Besides preserving fresh meat and vegetables, sweet milk and fresh butter are stored for use when wanted, wines are cooled before being supplied, and large quantities of ice are daily made for passengers' requirements in hot weather.

"From Australia, 5,000 to 10,000 carcases of mutton can be brought to the London market in the insulated cargo chambers of each steamer, while lately, fruits of various kinds have been successfully carried during the hottest season of the year."

4. And lastly, there is the method of preservation by antiseptic chemical agents, a method which is often combined with one of the others. Salting and smoking, associated often with drying, represent the earliest efforts in this direction. Salting is one of the oldest methods of preserving meat; a small quantity of saltpetre is usually added to the common salt to preserve a red colour in the flesh. Smoking is usually applied *after* salting. The creasote and other constituents of the smoke penetrate the substances exposed to it, and exercise a highly antiseptic and preservative action upon it. A certain amount of drying and coagulation of the albumen on the surface occurs at the same time.

One of the great objections to salting is that a portion of the salts and extractives, and a considerable amount of the albuminates, pass out into the brine. Analysis of the brine has shown that it contains much of the nutritious principle of the meat both organic and mineral. Liebig estimated the nutritive loss at one-third or more. Kühne has found that myosin is soluble in a 10 per cent. solution of chloride of sodium; hence a large quantity of this substance necessarily passes into the brine. The muscular fibre is also hardened by the salt, and rendered indigestible. Parkes considers salt beef to be of rather less than two-thirds the value of fresh beef. Whitelaw was able to obtain by dialysis a large quantity of flesh extract from the brine of salt beef; from two gallons of brine a fluid was obtained which, on evaporation, yielded one pound of extract.

Brine has sometimes been found to be poisonous; this occurs when it has been used over and over again. A large quantity of animal substance passes into it and appears to decompose, but no special poisonous agent has been isolated. Another important consideration is that the long continued use of salted meat leads to a deterioration of health, and the development of scurvy.

The flesh of the *hog*, however, seems especially adapted to salting and smoking, and its digestibility and wholesomeness are increased rather than diminished thereby. Bauer speaks of "smoked bacon as one of the wholsomest forms of meat. Whether boiled or eaten raw, it seems as a rule to be more easily digested by weak organs that almost any other. It appears to me not improbable that the flesh becomes more digestible in the process of smoking."

Fish, such as salmon, herrings, cod, haddock, sprats, and many other kinds, are preserved in vast quantities, by salting and smoking together, or by salting alone.

Immersion in vinegar, alcohol, or strong syrup, the application of sugar to the surface, are also common expedients for preserving both animal and vegetable foods.

There are many other antiseptic agents used for preserving food, such as the *vapour of sulphur*, the meat being placed in a close vessel in which sulphur is burnt; or *charcoal*, which is dusted over its surface; or *strong acetic acid;* or *calcium disulphide;* or *weak carbolic acid.* Injection of *alum* and *chloride* of aluminum into the blood-vessels will preserve meat for a long time; water should be injected first and the antiseptic solution afterwards. Borax, boric acid and salicylic acid have all been used for the preservation of food.

Aseptin, a powder, and *Aseptin amykos,* a liquid Swedish nostrum, used in the preservation of food, both owe their antiseptic properties to boric acid. This acid is also used largely in England and other countries for preserving milk. It is regarded by most authorities as harmless. A substance termed *Boro-glyceride,* a preparation patented by Barff in England and Le Bon in France, is made by heating together boric acid (62 parts) and glycerine (92 parts). It forms a tough, deliquescent mass, readily soluble in water and alcohol; and in solution in water in the proportion of one to forty it is extensively used as an antiseptic for the preservation of meat, fish, milk, and other food. Another substance termed *Glacialin* has been recommended for the same purpose; this consists of borax, boric acid, sugar and glycerine.

Much discussion has taken place, especially on the Continent, as to the propriety of allowing salicylic acid to be used for the preservation of wine, beer, milk, fish, meat, fruit and other food substances; and the decision has been almost universally against its use as being distinctly injurious to the healthy organism.

In addition to the preceding *general* account of the different methods of preserving foods, it may be useful to describe the measures usually adopted for preserving particular important articles of diet.

Milk may be preserved by various means. 1. It may be boiled, then placed in a bottle which should be completely filled and at once corked up and sealed so as to be air-tight. The milk lessens in bulk, a vacuum is formed on its surface and in this way it will keep for some time. It will keep longer if a little sugar be added. If it is heated in a close vessel to 250° F., it will keep for years. The butter may, however, separate. 2. The passing of sulphurous acid gas through milk after boiling, or the addition of sodium sulphite to it, will preserve it for some time. 3. The addition of a little carbonate of soda and sugar, with or without boiling, will keep it for ten or twelve days. 4. The addition of boric acid and the other antiseptics already mentioned. The method of preserving concentrated milk in tins has been described. Desiccated or dried milk is milk mixed with a little sugar and dried at a low temperature. It is said to form an excellent milk when dissolved in water.

Butter.—The tendency of butter to become *rancid*, especially in hot weather, is well known. This is due to the presence of some of the albuminous constituents of the milk, which, acting as a ferment, cause the setting free of the fatty acids. Washing the butter thoroughly so as to separate these substances completely, contributes greatly to its subsequent preservation. Indeed, it may be preserved for some time, but at the cost of some loss of flavour, by melting and shaking with boiling water so as to completely remove these substances. Butter also that has become rancid may be again rendered eatable by melting and agitating it repeatedly with boiling water, which removes the fatty acids; while melted it should be poured into ice-cold water. Salt is used very largely in the preservation of butter; it checks the decomposition of the casein which is present and so preserves the butter from decay. Sugar will also exert the same influence, and butter immersed in syrup is said to keep even better than when salted. Butter may also be preserved by excluding it from air, so that merely immersing it in cold water, which should be changed daily, will keep it fresh for a week or more. It is said that a weak solution of tartaric acid or water acidulated with acetic acid (3 grammes to a litre) is far more efficacious, and that butter has been kept fresh for two months by its means at a temperature of 60° to 68°. It should be kept in a closely-covered vessel.

Potatoes.—According to Parkes, sugar, in the form of molasses, is the best substance for preserving potatoes on a large scale; a cask is filled with alternate strata of molasses and peeled and sliced potatoes. On a small scale, boiling the potatoes for a few minutes will keep them for some time. Free exposure to air, turning the potatoes over and at once removing those that are bad, are useful plans. Preserved potatoes have already been described.

Liebig's Extract is a form of *preserved* and *condensed* meat.

It is prepared by subjecting meat entirely freed from tendons and fat to a moderate heat for some time until a viscid dark extract is obtained which contains the salts, creatin, and other organic nitrogenous substances. Mixed with warm water, it forms a nutritious and palatable fluid. One pound of mutton gives about two-fifths of an ounce of extract. It has no tendency to decomposition and will keep unaltered for years. Other extracts of meat resemble it more or less in composition.

Liebig's extract has been found remarkably restorative after the fatigue of great exertion and to increase cardiac power. It has been used with great effect mixed with wine to rouse wounded soldiers who have passed into a state of collapse. It does not, however, represent a true nutritive albuminate, as it contains no albumen or fibrin, its nitrogenous constituents being in the form of creatin and soluble extractives. It is believed to increase the power of the stomach to digest vegetable food, and while not capable of acting as a substitute for meat, yet assists also in digesting meat so that less meat is needed. It should not be taken in large quantities as it has been known to cause heaviness and torpor, probably owing to the excess of nitrogenous extractives introduced into the system. It is a useful addition to poor soups. A great number of condensed fluid meat extracts are prepared, most of which are of value as nutritious restoratives, but none of them can be said to be capable of completely taking the place of meat.

Meat biscuits can be made in a very simple way (*Parkes*) "by mixing together, cooking and baking 1 lb. flour, 1 lb. meat, $\frac{1}{4}$ lb. suet, $\frac{1}{2}$ lb. potatoes, with a little sugar, onion, salt, pepper and spices. A palatable meat biscuit, weighing about $1\frac{1}{4}$ lb., containing 10 to 12 per cent. of water, is thus obtained, which keeps quite unchanged for four months."

The celebrated *Erbswurst*, or *pea sausage*, of the German army contains pea-flour and fat pork, with some salt. It is ready cooked and can be quickly made into a soup. It was used largely in the Franco-German war, and was much liked for a few days, but it is said the men got eventually tired of it, and that in some it produced flatulence and diarrhœa; but it is obvious that however useful such a form of preserved food might be, it is one which should be varied with other foods, and not trusted to exclusively, or for long at a time.

CHAPTER VIII.

THE SCIENTIFIC BASIS OF DIETARIES AND RATIONS.

THE object of food is, as we have seen, to repair the waste and to minister to the growth of the bodily organs: to maintain a nutritive equilibrium between the bodily income and expenditure under all the varying conditions and circumstances to which the human organism may be exposed; to maintain all the functions of the body in healthy activity, and to prevent any loss of the normal body-weight. In the determination of a dietary or dietaries adequate to all these purposes, in the selection of suitable kinds and sufficient, but not excessive, amounts of food, experience has shown that it is not altogether safe to trust merely to the sensation of hunger or to the voluntary choice or desires of individuals. Such a reliance might lead to injurious over-indulgence on the one hand, and serious insufficiency on the other. It is therefore necessary that we should be provided with some accurate scientific data, which shall furnish a secure basis for the construction of the various diet scales and rations appropriate to the many varying periods and conditions of human life.

The practical considerations associated with this investigation are of the greatest general importance and interest, for they include the determination of such questions as the food of the soldier at home and in the field; the food of convicts in strict confinement and engaged in hard labour; of the inhabitants of various public institutions, such as schools, asylums, hospitals, etc.; the appropriate food in childhood, growing youth, and maturity in the different sexes; in sickness and in health; in different occupations, climates, etc.

A certain amount of valuable information can undoubtedly be obtained by reference to the long-established customs and habits of different classes of persons as founded on the teachings of a lengthened experience; but it is an advantage to be able to bring to the support of the conclusions founded on such data more precise experimental proof. To provide this is admittedly a difficult and complex problem.

The elaborate series of experiments undertaken by Voit and Pettenkofer had for their object the estimation of the influence which various foods or mixtures of foods had on metabolism. To do this it was needful to ascertain accurately the total bodily income and output, so as to discover under what circumstances a given amount of food either exactly maintained the nutritive equilibrium, and therefore the body-weight, or was attended with either loss or gain.

By this means these observers were enabled to determine, with precision, the amount of the three chief classes of alimentary substances—the albuminates, fats, and carbo-hydrates, which were respectively necessary to satisfy the wants of the organism, and also to ascertain what was the fate of any excess of these.

One fact, as might have been expected, soon became evident, viz. that the amount of alimentary substances consumed in the body, even under ordinary conditions, was very variable, and depended on the general nutritive condition of the body, on the amount of work performed, and on certain external circumstances; so that in order to estimate the amount of food needed by different persons, it became necessary to take the averages of a great number of experiments adapted to the experience of ordinary daily life, as well as to special conditions.

It was found that the two most important factors which determined the amount of food required by different persons were: first, physical development and body-weight; and second, the amount of work performed. In short, as might readily be supposed, a strong, well-developed man in active work required much more food than a small feebly-developed man leading an idle life.

The three following tables are abstracted from those given by Bauer as representing the results of Pettenkofer's and Voit's experiments to show the incoming and outgoing in the case of a powerful man weighing 69·5 kilos. (1) in a state of rest; and (2) during work; and (3) for purposes of comparison in a small and ill-nourished man during rest and with a liberal diet.

1.—INCOME AND OUTPUT WITH AN ABUNDANT DIET AND DURING REST.*

Income.		
Meat	139·7	grammes.
White of Egg	41·5	,,
Bread	450·0	,,
Milk	500·0	,,
Beer	1025·0	,,
Suet	70·0	,,
Butter	30·0	,,
Starch	70·0	,,
Sugar	17·0	,,
Salt	4·2	,,
Water	286·3	,,
Oxygen from Air	709·0	,,
Total	3342·7	,,
Output.		
Urine	1343·1	grammes.
Fæces	114·5	,,
Breath	1739·7	,,
	3197·3	,,
Balance +	145·4	,,

* Bauer, "Dietary of the Sick." It has not been thought necessary to reproduce all the details of the chemical analysis of the various foods consumed.

In this experiment a summary of the results of chemical analysis gives the following figures :—

	Taken in.	Consumed.	Stored up.
Albumen . . .	137	137	
Fat	117	52	65
Carbo-hydrates . .	352	352	

2.—Income and Output with an Abundant Diet and During Work.

Income.

Meat	151·3	grammes.
White of Egg . .	48·1	,,
Bread	450·0	,,
Milk	500·0	,,
Beer	1065·9	,,
Suet	60·2	,,
Butter	30·0	,,
Starch	70·0	,,
Sugar	17·0	,,
Salt	4·9	,,
Water	489·1	,,
Oxygen from Air . .	1006·1	,,
Total . .	3892·6	,,

Output.

Urine	1261·1	grammes.
Fæces	129·0	,,
Respiration . . .	2545·5	,,
	3935·6	,,
Balance —	43·0	,,

It was found on chemical analysis that *during hard work* whereas only the *same* quantity of albumen (137 grammes) was consumed as during rest, on the other hand, 173 grammes of fat were consumed, as compared with 52 during rest. The amount of carbo-hydrates was the same in both instances—352 grammes.

3.—INCOME AND OUTPUT IN A SMALL ILL-NOURISHED MAN, WITH AN ABUNDANT DIET DURING REST.

Income.

Meat	151·1	grammes.
White of Egg . .	61·8	,,
Bread	450·0	,,
Milk	509·6	,,
Beer	1012·7	,,
Suet	58·8	,,
Butter	30·0	,,
Starch	70·0	,,
Sugar	17·0	,,
Salt	4·3	,,
Water	41·4	,,
Oxygen from the Air .	600·7	,,
Total . .	3007·4	,,

Output.

Urine	1069·6	grammes.
Fæces	137·1	,,
Respiration	1597·8	,,
	2804·5	,,
Balance +	202·9	,,

As the result of these experiments, Voit fixed for the average daily needs of a moderate worker 118 grammes of albumen (nitrogen 18·3 and carbon 63) and 265 grammes of carbon, either in the form of fats or carbo-hydrates, making a total of 328 grammes of carbon.

The estimate given by Dujardin-Beaumetz* agrees

* 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, *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, 250 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.—"L'Hygiène Alimentaire."

closely with this: "An adult man submitted to moderate labour loses 20 grammes of nitrogen daily, and 300 grammes of carbon; these 20 grammes of nitrogen represent 124 grammes of dry proteid matters, and as these contain 64 grammes of carbon, on subtracting these 64 grammes from the 300 grammes necessary for nutrition, there remain 236 grammes of carbon to be derived from starch substances or from fats."

Moleschott's estimate is, for an adult working man, 130 grammes of albumen, 84 grammes of fat, 404 grammes of carbo-hydrates, and 30 grammes of salts.

The following table by Forster gives the analysis of the habitual diets of several persons of different occupation, with the relative amounts of nitrogen and carbon in each:—

	Albumen.	Fat.	Carbo-hydrates	Nitrogen	Carbon.
Labourer, age 36 .	133	95	422	21	321
Joiner . . .	131	68	494	20	342
Young Surgeon .	127	89	362	20	297
,, ,, .	134	102	292	21	280
Powerful Old Man	116	68	345		

Landois ("Text-book of Human Physiology") thus analyses the average income and expenditure of an adult doing a moderate amount of work:—

INCOME.

		C.	H.	N.	O.
Albumen, 120 grammes	=	64·18	8·60	18·88	28·34
Fats, 90 ,,	=	70·20	10·26	—	9·54
Starch, 330 ,,	=	146·82	20·33	—	162·85
		281·20	39·19	18·88	200·73

To this should be added:

In Air respired .	744·11 grains of oxygen.		
Water . . .	2818·0	,,	,,
Salts . . .	32·0	,,	,,

The whole is equal to $3\frac{1}{2}$ kilos. = 7 lb., *i.e.* about $\frac{1}{20}$th of the body-weight; so that about 6 per cent. of the water, about 6 per cent. of the fat, about 1 per cent. albumen, and about 0·4 per cent. of the salts of the body, are daily transformed within the organism.

Output or Expenditure.

	Water.	Carbon.	H.	N.	O.
By Respiration . .	330	248·8	—	?	631·15
,, Perspiration . .	660	2·6	—	—	7.2
,, Urine . . .	1700	9·8	3·3	15·8	11·1
,, Fæces . . .	128	20·0	3·0	3·0	12·0
	2818	281·2	6·3	18·8	661·45

To this is to be added: 298 grammes of water formed in the body by the oxidation of hydrogen. These 298 grammes of water = 34·59 H. and 263·41 O. 26 grammes of salts are given off in the urine, and 6 by the fæces.

At the time when it was believed that the amount of mechanical work performed by the organisms required the consumption of a corresponding amount of albuminates, a due supply of albumen was regarded as of the first importance in enabling the body to develop functional activity or muscular force; and it was a matter of common observation that persons who were habitually called upon for great exertion were accustomed to take large quantities of albuminous food. But since it has been established that the most strenuous muscular labour does not increase in the smallest degree the metabolism of albuminates in the body, we know that it is the non-nitrogenous alimentary principles—the fats and the carbo-hydrates—whose consumption is increased by muscular activity. This conclusion is not, however, inconsistent with the common observation that during active exertion the body requires a more liberal supply of albumen than when at rest, for in order to perform sustained and laborious physical efforts it is necessary to have well-developed and well-nourished muscles, which means the existence in the body of a large proportion of nitrogenous tissue, for the maintenance of which a corresponding proportion of albuminous food is needed. But a physically feeble person will not be enabled to perform an increased amount of muscular work simply by supplying him with a larger amount of albumen in his food. It would be necessary, in the first place, to produce an increased muscular development by raising his nutrition to a higher standard. Life can, no doubt, in certain circumstances, be maintained on a much smaller amount of food than an active labouring man requires, as is exemplified in the so-called "subsistence diet" of Playfair. The annexed table gives (in grammes) the amounts of the different classes of food, together with the relative proportions of carbon in each, required, according to Playfair, for mere subsistence, as well as in varying circumstances of muscular effort :—

	Albumen.	Fat.	Carbo-hydrates	Carbon.
Minimum ("subsistence") diet	57	14	340	190
Rest	71	28	340	210
Moderate exercise . .	119	51	530	337
Hard work	156	71	567	380
Intense exertion . . .	184	71	567	405

Voit has expressed surprise at Playfair's estimates of the quantity of albumen (57 and 71 grammes) in the first two cases, and he considers them far too low, unless for individuals of unusually small physique.

Parkes also points out, with regard to the subsistence diet of Playfair, that, while calculated as sufficient for the internal mechanical work of the body, it may be doubted if an average man could exist on it without losing weight, as it supposes absolute repose; and he regards the "rest" diet as probably the minimum for an adult male of average size and weight (150 lb. = 67 kilos).

Comparing the estimates of various authorities, Parkes has drawn up the following table of

STANDARD DAILY DIETS FOR A MAN IN ORDINARY WORK.

	Moleschott.		Pettenkofer and Voit.		Ranke.		Means.	
	oz. av.	grms.	oz. av.	grms.	oz. av.	grms.	oz. av.	grms
Albuminates	4·59	130	4·83	137	3·52	100	4·31	122
Fats . .	2·96	84	4·12	117	3·52	100	3·53	100
Carbo-hydrates	14·26	404	12·40	352	8·46	240	11·71	332
Salts . .	1·06	30	1·06	30	0·89	25	1·00	28
Total water-free food .	22·87	648	22·41	636	16·39	465	20·55	582

If we compare these with Playfair's diets, we notice a great discrepancy in the estimation of the requisite amount of fats. Either Playfair's must be defective, or the others excessive in this alimentary principle. It is true that in the *working* diets of Playfair the deficiency in fats is attempted to be compensated for by an excess of carbo-hydrates; but it is doubtful if the carbo-hydrates can advantageously take the place of fats to this extent in ordinary diets.

The constituents of the above diets are estimated as absolutely *water free;* so that, assuming the water-free food to be 23 oz., and a man's weight to be 150 lb., each pound-weight of the body receives in twenty-four hours 0·15 oz., or the whole body receives nearly one-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 oz. But from 50 to 80 oz. of water in the liquid form is usually taken in addition, and this would make the total supply of water = 70 to 90 oz., or half an ounce for each pound of body-weight.

Allowing for the modifying influence of varying conditions, we may fix the usual average daily range in different males as from 40 to 60 oz. of ordinary solid food, and from 50 to 60 oz. of water. Under great exertion men require an increased amount of food, especially in the form of albuminates and fats, and a total of 66 to 77 oz. of solid food (1·970 to 2·180 grammes) may be estimated as an average requirement under such circumstances.

AVERAGE DAILY WATER-FREE DIET REQUIRED FOR AN ADULT MAN IN VERY LABORIOUS WORK (*Parkes*).

Albuminates . .	6·0	to	7·0	oz.	or	170	to	198	grammes.
Fats	3·5	,,	4·5	,,	,,	99	,,	128	,,
Carbo-hydrates . .	16·0	,,	18·0	,,	,,	454	,,	510	,,
Salts	1·2	,,	1·5	,,	,,	34	,,	43	,,
Total water-free Food	26·7	,,	31·0	,,	,,	757	,,	879	,,

The following table (from Parkes) may be used as "an approximative basis for the calculation of diets according to size and work":—

Proximate Aliment.	For subsistence during rest.		For work of about 300 foot-tons per diem.		For work of about 100,000 kilogramme-metres per diem.	
	Ounces avoirdupois per lb. of body-weight.	Gramme per kilogramme of body-weight.	Ounces avoirdupois per lb. of body-weight.	Amount to be added to subsistence diet per lb. of body for every foot-ton of work.	Grammes per kilogramme of body-weight.	Amount to be added to subsistence diet per kilogramme of body-weight for every 1,000 kilogramme-metres of work
				oz. avoir.		grammes.
Albuminates .	·017	1·1	·031	·00005	1·9	·008
Fats . . .	·007	0·4	·019	·00004	0·9	·005
Carbo-hydrates .	·080	4·9	·095	·00005	7·2	·023
Salts . . .	·003	0·2	·007	·00001	0·4	·002
Total .	·107	6·6	·152	·00015	10·4	·038

Beyond 300 foot-tons (or 100,000 kilogramme-metres) the additions would require to be greater.

Proximate Aliment.	For work of 450 to 500 foot-tons per diem.		For work of about 150,000 kilogramme-metres per diem.	
	Ounces avoirdupois per lb. of body-weight.	Amount to be added to ordinary work diet per lb. of body-weight for every foot-ton of work beyond 300.	Grammes per kilogramme of body-weight.	Amount to be added to ordinary work diet per kilogramme of body-weight for every 1,000 kilogramme-metres beyond 100,000.
		ounces avoir.		grammes.
Albuminates . . .	·047	·000107	2·9	·020
Fats	·030	·000068	1·9	·020
Carbo-hydrates . .	·120	·000166	7·6	·008
Salts	·010	·000020	0·6	·004
Total	·207	·000361	13·0	·052

The following is another useful table (from Parkes also), "compiled from, in most cases, several analyses by different authors," *for calculating diets.* From such tables of mean composition the four classes of alimentary principles in any diet, the articles of which are known, may be calculated. Such tables are, of course, merely approximative; "they are very useful as giving a general idea of diet, although they are not accurate enough to be used in physiological inquiries."

Articles.	In 100 parts.				
	Water	Albuminates.	Fats.	Carbo-hydrates	Salts.
Meat of best quality, with little fat, like Beef-steaks.	74·4	20·5	3·5	—	1·6
Uncooked Meat of the kind supplied to soldiers, Beef and Mutton . . .	75	15	8·4	—	1·6
Uncooked Meat of fattened cattle, calculated from Lawes' and Gilbert's experiments. These numbers are to be used if the meat is very fat . . .	63	14	19	—	3·7
Cooked Meat, roast, no dripping being lost. Boiled assumed to be the same .	54	27·6	15·45	—	2·95
Corned Beef (Chicago) .	40	40	15	—	5
Salt Beef (Girardin) . .	49·1	29·6	0·2	—	21·1
Salt Pork ,, . .	44·1	26·1	7·0	—	22·8
Fat Pork (Letheby) . .	39·0	9·8	48·9	—	2·3
Dried Bacon ,, . .	15·0	8·8	73·3	—	2·9
Smoked Ham (König) .	27·8	24·0	36·5	—	10·1
Horseflesh ,, . .	74·3	21·7	2·6	—	1·0
White Fish (Letheby) .	78·0	18·1	2·4	—	1·0
Poultry	74·0	21·0	3·8	—	1·2
Bread, White Wheaten, of average quality . .	40	8	1·5	49·2	1·3
Wheat Flour, of average quality	15	11	2	70·3	1·7

Articles.	In 100 parts.				
	Water	Albu-min-ates.	Fats.	Car-bo-hy-drates	Salts.
Biscuit	8	15·6	1·3	73·4	1·7
Rice	10	5	0·8	83·2	0·5
Oatmeal (Letheby) . .	15	12·6	5·6	63·0	3
Maize (Poggiali), cellulose excluded	13·5	10	6·7	64·5	1·4
Macaroni (König) . .	13·1	9	0·3	76·8	0·8
Millet (König), cellulose excluded	12·3	11·3	3·6	67·3	2·3
Arrowroot	15·4	0·8	—	83·3	0·27
Peas (dry)	15	22	2	53	2·4
Potatoes	74	2·0	0·16	21·0	1
Carrots (cellulose excluded).	85	1·6	0·25	8·4	1·0
Cabbage	91	1·8	0·5	5·8	0·7
Butter	6	0·3	91	—	variable
Egg (10 per cent. must be deducted for shell from weight of egg). . .	73·5	13·5	11·6	—	1
Cheese	36·8	33·5	24·3	—	5·4
Milk (sp. gr. 1·029 and over)	86·8	4·	3·7	4·8	0·7
Cream (Letheby) . .	66	2·7	26·7	2·8	1·8
Skimmed Milk (Letheby) .	88	4·0	1·8	5·4	0·8
Sugar	3	—	—	96·5	0·5
Pemmican (De Chaumont) .	7·2	35·4	55·2	—	1·8

The gelatin of meat is reckoned with the albuminates. It is not certain what deduction should be made on account of its lower nutritive value, which is about one-fourth that of albumen, according to Bischoff.

"The mode of using the above table is very simple. The quantity of uncooked meat or bread being known, and it being assumed or proved that there is no loss in cooking, a rule of three brings out at once the proportions. Thus, the ration allowance of meat for soldiers being 12 oz., 2·4 oz., or 20 per cent., is deducted for bone, as the soldier does not get the best parts. The quantity of water in the remaining 9·6 oz. will be $\frac{75 \times 9{\cdot}6}{100} = 7{\cdot}2$, and the water-free solids will be 2·4 oz. The albuminates will be 1·44 oz., the fats ·8064 oz., and the salts ·1536 oz." (*Parkes.*)

It is difficult to estimate the value of salt beef and pork, as much of the nutritive matters passes out into the brine. This has been estimated at as much as from one-third to one-half. It appears that myosin is soluble in a 10 per cent. solution of chloride of sodium; therefore a large proportion of the substance necessarily passes into the brine. "Analyses show, it is true, a large percentage of fibrous and cellular tissue in salt meat, but this is made up of indigestible nitrogenous substances, which afford, probably, little real nutritive material. Perhaps salt beef may be reckoned as equal to two-thirds the quantity of fresh beef; this estimate is certainly quite high enough." (*Parkes.*)

If we again refer to the table of "standard daily diets" we shall be able to ascertain the relative proportion of the nitrogenous to the non-nitrogenous substances in them; it will be found to be about 1 part of nitrogenous to 3½ to 4 of non-nitrogenous substances, *e.g.*:—

	Moleschott.	Pettenkofer and Voit.	Ranke.	Mean.
Albuminates .	100	100	100	100
Fats . .	65	87	100	84
Carbo-hydrates	315	258	240	271
Salts . .	23	22	25	23

If it is required, as may sometimes be the case, to calculate the amount of nitrogen and carbon, as well as that of hydrogen and oxygen in the constituents of any diet, Parkes gives two methods by which this may be done.

"1. Calculate out the dry albuminates, fat, and carbo-hydrates in ounces, and then use the following table :—

Water-free Constituents.		Nitrogen.	Carbon.	Hydrogen.	Sulphur
		grains.	grains.	grains.	grains.
Albuminate :	1 oz. contains .	69	212	13	8
Fat	,, ,, .	—	336	48	—
Carbo-hydrates					
(*a*) Starch	,, ,, .	—	194	—	—
(*b*) Cane Sugar	,, ,, .	—	184	—	—
(*c*) { Lactin / Glucose }	,, ,, .	—	175	—	—

"The total amount of carbon in one ounce of albuminates is 233 grains, but of this about 29 grains are converted into urea and are therefore oxidised only as far as carbon monoxide; making allowance for this we have a nett total equal to 212 grains of carbon fully oxidised.

"2. In the following table, the calculation of these ingredients per ounce has been made; the substance being supposed to be in its natural state, and to have the composition already assigned to it in the former table :—

Substance.	One ounce (= 437·5 grains) contains in its natural state in grains—					
	Water	Nitrogen.	Carbon capable of being oxidised.	Hydrogen capable of being oxidised.	Sulphur capable of being oxidised.	Salts
Uncooked Meat (Beef) of the best quality .	326	14·14	55	4·4	1·6	7
Uncooked Meat as supplied to soldiers . .	328	10·35	60	6·0	1·2	7

Substance.	One ounce (= 437·5 grains) contains in its natural state in grains—					
	Water	Nitrogen.	Carbon capable of being oxidised.	Hydrogen capable of being oxidised.	Sulphur capable of being oxidised.	Salts
Uncooked Fat Meat (Beef)	276	9·6	94	10·9	1·1	16
Cooked Meat	236	19·0	110	11·0	2·2	13
Corned Beef (Chicago)	175	27·6	135	12·1	3·2	21
Salt Beef	215	20·4	63	3·9	2·4	92
Salt Pork	193	18·0	79	6·8	2·1	100
Fat Pork	170	6·8	185	24·8	0·8	10
Dried Bacon	66	6·1	205	36·8	0·7	12
Smoked Ham	122	16·6	174	20·6	2·0	44
Horseflesh	325	15·0	55	4·0	1·7	4
White Fish	341	12·5	48	3·7	1·5	—
Poultry	324	14·5	57	4·5	1·7	5
Bread	173	5·5	116	1·7	0·6	5
Wheat Flour	66	7·6	166	2·4	0·9	7
Biscuit	35	10·8	180	2·6	1·3	7
Rice	44	3·5	175	3·3	0·4	2
Oatmeal	66	8·7	168	4·8	1·1	13
Maize	69	7·0	169	1·4	0·8	6
Macaroni	57	6·2	169	2·9	0·7	3
Millet	54	7·8	166	2·5	0·9	10
Arrowroot	57	0·5	162	—	—	—
Peas (dried)	66	15·2	156	3·9	1·7	10
Potatoes	324	1·4	45	0·4	0·2	4
Carrots	372	1·1	20	0·4	0·1	4
Cabbage	398	1·2	17	0·5	0·1	3
Butter	26	0·2	312	43·7	—	12
Eggs	322	9·3	68	7·4	1·1	4
Cheese	161	23·2	153	16·0	2·7	24
Milk (sp. gr. 1·029 and over)	380	2·75	30	2·3	0·3	3
Cream	289	1·9	100	13·1	0·2	8
Skimmed Milk	385	2·8	24	1·2	0·3	3
Sugar	13	—	178	—	—	2
Pemmican	31	24·4	250	31·1	2·7	8

It has been stated that the standard daily diet of an adult man in ordinary work should contain 20 grammes of nitrogen and 300 grammes of carbon: this would be equal to 308·6 and 4,629 *grains*. In order to use the above table Parkes gives the following estimate in *grains*, founded on Moleschott's standard:—

Nitrogen	317 grains.
Carbon	4,750 ,,
Hydrogen	202 ,,
Sulphur	24 ,,
Salts	461 ,,

Some range, however, is necessary to adapt a diet to different persons under varying circumstances. For adult men the *usual* range is from 250 to 350 grains (17 to 23 grammes) of nitrogen, and the *extreme* range 140 (mere subsistence estimate of Playfair) to 500 grains (very great exertion) or 9 to 33 grammes.

Ill-fed London needlewoman, according to E. Smith's observations, had	135 grains	of nitrogen,	and	3,271	of carbon.
Irish farm labourers . .	349	,,	,, ,,	6,195	,,
And operatives during Cotton famine in Lancashire	180 to 200	,,	,,	3,900 to 4,300	,,
Prisoners on light labour (Wilson) . . .	224	,,	,, ,,	4,651	,,
Prisoners on hard labour (Wilson)	255	,,	,, ,,	5,289	,,
(*On this diet they lost weight.*)					
Military prisoners with hard labour . .	281	,,	,, ,,	5,373	,,
(*On this diet they also lost weight.*)					
Military prisoners in India.	300	,,	,, ,,	5,300	,,
(*These did not lose weight.*)					

The amounts of carbon range in various diets from about 3,500 to 6,000 grains. Pettenkofer's and Voit's observations on two healthy men, on several occasions, in ordinary exercise, showed a daily consumption of 19·82 grammes = 305·8 grains of nitrogen, and Parkes's experiments on four healthy average men in common work showed that they could be maintained in perfect health and uniform weight on a daily allowance of

293 to 305 grains of nitrogen. In the best diets the proportion between the nitrogen and carbon is nitrogen 1 to carbon 15.

The following table, adapted from Dujardin-Beaumetz, also shows the percentage amount of nitrogen and carbon in various articles of food. 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
,, 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
Gudgeon	2·77	13·50
Eel	2·00	30·05
Mussels	1·80	9·00
Oysters	2·13	7·18
Lobster (uncooked)	2·93	10·96
Eggs	1·90	13·50
Milk (Cow's)	0·66	8·00
,, (Goat's)	0·69	8·60
Cheese (Brie)	2·93	35·00
,, (Gruyère)	5·00	38·00
,, (Roquefort)	4·21	44·44

	Nitrogen.	C + H. Combustibles calculated as carbon.
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, 30 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
Chestnuts (fresh)	0·64	35·00
,, (dried)	1·04	48·00
Potatoes	0·33	11·00
Beans	4·50	42·00
Haricots (dry)	3·92	43·00
Lentils ,,	3·87	43·00
Peas ,,	3·66	44·00
Carrots	0·31	5·50
Mushrooms	0·60	4·52
Figs (fresh)	0·41	15·50
,, (dry)	0·92	34·00
Plums	0·75	28·00
Coffee (infusion of 100 grammes)	1·10	9·00
Tea ,, ,, ,,	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

Adopting French weights, and remembering that the average weight of an adult man is 67 kilogrammes, it is easy to apply this table, on the calculation that the daily ration should fluctuate between 6 to 9 grammes of carbon, and 0·250 to 0·360 of nitrogen, for each kilogramme of body-weight.

Advanced age necessitates a considerable reduction in the amount of food allowed, for not only are all the organs, and especially the voluntary muscles (except in certain exceptional instances of unusually vigorous old age) more or less wasted, but the digestive and assimilative functions are far less active, and are unable to digest and utilise the same amount of food as formerly.

In an institution for the widows of beneficed clergymen, Forster found that a number of old ladies were content with an average allowance of 67 grammes of albumen, 38 of fat, and 266 of carbo-hydrates, while others required rather more—viz. 80 grammes of albumen, 49 of fat, and 266 of carbo-hydrates; but both these diets are much richer in albuminates and fats than Playfair's "subsistence diet."

Dujardin-Beaumetz regards the following as a fair basis for the estimation of the average daily dietary of an adult man:—124 grammes of albuminates, 430 grammes of carbo-hydrates, 55 grammes of fat; this would correspond with a bread and meat ration of—

819 grammes (about 28 oz.) White Bread.
259 „ (about 9 oz.) Meat.

Economical reasons may occasionally require that we should cut down the dietary to the lowest level compatible with the maintenance of healthy existence; but it is always advisable when practicable to allow a certain excess over and above the strict physiological necessities. The effects of a *deficient* diet are usually not slow to make their appearance. They are—loss of weight; a lowered capacity for exertion and functional activity; often an unhealthy, cachectic aspect, and a diminished power of resistance to unfavourable influences, so that during periods of famine or enforced privation the rate of mortality rises enormously. The consequences of immoderate feeding and of habitual excess are frequently also sufficiently conspicuous. In many cases an unusual, unequal, and unsightly deposition of fat takes place in connection with the abdominal and other organs, together with disturbances in the functions of the liver and other organs of digestion. But apart from the deposition of fat, which is not an invariable consequence, excess of food leads to retarded metabolism and imperfect nutritive changes, indicated sometimes by the presence of uric acid deposits, of oxalates in the urine, of an excessive excretion of urea. The disturbances of metabolism which lead to these deposits are as yet, however, only imperfectly understood; but there is a vast deal of evidence which points to immoderate feeding as one of their common antecedents.

Not only is it important to have due regard to quantity in the construction of dietaries, but it is also equally necessary to have regard to the proportionate *composition* and *quality* of foods. A particular food-stuff may contain all the constituents necessary for the nutrition of the body, but may yet be quite unsuitable to form the *sole* food of the organism, on account of the unfavourable *proportions* in which they may exist in it. Or another food-stuff may contain some or all of the necessary elements of nutrition, but they may not all be digestible and utilisable. These considerations show the necessity of mingling or combining different articles of food in due and proper proportions in the construction of diet-tables.

The following table, which is modified from one by Voit, shows in a striking manner the unsuitableness of many common articles of food to be employed as the sole constituents of human diet, and the great wastefulness on the one hand and insufficiency on the other which would be involved in the attempt.

In order to yield the necessary daily ration of nitrogen and carbon, the following quantities of the undermentioned articles would be required ; for " experience has shown that the diet best suited for the body must contain one part of nitrogenous foods to three and a half or at most four and a half of the non-nitrogenous " :—*

	To yield 18·3 grammes Nitrogen.		To yield 328 grammes Carbon.
Cheese	272	Bacon	450
Peas	520	Maize	801
Lean Meat	538	Wheat Meal	824
Wheat Flour	796	Rice	896
Eggs (18)	905	Peas	919
Maize	989	Cheese	1,160
Black Bread	1,430	Black Bread	1,346
Rice	1,868	Eggs (43)	2,231
Milk	2,905	Lean Meat	2,620
Potatoes	4,575	Potatoes	3,124
Bacon	4,796	Milk	4,652
Cabbage	7,625	Cabbage	9,318
Turnips	8,714	Turnips	10,650
Beer	17,000	Beer	13,160

It would be scarcely possible for any individual to consume and digest daily 2,620 grammes (*i.e.* about 90 ounces) of meat, the quantity necessary in order to yield the daily requirement of carbon, while the waste of nitrogen would be prodigious ; on the other hand, it would require 4,575 grammes or about 10 lb. of potatoes to yield the daily requirement of nitrogen. And milk, which is the food of Nature's own selection for the infant, would be most wasteful as the sole food for the adult, as he would require 4,652 grammes or 10 pints to furnish the daily supply

* Landois also gives the following table to show how far the foods mentioned therein correspond to these requirements, and how

of carbon he requires, and a considerable proportion of the nitrogen would be wasted. Whereas in a mixed diet of meat and potatoes, less than 538 grammes of the former together with less than 3,124 grammes of the latter would yield respectively the amount of nitrogen and carbon required.

The carbon necessary for nutrition can be provided, as we have seen, either in the form of fats or of *carbo-hydrates*. If in the form of fat, then, according to Voit's calculations, an average working man would require for his daily consumption 346 grammes; if in the form of starch 596 grammes. But it is no doubt better to obtain the carbon that we require in our food in part from both classes of aliments—from a mixture of fat and farinaceous foods. This appears to suit the digestive capacities of man as well as his nutritive requirements best.

they should be combined to produce a satisfactory diet ("Text-Book of Human Physiology"):—

PROPORTIONS OF NITROGENOUS AND NON-NITROGENOUS SUBSTANCES.

	Nitrogenous.		Non-Nitrogenous.
1. Veal	10	to	1
2. Horse's Flesh	10	,,	2
3. Beef	10	,,	17
4. Lentils	10	,,	21
5. Beans	10	,,	22
6. Peas	10	,,	23
7. Mutton	10	,,	27
8. Pork	10	,,	30
9. *Cow's Milk*	10	,,	30
10. Human Milk	10	,,	37
11. *Wheaten Flour*	10	,,	46
12. Oatmeal	10	,,	50
13. Rye Meal	10	,,	57
14. Barley Meal	10	,,	57
15. Potatoes (white)	10	,,	86
16. ,, (blue)	10	,,	115
17. Rice	10	,,	123
18. Buckwheat Meal	10	,,	130

Besides human milk (too rich in albuminates for *adults*), it is seen that wheat flour contains nearly the right proportions of nitrogenous to non-nitrogenous substances.

Carbo-hydrates are not able to minister as completely as the fats do to the functions of tissue growth and repair; while, on the other hand, a large proportion of fat in the food is not, as a rule, well tolerated by the digestive organs for long at a time, unless under exceptional conditions of climate, as amongst the inhabitants of Arctic regions, where food possessing a relatively large capacity for heat-production is especially needed. It is not uncommon, moreover, to find individual peculiarities with regard to the capacity for taking fats, some persons being incapable of digesting but very small quantities; in such cases the deficiency must be supplied by a proportionate allowance of carbo-hydrates.

The force-value of various foods.—Two chief conditions determine the possible amount of force that can be manifested in the body—1st, the amount of potential energy contained in the food, and this may be readily ascertained and expressed in units of heat or of motion; and 2nd, the degree in which the assimilative processes in the body are able to liberate and make use of this energy. An ounce of albumen if burnt in oxygen will yield a certain amount of heat, but no such complete oxidation can occur in the body, for about one-third of the constituents of the albumen is excreted, incompletely oxidised, in the form of urea. It is different with some of the carbo-hydrates, and a soluble carbo-hydrate, like sugar, is completely oxidised within the body and converted into carbonic acid and water, so that its *actual* energy in the body is equal to its theoretical energy.

It has been calculated (*Parkes*) that

			Foot-tons of potential energy.
One ounce of dry	Albuminate	yields	173
,, ,,	Fat	,,	378
,, ,,	Starch	,,	138
,, ,,	Cane Sugar	,,	131
,, ,,	Lactin or Glucose	,,	124

also that

					Foot-tons of potential energy.
One grain of	Carbon	in conversion into	CO_2	yields	0·710
,,	Hydrogen	,, ,,	H_2O	,,	3·000
,,	Sulphur	,, ,,	SO_2	,,	0·205
,,	Phosphorus	,, ,,	P_2O_3	,,	0·510
,,	Carbon (forming Urea)			,,	0·198

The following table embodying Dr. Frankland's experimental results displays a close agreement with theoretical results, and is useful as showing what can be obtained from food. It would, however, be an error to suppose that the value of food is in exact relation to the possible energy it can yield. To produce this energy, not only must it undergo suitable preparation and digestion within the body, but the setting free of energy must take place where and how it may best serve the purposes of nutrition. "The mere expression of potential energy cannot fix dietetic value, which may be dependent on conditions in the body unknown to us." Gelatin, for instance, cannot completely supply the place of albumen, although its potential energy is but little less, and it is readily oxidised in the body; yet, owing to some unknown conditions, its energy has a different direction to that of albumen.

According to Frankland,

	Heat units.
One gramme of dry Isinglass when burnt in Oxygen will develop	4·520
One gramme of dry boiled Ham when burnt in Oxygen will develop	4·343
One gramme of dry Beef when burnt in Oxygen will develop	5·313

which shows the potential energy of isinglass to be greater than that of ham, yet its nutritive power is far inferior.

Such tables of energy are valuable as affording broad indications, and as representing in a general way the value of a diet; but they must not be taken as throwing light on the obscurities of the nutritive processes.

Energy developed by 1 oz. 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) ,,	57·8	243
Beef, fattened ,,	96·0	280
Meat, *cooked*	102·6	240
Corned Beef (Chicago)	124·0	217
Salt Beef	52·0	138
,, Pork	71·6	166
Fat ,,	202·0	336
Dried Bacon	292·3	346
Smoked Ham	179·6	267
Horseflesh	46·4	189
White Fish	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

The advisability, in arranging dietaries, of avoiding monotony and providing variety in food should never be forgotten; for the digestibility, and therefore the nutritive value, of food depends greatly on its palatableness, and the stimulus thereby given to the digestive secretions.

CHAPTER IX.

CERTAIN DIETARIES—PRISON DIETARIES—SOLDIERS DIETARIES—SEAMEN'S DIETARIES.

We may now examine with advantage certain dietaries, especially those adopted in prisons and in the army and navy. Amongst the other advantages attending the transfer of the local prisons to Government has been the adoption of an uniform and improved dietary for prisoners. The Commissioners of Prisons in their Eleventh Report (1887-88) allude to the results of the adoption of the recommendations of the committee appointed in 1878 for establishing uniformity in the diet of prisoners in all prisons as entirely satisfactory, and as having "fulfilled the object it was intended to serve," in evidence of which they mention "the low rates of sickness and mortality, referred to later on, which would be incompatible with an insufficient amount of food, or a diet not composed of the proper ingredients;" and they subsequently cite the following facts as proof of the improvement in health of the inmates of local prisons since 1878:—"The yearly average death-rate for the 16½ years ended the 31st of March, 1878, was 11·6 per 1,000, while for the ten years ended 31st March, 1888, it was 8·1." They claim the "great merit of simplicity and economy" for the dietary now adopted, and they state that they "have every reason to believe it furnishes sufficient, and not more than sufficient, amount of food to all persons who are subject to it. Reports received from the medical officers of the principal prisons where it has been in use entirely corroborate" this belief.

The view of prison-life taken by the Committee who undertook to report on the subject of prison dietaries is certainly somewhat optimistic, but it merits the consideration due to the fact that its members had had a long familiarity with the inmates of prisons. "Imprisonment," they say, "as now generally conducted, is a condition more or less akin to that of 'physiological rest.' The struggle for survival is suspended; and the prisoner appears to feel that the prayer for daily bread is rendered unnecessary by the solicitude of his custodians. Tranquillity of mind and freedom from anxiety are leading characteristics of his life. From the moment that the prison gates close behind him the tendency in most cases is to lessened waste of tissue; he lives, in fact, less rapidly than before.

> "'He is insensibly subdued
> To settled quiet,'

and finds, in many instances, a peace and repose to which, as a law-abiding citizen, he was perchance a stranger"! They point out that the work exacted of the prisoner is never excessive; that he is, as a rule, free from worry; that he is well clothed and housed, and surrounded, even in the depths of winter, by a warm atmosphere; that he spends nine hours out of the twenty-four in bed; that he is exempt from distracting emotions and desires. "He is scrupulously protected from all preventible bodily suffering, and may be said to be an inmate of a hygienic hospital for the promotion of the physical and mental health"!

One of the first recommendations of this Committee is that the diet should vary with the length of sentence. "The shorter the term of imprisonment, the more strongly should the penal element be manifested in the diet. Partial abstinence from food for a limited period is not only safe under ordinary circumstances, but frequently beneficial, and we think that a spare diet is all that is necessary for a prisoner undergoing a sentence of a few days or weeks." At the same time they recommend that "all prisoners," whatever their length of sentence, should commence with the lowest diet, and "graduate through the dietaries proper to all the sentences shorter than their own, until they reach the dietary proper to their own class;" and they formed this recommendation on the consideration "that the ends of justice are in a serious measure defeated by at once giving the more guilty criminal a diet which is in striking contrast with that received by a prisoner who has committed some comparatively trifling offence." In alluding to the objections that have been raised to "progressive dietaries," and to the placing prisoners sentenced to hard labour on the lowest diets during the first period of imprisonment, when "want of liberty is most keenly felt," and its depressing influences are most evident, they regard them as "relevant only to cases in which that principle is carried to its fullest extent," and they insist that "the advantages of the progressive principle may be retained without incurring any risk of inflicting injury." According to the length of sentence they recommend four classes of diets—

Class I.—For periods of 7 days and under.
Class II.—For periods of more than 7 days, and not more than 1 month.
Class III.—For periods of more than 1 month, and not more than 4 months.
Class IV.—For periods of more than 4 months.

With respect to Class I. they say: "In such cases a reduced allowance of food for a few days is beneficial rather than otherwise, and a strong penal element may be introduced not only with safety but advantage." This diet consists of one pound of bread daily, together with a hot meal once a day, "in the shape of a nutritive stirabout, composed of equal parts of oatmeal and Indian meal." They do not consider that any distinction should be made between the sexes, nor, during this very short term, between prisoners with and those without hard labour.

For Class II., *i.e.* prisoners undergoing more than seven days, but not more than one month's imprisonment, the following is the dietary adopted :—

			Men with hard labour.	Men without hard labour and Women.
BREAKFAST	Daily	Bread	6 ounces	5 ounces
		Gruel	1 pint	1 pint
DINNER	Sun. & Wed.	Suet Pudding	8 ounces	6 ounces
		Bread	6 ,,	5 ,,
	Mon. & Fri.	Bread	6 ,,	5 ,,
		Potatoes	8 ,,	8 ,,
	Tues., Thurs., & Sat.	Bread	6 ,,	5 ,,
		Soup	½ pint	½ pint
SUPPER	Daily	Bread	6 ounces	5 ounces
		Gruel	1 pint	1 pint

For Class III., *i.e.* prisoners undergoing one month and not more than four months' imprisonment, the dietary prescribed is the following :—

			Men with hard labour.	Men without hard labour and Women.
BREAKFAST	Daily	Bread	8 ounces	6 ounces
		Gruel	1 pint	1 pint
DINNER	Sun. & Wed.	Bread	4 ounces	4 ounces
		Potatoes	8 ,,	6 ,,
		Suet Pudding	8 ,,	6 ,,
	Mon. & Fri.	Bread	8 ,,	6 ,,
		Potatoes	8 ,,	8 ,,
		Cooked Meat without bone	3 ,,	2 ,,
	Tues., Thurs., & Sat.	Bread	8 ,,	6 ,,
		Potatoes	8 ,,	6 ,,
		Soup	¾ pint	¾ pint
SUPPER	Daily	Bread	6 ounces	6 ounces
		Gruel	1 pint	1 pint

"The distinction between the diets of men with hard labour on the one side, and that of men without hard labour and of women on the other, consists in a deduction of one-fifth of the solid articles, and one-sixth of the whole, the difference being equally distributed in the course of the week between the nitrogenous and non-nitrogenous elements." And with regard to female prisoners they observe, "the demands made upon their physical energies are practically much the same whether the sentence be with or without hard labour. Their employments are not such as to admit of that sharply drawn distinction between hard labour and light labour which is possible among the males; there is not the same inequality in the expenditure of energy; and differences of diet founded upon distinction as to labour, which are for the most part hypothetical, are apt to be a source of injustice, and to give rise to bickering and jealousy. We therefore recommend that in the respective classes the diet distinction be one and the same for all women, whether with or without hard labour."

For Class IV., *i.e.* prisoners undergoing more than four months' imprisonment, the dietary adopted is the following:—

			Men with hard labour.	Men without hard labour and Women.
BREAKFAST	Daily	Bread	8 ounces	6 ounces
		Porridge	1 pint	—
		Gruel	—	1 pint
DINNER	Sun. & Wed.	Bread	6 ounces	4 ounces
		Potatoes	8 "	8 "
		Suet Pudding	12 "	10 "
	Mon. & Fri.	Bread	8 "	6 "
		Potatoes	12 "	10 "
		Cooked meat without bone	4 "	3 "
	Tues., Thurs., & Sat.	Bread	8 "	6 "
		Potatoes	12 "	10 "
		Soup	1 pint	1 pint

			Men with hard labour.	Men without hard labour and Women.
SUPPER .	Daily . .	Bread . .	8 ounces	6 ounces
		Porridge .	1 pint	—
		Gruel . .	—	1 pint

It is suggested that *bacon* and *haricot beans* should be substituted for beef in the Monday's dinner, and it is pointed out that not only would this be superior in nutritive value but would also effect a considerable saving. *E.g.:*

4 oz.	of Beef (cooked) without bone	costs	$3\frac{1}{2}$d.	$= 4\frac{3}{4}$d.
12 ,,	Potatoes	,,	$\frac{3}{4}$d.	
8 ,,	Bread	,,	$\frac{1}{2}$d.	

whereas

9 oz.	of cooked Haricot Beans	costs	$\frac{1}{2}$d.	$= 2\frac{1}{4}$d.
1 ,,	,, Fat Bacon .	,,	$\frac{1}{2}$d.	
12 ,,	Potatoes	,,	$\frac{3}{4}$d.	
8 ,,	Bread	,,	$\frac{1}{2}$d.	

being an economy of $2\frac{1}{2}$d. on each dinner.

In the application of the "progressive" principle they recommend, in order to avoid any risk of inflicting injury, that it should be "so graduated as to accommodate itself to the circumstances of the various classes of prisoners," as shown in the following diagram. A prisoner of the 2nd Class beginning with the diet of the 1st Class, and after seven days passing on to that of his own class, and so on.

DIAGRAM TO SHOW APPLICATION OF PROGRESSIVE PRINCIPLE.

Term.	Class I.	Class II.	Class III.	Class IV.
Seven days and under	Whole term.	—	—	—
More than seven days and not more than one month	Seven days.	Remainder of term.	—	—
More than one month and not more than four months	—	One month.	Remainder of term.	—
More than four months	—	—	Four months.	Remainder of term.

For making the bread, *whole meal* is recommended to be employed, which contains all the constituents of the grain, except "the outer and highly silicious envelope of which the coarse bran is composed." In order to avoid the *heaviness* which bread made from whole meal is apt to present, the following directions as to the method of preparing the dough are given :—

"If, in the manufacture of bread, the whole meal be subjected to the same treatment as ordinary flour, the result will be a somewhat heavy loaf, owing to the presence in all the envelopes of a ferment termed 'cerealin.' This ferment is analogous to the diastase of malt, and, under certain conditions, exerts an energetic influence on starch, giving rise to a compound of dextrin and sugar, which by its viscidity prevents the dough from being sufficiently puffed up by the carbonic acid generated in the process of fermentation. In order to avoid this inconvenient action of the cerealin, it is necessary to make the dough of flour only. The sharps, etc., should not be added until the dough is nearly ready to be baked, when the whole should be kneaded together quickly, weighed off into loaves, and baked in the usual way. The reason for keeping the intermediary products apart from the dough until the latter is nearly ready for the oven, is that the period of incubation is then so short that the leavening action of the cerealin does not take place, and the bread produced is light and porous. We are able to report that this process has been adopted at Millbank Prison with very satisfactory results, and that the bread is more nutritious than that hitherto made in the same prison with seconds flour."

They add in a note:—"We think that the advantages possessed by the prisoner over large sections of the population with regard to the *quality* of the bread given to him should not escape notice."

Beef is the *meat* recommended for healthy prisoners at labour, and mutton for the sick in hospital; and in order that the prisoner may get all the constituents of the meat, it is recommended that the broth in which the meat is boiled should be served with it.

The **soup** is recommended to be made from the neck, clod, cheek, leg, or shin of beef, together with split peas, fresh vegetables, and onions. "In order to extract all the gelatin from the bones, they should be broken or sawn into small pieces, and should be simmered for some hours before the cooking of the meat is commenced. The peas should be soaked overnight in cold *soft* water, or water to which a little washing soda has been added. The meat should be cut into pieces about one inch square, and placed in cold water. When the soluble constituents are dissolved out, the temperature of the liquor should be gradually raised to about 160° Fahrenheit, and should be maintained at that point until the meat is tender and nearly cooked. The peas should be boiled gently; and the fresh vegetables, divided into small pieces, should be boiled or steamed. The whole should then be mingled together, and gently simmered until ready. Lastly, add the pepper and salt. Care should be taken that none of the ingredients are so over-cooked as to be imperceptible in the soup." The proportions are: In every pint, 4 oz. of clod (or shoulder), cheek, neck, leg, or shin of beef; 4 oz. of split peas; 2 oz. fresh vegetables; $1\frac{1}{2}$ oz. onions; pepper, and salt.

"**Suet pudding.**—Each pound contains $1\frac{1}{2}$ oz. mutton suet, 8 oz. of flour, and about $6\frac{1}{2}$ oz. of water.

"**Potatoes.**—The entire absence of vegetable acids from a prison dietary would result, as is well known, in an outbreak of scurvy, and the potato is chiefly valuable as supplying the anti-scorbutic element in its cheapest form. This vegetable is characterised by a very large percentage of starch, which is of the same nutritive value as starch obtained from other sources. 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 anti-scorbutic principle in which resides its chief value as an article of diet."

The **gruel** is made with 2 oz. of coarse Scotch oatmeal to the pint, with salt, and one of its advantages is that it can be served *hot.* The Committee hold a high opinion of its value as a nutritive and economical food.

Porridge is ordered to be made with 3 oz. of coarse Scotch oatmeal to the pint, with salt.

Stirabout is given to prisoners in Class I., as well as to prisoners who are ill-conducted or idle. It is made thus: 3 oz. of Indian meal, and afterwards 5 oz. of oatmeal, are stirred into 2½ pints of boiling water, to which ¼ oz. of salt has been added; it is kept constantly stirred, and when it is evaporated to a pint and a half, the meals are sufficiently cooked.

Cocoa is introduced into some of the dietaries, on the ground "that the health of prisoners undergoing long sentences will be benefited by the introduction of some slight change of diet at the expiration of nine months from conviction, and, with this object in view, we recommend that at this period of imprisonment, cocoa and a small quantity of extra bread be issued three times a week for breakfast in lieu of porridge." This cocoa is made by ¾ oz. of flaked or Admiralty cocoa being added to every pint of water, and it is sweetened by the addition of ¾ oz. of molasses or sugar to the pint for flaked cocoa, and ½ oz. for Admiralty cocoa.

Correctional diet.—The most common diet in use for *correctional* purposes consists of a pound of bread and a pint of water per diem; and the Committee see no objection to this if its employment be *limited to a period of three days* at a time. "After that, one of the undermentioned *stirabout* diets, according to labour performed," should be given for three days before the repetition of the bread-and-water diet again for three days, "and a second interval on the stirabout diet is to elapse before it is again repeated. The entire period, including intervals, for which any single term of this diet may be ordered is not to exceed fifteen days. No task of labour is to be enforced on any one of the nine days on which the bread and water constitute the sole food supplied to the prisoner."

The "Stirabout Diet" referred to is as follows:—

1st.—*For Men and Women performing a Daily Task of any Labour not expressly defined as Hard Labour.*

BREAKFAST . .	Bread, 8 oz.
DINNER . .	1 pint of Stirabout, containing 2 oz. of oatmeal and 2 oz. of Indian meal, with salt. Potatoes, 8 oz.
SUPPER . .	Bread, 8 oz.

"This diet to be limited, in the first place, to twenty-one days; after that, the diet of the class to which the prisoner belongs for one week before its repetition, when it is to be limited to fourteen days. The entire period, including the interval, for which any single term of this diet may be ordered is not to exceed forty-two days."

2nd.—*Full Stirabout Diet for Men performing a Daily Task of Hard Labour.*

BREAKFAST . .	Bread, 8 oz.
DINNER . .	1½ pint of Stirabout, containing 3 oz. of oatmeal and 3 oz. of Indian meal, with salt. Potatoes, 8 oz. Bread, 8 oz.
SUPPER . .	Bread, 8 oz.

"This diet to be limited, in the first place, to forty-two days; after that, the diet of the class to which the prisoner belongs, for fourteen days before its repetition, when it is to be limited to twenty-eight days. The entire period, including the interval, for which any single term of this diet may be ordered is not to exceed eighty-four days."

The amount of the proximate aliments (as water-free solids) in each diet, as well as the amount of nitrogen and carbon, is set forth in the following tables, and the approximate value in grammes is added for purposes of comparison :—

CLASS I.

Men with and without Hard Labour, and Women.

Nitrogenous Matters (Albuminates)	2·00 oz.	(56·7 grammes)
Carbo-hydrates	12·02 ,,	(340·2 ,,)
Fat	0·67 ,,	(19·0 ,,)
Mineral Substances . . .	0·76 ,,	(21·0 ,,)

Nitrogen.	*Carbon.*
0·30 oz. (7·5 grammes).	7·44 oz. (210·9 grammes).

CLASS II.

(*a*) *Men without Hard Labour, and Women.*

Albuminates	2·23 oz.	(63·2 grammes)
Carbo-hydrates	11·87 ,,	(336·5 ,,)
Fat	0·67 ,,	(19·0 ,,)
Mineral	1·09 ,,	(30·9 ,,)

Nitrogen.	*Carbon.*
0·34 oz. (9·6 grammes).	7·46 oz. (211·5 grammes).

(*b*) *Men with Hard Labour.*

Albuminates	2·50 oz.	(70·8 grammes)
Carbo-hydrates	13·60 ,,	(385·5 ,,)
Fats	0·76 ,,	(21·0 ,,)
Mineral	1·14 ,,	(32·3 ,,)

Nitrogen.	*Carbon.*
0·38 oz. (10·75 grammes).	8·51 oz. (241·25 grammes).

CLASS III.

(*a*) *Men without Hard Labour, and Women.*

Albuminates	2·94 oz.	(85·0 grammes)
Carbo-hydrates	14·32 ,,	(406·0 ,,)
Fats	0·87 ,,	(24·6 ,,)
Mineral	1·24 ,,	(35·1 ,,)

Nitrogen.	*Carbon.*
0·44 oz. (12·4 grammes).	9·04 oz. (256·2 grammes).

(b) Men with Hard Labour.

Albuminates	3·27 oz.	(92·7 grammes)
Carbo-hydrates	16·65 ,,	(472·0 ,,)
Fats	0·98 ,,	(27·9 ,,)
Mineral	1·31 ,,	(37·1 ,,)

Nitrogen.	*Carbon.*
0·49 oz. (13·7 grammes).	10·40 oz. (295·0 grammes).

CLASS IV.

(a) Men without Hard Labour, and Women.

Albuminates	3·23 oz.	(91·5 grammes)
Carbo-hydrates	15·51 ,,	(440·0 ,,)
Fat	1·00 ,,	(28·35 ,,)
Mineral	1·27 ,,	(36·00 ,,)

Nitrogen.	*Carbon.*
0·49 oz. (14·0 grammes).	9·84 oz. (279·0 grammes).

(b) Men with Hard Labour.

Albuminates	4·09 oz.	(116·0 grammes)
Carbo-hydrates	20·17 ,,	(572·0 ,,)
Fat	1·30 ,,	(37·0 ,,)
Mineral	1·55 ,,	(44·0 ,,)

Nitrogen.	*Carbon.*
0·61 oz. (17·0 grammes).	12·78 oz. (362·3 grammes).

On examination of these diets, it will be seen that Class I. contains about the same quantities of the several alimentary substances as are contained in Playfair's subsistence diet; and as it is only applicable to the short period of seven days, its defects are not likely to be attended by any serious consequences unless prisoners are set to "hard labour" when on this diet. For this it is quite inadequate, even for so short a period; and, as the offences for which such short sentences are considered a sufficient punishment are of the most trivial nature, there seems to be no good reason for insisting on such a highly *correctional* dietary for these the least criminal of offenders.

The diet for Class II. is of more importance, as it applies to sentences of one month; and a defective diet—if it should be defective—for that length of time might have an injurious effect on the prisoner's health. And it should be remembered that the loss of health attending such a diet is not so likely to make itself manifest *during* as immediately after this short term of imprisonment, when the prisoner attempts to resume his daily labour; so that the statistics of the health of the prisoners *while in prison* would scarcely bear on these cases.

Again, we have also to consider that a sentence of a month's imprisonment, *without hard labour*, is often the punishment of very trivial offences, and certainly not such as would seem to call for a severely correctional diet.

This diet is very little in excess of Playfair's mere subsistence diet, and much below Moleschott's estimate of what is necessary for a man in ordinary work. The defect is chiefly in albuminates :—

Class II. Prison Diets.		Playfair's Subsistence Diet.	Moleschott's.
	oz. grammes.	oz. grammes.	oz. grammes.
Albuminates .	2·23 or 63·2	2·0 or 57	4·59 or 130
Carbo-hydrates.	11·87 „ 336·5	12·0 „ 340	14·26 „ 404
Fats . .	0·67 „ 19·0	0·5 „ 14	2·96 „ 84
Salts . .	1·09 „ 30·9	0·5 „ 14	1·06 „ 30

The diet for men of this class, with *hard labour*, though more satisfactory, is, no doubt, defective in albuminates and fats. This will be seen by comparing it with the average of several dietaries calculated for men in ordinary work :—

Prison Diet, Class II.		Mean of several Diets (Parkes).	Deficiency.
	grammes.	grammes.	grammes.
Albuminates . .	70·8	122	51·2
Carbo-hydrates .	385·5	332	(+ 53·5)
Fats . . .	21·0	100	79·0
Salts . . .	32·3	28	(+ 4·3)

As has been already pointed out, the effects of such a dietary could only be accurately estimated by statistics of the health of prisoners *after their discharge* from such short terms of imprisonment.

The hard labour diets of Classes III. and IV. appear ample, even when compared with the liberal estimate of Moleschott, except that they are very defective in fats, which defect can scarcely be compensated for by the relative excess of carbo-hydrates.

Prison Diet:	Class III. and	Class IV.	Moleschott's.
	grammes.	grammes.	grammes.
Albuminates . .	92·7	116·0	130
Carbo-hydrates .	472·0	572·0	404
Fats . . .	27·9	37·0	84
Salts . . .	37·1	44·0	30

These diets would certainly be improved by increasing the proportion of fats and diminishing the carbo-hydrates to a corresponding amount.

In connection with these prison diets, Dr. de Chaumont's remarks on the effect on soldiers of imprisonment in convict prisons particularly are interesting. He says, referring to the circumstance that soldiers are sometimes, as a matter of convenience, confined in convict prisons: "The ordinary diet which is sufficient for the convict is insufficient for the soldier, and that for several reasons : (1) the convict is on the average a smaller man. (2) The previous life of the convict is an irregular one, in which his food is generally insufficient ; whereas the soldier's life is usually the opposite—his food is fairly good and his meals are regular. (3) The crimes for which the convict is imprisoned are crimes against society, and his removal to a prison cannot be considered much of a degradation morally, whereas his physical condition is really improved ; on the other hand, the soldier's crime is often one of a military character only ; hence his removal to a prison is a moral degradation, especially if it be a convict prison. The result is that, whilst the majority of the civil prisoners retain their weight or even gain, the majority of soldier prisoners lose. It is also found that age has an effect, the older men losing, the younger generally gaining. Length of sentence has also an influence, partly on account of some difference of diet and work, but probably directly on account of the system ultimately accommodating itself to the altered conditions. Thus the men who lose weight are—the heaviest originally, the oldest, and those with shortest sentences. Those who are stationary or gain weight are—the lightest originally, the youngest, and those with longest sentences."

The soldier's dietary. — The soldier's daily rations when on home service which he receives from Government consist of 1 lb. of bread and $\frac{3}{4}$ lb. of meat ; he also has "an allowance, in the nature of partial board wages, estimated at 5d. a day, which is supposed to be, and which, according to regulations, may be expended on his diet."

Parkes gives the following table as representing the usual articles of food, with nutritive value in ounces avoirdupois, which each soldier consumes daily :—

Articles of Food.	Quantity.	Water.	Albuminates	Fat.	Carbo-hydrates	Salts	Total Water-free Food.
	oz.						
Meat (¼ bone) .	12·00	7·20	1·44	0·81	—	·15	2·40
Bread . .	24·00	9·60	1·92	0·36	11·81	·31	14·40
Potatoes . .	16·00	11·84	0·32	0·02	3·36	0·2	3·72
Green or other Vegetables .	8·00	7·28	0·14	0·04	0·46	0·6	0·70
Milk . .	3·25	2·82	0·13	0·12	0·16	0·2	0·43
Sugar . .	1·33	0·04	—	—	1·29	—	1·29
Salt . . .	0·25	—	—	—	—	·25	0·25
Coffee . .	0·33	—	—	—	—	—	—
Tea . . .	0·16	—	—	—	—	—	—
Total quantity .	65·32	38·78	3·95	1·35	17·08	·81	23·19

Calculating out the nitrogen, carbon, etc., in these substances, we get :—

Nitrogen		272	grains.
Carbon in Albuminates . .	837	4,588	,,
,, Fats	454		
,, Carbo-hydrates	3,297		
Hydrogen in Albuminates .	51	116	,,
,, Fats . .	65		
Sulphur in Albuminates . .		32	,,

To compare it with Moleschott's standard diet, we must state the quantities in grammes.

	Moleschott's.	English Soldier's Diet.
	grammes.	grammes.
Albuminates	130	113
Fat	84	38
Carbo-hydrates	404	482
Salts	30	23

Parkes observes with regard to this diet that it contains considerably less nitrogen than the standard diet, as is indeed evident by the comparison we have given above; that it contains about the correct amount of carbon, but it would be better if less of the carbon were obtained from carbo-hydrates and more from fat. He recommends the addition of more meat or of cheese, and the addition also of butter or some other fat or oil. He also suggests the introduction of peas and beans, as in the French army. Professor de Chaumont was also of opinion that the food of the soldier is deficient, especially for the younger men, and he thought it highly desirable that the ration of meat should be increased. From inquiries among soldiers, he found that the recruits and young soldiers could eat much more; though the old soldiers, "many of whom had been long accustomed to take spirits, and who had injured their digestive powers by so doing, took less food."

Parkes calculated that "the total energy obtainable in the body from the soldier's daily diet appears to be equal to lifting 3,542 tons one foot. The amount for the internal and external mechanical work of the body being taken at 600 tons lifted a foot, there remains 2,942 tons for the animal heat and all the other processes." He points also to the deficiency of condiments in the soldier's food and advocates especially the use of vinegar, as a digestive agent, a flavourer and an anti-scorbutic.

The Report of a Committee appointed to inquire into the question of Soldiers' dietary, was presented to both Houses of Parliament in June, 1889, and contains some interesting matters bearing on this subject.

It points out that as the soldier receives *an allowance for food* as well as a ration of $\frac{3}{4}$ lb. of meat and 1 lb. of bread, the question is not whether these are sufficient in themselves, "but whether these supplies, supplemented by other articles provided out of the messing stoppage, afford a sufficient diet for the soldier." The evidence of the manager of Pearce's Dining and Refreshment Rooms, an institution supplying about 30,000 meals daily to carmen, bricklayers, etc., in London, showed that the average amount of meat without bone supplied to each man for dinner was 5 oz. uncooked, yielding when cooked about 4 oz.

According to Brigade-Surgeon Maunsell, who weighed 1,232 rations, the average amount of cooked meat supplied daily to the soldier was 7 oz. 1 dram, exclusive of bone and dripping.

The Report also points out that the British soldier receives a larger meat ration than any Continental soldier, and that with the existing scale of diet recruits almost invariably increase in weight.

The most interesting and practical part of the Report, to which we shall return immediately, is that which refers to the considerable success which has attended the experiments of Colonel Burnett of the 1st Battalion Royal Irish Rifles at Mullingar, for supplying his men with what Surgeon-Major Notter, Professor of Military Hygiene at Netley, has described as a model diet, with a stoppage of only 3d., instead of 5d., a day. This system, or one somewhat similar, appears also to exist in many other regiments. Complaints as to the quality of the bread supplied to the army, the Report states, were almost universal and well-founded. It was often imperfectly baked and became stale and sour within a few hours of its issue. Large quantities of ration bread were thrown away by the troops and other bread was purchased in its place. Two qualities used to be supplied—(1) Hospital bread made of "Households No. 1" flour, and (2) Ration bread made of "London seconds" flour. The defect in the bread was believed to be due to the use of brewer's yeast, instead of patent yeast, and to imperfect baking owing to the size of the loaves. By adopting 2 lb. loaves instead of 4 lb., and patent instead of brewer's yeast, the bread has been found quite satisfactory and will keep for several days without becoming sour.

As the class from which the army is recruited rarely eat dark-coloured bread, and have a great prejudice in favour of white bread, it is recommended by the Committee that the ration bread should be made from the same class of flour as the hospital bread.

The Committee strongly advise the observance of more care and skill in cooking, as well as the saving and utilisation of the dripping in improving the diet (in that particular in which it is most defective, viz. in fat), and the bones for making soups. Cooking in some regiments was found to be attended with much greater waste than in others—in one, 34 lb. 8 oz. of mutton lost in cooking 9 lb. $10\frac{1}{2}$ oz.; whereas in another, 27 lb. 12 oz., also of mutton, lost only 4 lb. $8\frac{1}{2}$ oz.: so that in one case the soldier received only $6\frac{1}{2}$ oz., in the other as much as $7\frac{3}{4}$ oz. of cooked meat.

It has been recognised that the interval between the light tea meal at 4 p.m. and breakfast next day at 7 or 8 a.m. is too long for the soldier, and especially the *young* soldier, to be without food. It will be seen how, by adopting Colonel Burnett's system, this meal, which soldiers rarely care for, may be made attractive.

The Committee consider that the chief defects in the soldier's diet are due to insufficient interest being taken in this subject by the officers, and that the soldier's rations, supplemented by even a smaller sum than the authorised messing contribution of 5d. a day, afford, with *proper regimental arrangements*, a sufficient diet. They object to frozen meat, as it loses 10 per cent. more in cooking than fresh meat; and to the suggestion that fish and pork might form part of the Government ration as an occasional substitute for beef and mutton, they reply that the former is impracticable for general application, owing to the cost of the more nourishing kinds of fish, and the difficulty of insuring fresh supplies at inland stations; and as to the latter, there would be great difficulty in insuring a thoroughly good supply of healthy meat. The cost of adopting the recommendation of the Committee to use "No. 1 households" instead of the flour now used, and baking 2 lb. instead of 4 lb. loaves, will be £11,200.

In an appendix to their Report the Committee publish a Memorandum from Colonel C. J. Burnett setting forth the "innovations and improvements" he has made in the messing and rations of the men under his command. Having "formed the conclusion that the quantity of bread and meat at present issued to the soldier was sufficient, if carefully and judiciously looked after," he resolved to put his ideas into practice and to ascertain if he had formed a correct judgment or otherwise. He turned his attention first to the principal meal, the dinner. "I found," he says, "that, although it appeared sufficient, still something seemed wanting in it, for many of the men after this meal adjourned to the canteen—a course which, I reasoned, they would not follow had their appetites been thoroughly satisfied at the dinner table. It struck me that a basin of good soup would be the requisite thing in this case, and I accordingly took measures to give it a trial, without causing any extra expense to the soldier. To do this, I had the bones separated from the meat in the cook-houses and crushed, and each lot weighed and recorded to prevent any undue waste.

"The first morning this was done I directed each company to obtain two sheep's heads (or one bullock's head) to create a stock, and with these heads (also broken up and crushed) and the day's bones the soup was made, and seasoned with a small quantity of vegetables. I tasted the soup the first morning, and found that the result exceeded my most sanguine expectations. That afternoon I had the heads and bones put into the boiler again, and allowed to simmer the remainder of the day, adding to this the following morning the next day's bones. As might be expected, the soup on the second day was most excellent, surpassing in quality that made at first. In this way three days' bones have been used every day for making soups, each day the oldest lot of bones being replaced by the new lot from the rations. The bones are kept in separate nets, to which are attached wooden 'tallies,' to distinguish them. No stock has been purchased since the first day, the only expense incurred being in the purchase of vegetables. The soup is varied to suit the wishes of the men, and a list is hung up in each room from which they may make their selection. This list comprises:—

Split peas	soup.
Green peas	,,
Barley	,,
Vegetables	,,
Mullagatawny	,,
Lentil	,,

"The cost of the ingredients for these (including vegetables) ranges from 1s. to 1s. 6d. per company, but the latter is the maximum. I may here say that I have, from the beginning, frequently and without notice, visited the men at their dinners, and assured myself that this arrangement has caused the greatest satisfaction amongst them, and made their dinner meal an ample and enjoyable one to them. As a significant fact of what this has done towards satisfying them, I would here state that since the introduction of the soup I have not had a single complaint regarding the quality or quantity of his meat from any man of the battalion. The system is now fairly established in the battalion, and irrespective of the nature of the man's dinner, he is supplied with a basin of good wholesome soup in addition.

"Having made this improvement in the men's dinners, I next turned my attention to their breakfasts, which hitherto had been supplied to them in strict accordance with the scale laid down in the 'Messing Book' (Army Book 48), any little extra in the shape of butter, cheese, jam, eggs, etc., being purchased by the soldier from his own pocket. My first thought was how to provide him with these extras without encroaching on his pocket, and to do this I knew it would be necessary to make a retrenchment in some direction, without deducting from his other meals. It had always been the custom in the battalion (copied from other regiments on arrival home in 1882) to provide the men with an extra $\frac{1}{2}$ lb. bread at the tea meal. This was paid for out of their messing money, and was familiarly known as 'tea bread.' It is, I believe, provided in most regiments at home. At various times, when making periodical inspections of the barracks, I had noticed that the refuse barrels were more than half full of stale bread, thrown out by the men, and on making close inquiries, I learnt that the ration bread, supplied in the morning, lasted the men for breakfast and dinner, and then left a quantity over for tea. But the men, knowing that they were getting fresh bread of a better quality for tea (the 'tea bread' referred to), made no effort to save or utilise the remnants of their ration loaves, but threw them in large quantities into the refuse barrels. Further, from personal inquiries that I made amongst the men themselves, and from visits which I made to the barrack rooms after the men had had their tea meal, I found that even the 'tea bread' was not wholly used, but was considerably wasted. I saw my way at once to giving them something extra for their breakfasts. Giving directions to the Quartermaster to issue $\frac{3}{4}$ lb. bread per man, as rations, in the morning, for breakfast and dinner, and $\frac{1}{4}$ lb. in the afternoon for tea, I, at the same time, instructed officers commanding companies to draw $\frac{1}{4}$ lb. 'tea bread' only, as extra messing. This still gave the man $\frac{1}{2}$ lb. bread for tea, and kept it out of the refuse barrels. With the money saved from the other $\frac{1}{4}$ lb. 'tea bread,' I ordered the men to be supplied with something extra for breakfast, in the shape of butter, jam, marmalade, eggs, bacon, cheese, fried liver, oatmeal porridge, herrings, and many other little sundries, which were previously almost unknown luxuries to the soldier, particularly the improvident one. To do the cooking necessary in such cases, I supplied each company with frying-pans and saucepans from the Canteen Fund, and any little cooking that is requisite is carried out by the orderly man of each squad in the barrack room. This saves the cook much extra work, insures the cooked 'extras' being served on the table quite hot, and gives every man a useful insight into the method of cooking his meals.

"Now that this part of the breakfast was arranged, I turned my attention to the tea, which the majority of the men prefer for breakfast. What seemed at first fair tea, I found, on closer scrutiny, to be very poor and open to considerable improvement; but the method of making it (which is apparently the system prevailing amongst soldier cooks) was a great drawback to any appreciable improvement being carried out. I will just explain here how I saw the tea made in the cook-house on the day that I went there to witness it. After the water had been boiled in the boiler, the cook took the six cans for the company (in which the tea is carried by the men from the cook-house), and put all the dry tea into one can, filled it up with hot water, and then put the can on the range to 'draw.' These cans are barrack furniture, and are without lids, consequently as the can was open while the tea was 'drawing,' the greater part of the aroma and strength escaped in the steam. After the tea was 'drawn' in this can, it was strained, the leaves taken out and thrown away, the tea poured in in equal parts into the other cans, which were then filled up with hot water, and sweetened with sugar and milk. With the intention of improving this, I ordered lids for the cans to be made in the regimental workshops, at a cost of a few pence each, which I defrayed from the Refuse Fund. When these lids were ready, I thought I would also make an alteration in the method of making the tea, with a view of improving it. Taking a company with about 60 men in it, I found that they were getting 12 oz. tea at 1s. 8d. per lb. = 1s. 3d. Instead of this I obtained 8 oz. tea of a superior quality, at 2s. per lb. = 1s., and instead of having the tea made all in one can, I had the dry tea divided into six equal parts, and put in separately into each can, then 'wetted' with the boiling water, and each can put on the range to 'draw,' properly covered over with lids. When the tea was 'drawn' and sweetened, it was found to be most excellent, and far superior in every way to what they were getting before, besides costing 3d. per diem less. This method, which applies to coffee as well as tea, has now been adopted throughout the battalion.

"Having accomplished so much with the breakfasts and dinners, I thought it my duty to see what could be done in the way of improving the men's tea meal. During many years' service in India, I had always found that the tea meal was not popular amongst soldiers, and that very few partook of it. In order to judge for myself whether such was also the case at home, I made random visits to several barrack rooms during the hours for 'tea,' and found in every case only about two or three men in a room making a meal. The bread and tea belonging to the others seemed to be lying about on the tables and shelves, palpably not wanted. The nature of the meal itself was sufficient to bring about this result, consisting as it did of a basin of weak and ill-flavoured tea, and a piece of dry bread, anything else having to be supplemented from the soldier's own pocket. Taking a company of 60 men, I found that their tea meal cost them 4s. $7\frac{3}{4}$d., which was made up as follows :—

	s.	*d.*
12 oz. Tea	1	3
4 lb. Sugar	0	10
$2\frac{1}{2}$ quarts Milk	0	$6\frac{1}{4}$
$7\frac{1}{2}$ loaves 'Tea-bread' (2 lb. each) .	2	$0\frac{1}{2}$
Total . .	4	$7\frac{3}{4}$

"Looking round, in my efforts to make this meal an attractive one for the men, it occurred to me that if it could take the form of a hot supper it would find universal favour, and would, moreover, prove a substantial benefit to the men. It was decided, as an experiment, to discontinue the 'tea bread' altogether, and take the money expended on it towards paying for the suppers. As stated, this was only resolved on as an experiment, and it was the intention, had it proved unsatisfactory, to try some other plan. The new arrangement was first tried with one company. A list was drawn up of what was considered would be necessary for making an Irish stew, and giving the men a basin of coffee, and comprising the following :—

		s.	d.
1	Bullock's Head	1	0
2	lb. Meat	0	8½
1½	stone Potatoes	0	6
	Vegetables	0	3
1	lb. Coffee	0	10
3	lb. Sugar	0	7½
2	pints Milk	0	2½
¼	lb. ration Bread	free	
	Total	4	1½

"(It may not always be easy to procure a bullock's head, but other material in the way of cows' heads, sheep's heads, shin, gravy meat, etc., can in such cases be substituted, and answer the purpose just as well.)

"Need I say that I was surprised myself at the result? The stew was most excellent, and with the basin of coffee and the bread, formed a most comforting and nourishing meal. After the first night the stews were even better, as the cook had stock to work on from the previous night, in addition to the fresh material given him.

"The plan was rapidly adopted by every company in the battalion, and now at the evening meal, instead of finding two or three men sitting down to the table, it is the exception to find any men away from it; and this in itself speaks to the way in which it has been received and appreciated by the men. The suppers have become universal in all the rooms, and it is a most comforting sight every evening, particularly now during the cold winter evenings, to go round the barrack rooms and find the companies, almost to a man, sitting at their supper tables, thoroughly enjoying their warm and nourishing meal.

"Already these changes are beginning to develop habits of thrift in the men. The potatoes remaining over from the dinners, instead of being consigned to the refuse barrels as before, are carefully preserved and used with the suppers at night; scraps of bread are collected daily, and utilised for making bread puddings on Sundays; the fat from the stews is saved and used for frying liver for breakfast, thus saving the expense of buying dripping, etc., and the men themselves are considerably in pocket, as the supper bar in the recreation room is now quite deserted, the men being amply satisfied with their meals. There has been no stinting in any one direction, no taking from one meal to make up another. All that has been done has been simply to divert unnecessary waste, and turn the proceeds to a practical and useful purpose, and give the soldier the uttermost value for every farthing of his money. Everything that has been done has not caused any expense to the Government, nor has the soldier been called on to pay a farthing more than the threepence a day messing money he has always paid, and, above all, he is now thoroughly satisfied with the quantity and quality of his ration."

The following is the Report of Surgeon-Major J. L. Notter, Professor of Military Hygiene, Army Medical School, on Colonel Burnett's system, together with Colonel Burnett's reply thereto:—

"I have at last completed working out the value of your diets, and I must say it has astonished me. You have done wonders in the way of improving the soldier's food.

"Herewith the results, and I have added a standard diet by Moleschott, who is one of the greatest authorities we have:—

	Standard.	Col. Burnett's System.
	oz.	oz.
Albuminates	4·59	4·9249
Fats	2·96	2·1408
Carbo-hydrates	14·26	16·3630

"On taking the ordinary ration we have—

	Ordinary Scale.	Col. Burnett's.
	grains.	grains.
Nitrogen	276	344·447
Carbon	4588	4912·684

"Your system only requires *one* improvement. It is still deficient in *fats,* and if you could add 1 oz. of bacon daily at the cost, say, of ½d., it would be an excellent diet *in every respect.* It would actually provide him [the soldier] with 323 foot-tons of mechanical energy, which means a very good day's work. It is no small honour to have succeeded so far. You have done wonders, and I am sure you will not mind my making this suggestion to you about its not containing quite enough of fat. Butter, bacon, cheese, suet, lard, any of these would supply this, but you want to add about 1 oz. per diem for each man.

"The soup gave a large amount of nitrogen in a good form.

"The standard diet I have given will easily show you where yours is too small, *in fats,* and I am sure you can easily make this improvement."

To this Colonel Burnett replies :—

"I can easily manage the fat, and have done so already for four days in the week, because on two days in the week I give pies and puddings, which contain each 3½ lb. of dripping for 50 men. Then, on one day a week, I give every man 2 oz. of bacon, and, now eggs are cheap, an egg for breakfast. The dripping does not, of course, appear in the grocery book, because I save it from the stews, so it costs nothing. I buy dripping, and give the men 2 oz. one day a week, and I can run to two more ounces of bacon for a second day. This will give more than the fat theory demands."

SCALE OF MESSING FOR THE GUIDANCE OF COLOUR-SERGEANTS.

(*On which Dr. Notter's Analysis is based.*)

Coffee, $2\frac{1}{2}$ oz. to 10 men (one meal).
Tea, 1 oz. to 7 men (one meal).
Sugar for tea, $7\frac{1}{2}$ oz. to every 10 men (one meal).
Cheese, 1 oz. per man.
Butter, 1 oz. per man.
Jam, 2 oz. per man.
Marmalade, 2 oz. per man.
Golden syrup, $2\frac{1}{2}$ oz. per man.
Brawn, 2 oz. per man (breakfast and supper).
Corned beef, 2 oz. per man (breakfast and supper).
Potatoes, 1 stone for every 12 men (dinner).

,, 2 stone for supper per company	of 60 men.
Vegetables for soups, 4 lb. per company	
,, supper, 3 lb. per company	
Onions for soup, 3 lb. per company	
,, supper, 2 lb. per company	
Salt, 2 lb. per diem ($1\frac{1}{2}$ drum) per company	
Pepper, 3 oz. per diem per company	
Mustard, 3 oz. per diem per company	

Herrings, 1 per man.
Split peas for soup, 1 lb. for 10 men.
Lentils for soup, 1 lb. for 10 men.
Barley for soup, 1 lb. for 10 men.
Curry powder, 5 oz. for soups or curried breakfasts, dinners, or suppers, for company of 60 men.
Flour for soup, 1 lb. per diem per company, for thickening.
Celery seed for soup, one packet per diem per company.
Milk, $1\frac{1}{4}$ pint for every 10 men (one meal).
,, for tripe stew, 2 quarts per company.
,, for porridge, 1 quart for 15 men.
Oatmeal, 1 lb. for every 9 men.
Golden syrup, for porridge, 3 tins (6 lb.) per company.
Bacon, 2 oz. per man.
Eggs, 1 per man.

The above Scale to be adhered to in making up Messing Books.

Two days' "Messing Account" is now added, to show the actual cost of carrying out this system :—

"H" COMPANY. DAILY MESSING ACCOUNT.
Mullingar, 11*th January*, 1889 (*Friday*).

			£ s. d.
Balance *Cr.* brought forward			0 4 10¾
48 Men in Mess at 3d.			0 12 0
Add any money from Refuse Fund			—
Total			0 16 10¾
Deduct Balance Debt brought forward			—
To be expended.			0 16 10¾
	Quantity	**Rate.**	
	lb. oz.	s. d.	
Tea	0 6	2 0	0 0 9
Coffee	0 12	0 10	0 0 7½
Sugar	3 0	0 2	0 0 6
,, ...	3 0	0 1¾	0 0 5¼
Currants	—	—	—
Brawn	2 0	0 5	0 0 10
Lemon Peel	—	—	—
Pepper	0 4	1 2	0 0 3½
Salt, 2 drums	—	0 1	0 0 2
Mustard	0 4	0 11	0 0 2¾
Butter	1 0	1 1	0 1 1
Barley	—	—	—
Bread . . . . loaves	—	—	—
Herrings, 2 doz.	—	0 8	0 1 4
Baking Powder	—	—	—
Celery Seed, 1 packet	—	0 1	0 0 1
Oatmeal	—	—	—
Split Peas	6 0	0 1½	0 0 9
Potatoes, 4 stone	—	0 5	0 1 8
Vegetables	6 0	0 1	0 0 6
Onions	5 0	0 1¼	0 0 6¼
Herbs	—	—	—
Milk, 3½ quarts	—	0 2½	0 0 8¾
Bacon	—	—	—
Total	—	—	0 10 6
Total expended			0 10 6
Balance *Cr.*			0 6 4¾
Balance *Dr.*			—

BREAKFAST.

No. of Mess.	No. of Men.	Extras provided.	Amount.
			£ s. d.
1	11	Brawn	0 0 10
2 3 4	24	Herrings	0 1 4
5	14	Butter	0 1 1
	49		0 3 3

SUPPER—Porridge.

"E" COMPANY. DAILY MESSING ACCOUNT.

4th February, 1889.

Of which Dr. Notter says, "This last scale of diet is most satisfactory in every way."

	£ s. d.
Balance *Cr.* brought forward	0 18 5
46 Men in Mess at 3d.	0 11 6
Add any money from Refuse Fund	—
Total	1 9 11
Deduct Balance Debt brought forward	—
To be expended	1 9 11

	Quantity lb. oz.	Rate. s. d.	£ s. d.
Tea	0 8	2 0	0 1 0
Coffee	0 12	0 10	0 0 7½
Sugar	2 8	0 2	0 0 5
"	3 8	0 1¾	0 0 6¼
Currants	—	—	—
Spice	—	—	—
Lemon Peel	—	—	—
Pepper	0 2	1 2	0 0 1¾
Salt, 1 drum	—	0 1	0 0 1
Mustard	0 2	0 11	0 0 1½
Butter	2 15	1 1	0 3 2¼
Barley	5 0	0 1¾	0 0 8¾
Bread loaves	—	—	—
Flour	1 0	0 1½	0 0 1½
Baking Powder	—	—	—
Curry Powder	0 5	1 10	0 0 7
Oatmeal	—	—	—
Split Peas	—	—	—
Potatoes, 7 stone	—	0 5	0 2 11
Vegetables	7 0	0 1	0 0 7
Onions	5 0	0 1¼	0 0 6¼
Herbs, celery seed, 1 packet	—	0 1	0 0 1
Milk, 4 quarts	—	0 2½	0 0 10
Bacon	—	—	—
Total	—	—	0 12 6
Supper, 5 lb. beef (curried stew)	—	—	0 1 9
Total expended			0 14 3
Balance *Cr.*			0 15 8
Balance *Dr.*			—

Squad.	Breakfast.	Amount. £ s. d.
1 2 3	Butter for breakfast (1 oz. per man)	0 3 2¼

Supper consisted of curried stew, made of 5 lb.

of beef, 2 stone of potatoes, with vegetables and onions, together with the usual basin of coffee, and $\frac{1}{4}$ lb. ration bread.

Colonel Burnett has succeeded completely in showing that "with the Government ration, supplemented by a stoppage of 3d. per day from the soldier, the demands of science in the matter of feeding the Army can be satisfied," and Dr. Notter adds, "The ration Colonel Burnett issues is ample, and he states he can provide this *anywhere* without extra cost."

For campaigning no strict scale of diet is or can be laid down; it would have to be fixed at the time, and would depend on the character of the campaign. The scale should be very liberal, and besides the *usual* articles of diet, *extras* should be supplied for special purposes, such as forced marches, rapid movements at a distance from the base of supplies, etc. The usual ration should contain at least 375 to 400 grains of nitrogen. Parkes suggests the following as a liberal and varied war ration:—

Bread	$1\frac{1}{4}$ lb.
Fresh Meat, without bone	1 ,,
Peas or Beans	3 oz.
Potatoes and Green Vegetables	1 lb.
Cheese	2 oz.
Sugar	2 ,,
Salt	$\frac{1}{2}$,,
Pepper	$\frac{1}{20}$,,
Ground Coffee	1 ,,
Tea	$\frac{1}{2}$,,
Red Wine	10 ,,
Or Beer	20 ,,

The nutritive value of this diet is about 380 grains of nitrogen and 5,000 of carbon.

As useful extras he mentions salt meat, Australian meat, Chicago meat, dried meat, Liebig's Extract, pea and beef sausages, biscuits, flour, meat biscuits, rice, lime juice, preserved vegetables, brandy or rum, and vinegar.

"Bread (which should be well baked) should be issued as long as possible; and if biscuit is issued for more than a week, flour or rice should be added to it. When salt meat is issued for several days in succession, vinegar should be given with it. If no vegetables can be obtained, lime juice should be early had recourse to." He strongly advises that red wine or beer should be supplied, and not spirits. All the Continental armies issue wine rations in war. The use of concentrated and cooked foods is very important for rapid expeditions.

The dietary suitable for India and for service in tropical climates must be proportionate to the amount of mechanical work done, as in temperate climates. In India, as elsewhere, it must balance the expenditure of energy. It has been thought that it would be beneficial to derive the food supplies more extensively from the vegetable kingdom in India than at home, so as to restrict the amount of animal food taken within comparatively narrow limits. But the testimony of some of the most experienced medical officers is opposed to this. "It has often been said that Europeans in India should imitate the natives in their food, but this opinion is based on a misconception. The use of ages has accustomed the Hindu to the custom of taking large quantities of rice, with pulses or corn. Put a European on this diet and he could not at first digest it; the very bulk would be too much for him. The Hindu, with this diet, is obliged to take large quantities of condiments (pepper, etc.). The European who did the same would produce acute gastric catarrh and hepatic congestion in a very short time." It is certain that in the Indian climate spirits are injurious, and wine and beer should be taken in great moderation. The men should not be allowed more than a quart of beer a day, and they would be healthier with a pint. In the hot stations and seasons entire abstinence from alcoholic stimulants should be the rule, and tea and coffee should be chosen as the best beverages. The tendency to scurvy, which is greater in the Tropics than at home, points to the desirability and importance of consuming a due proportion of fruit.

Ration of the French soldier.—Dujardin-Beaumetz makes the remarkable statement that the ration of the French soldier is superior to that of the soldiers of other armies, an opinion which another French authority, Prof. Germain Sée, is far from sharing, who points out the superiority of the ration of the British soldier, and expresses great dissatisfaction both as to the quantity and quality of the French soldier's rations.

The State provides the meat at thirty-five per cent. under market price; it also supplies the common bread (*pain de munition*). The white bread (*pain de soupe*) has to be bought by the soldier. For this and other articles of diet he has to subscribe forty-three centimes out of his daily pay of forty-eight centimes, leaving him five centimes, *i.e.* a halfpenny, to receive in cash. His dietary consists of—

	Grammes.	Oz. avoir.
Munition Bread	750	26·4
White Bread (for Soup) . .	260	8·8
Meat (uncooked)	300	10·6
Vegetables (green) . . .	100	3·5
„ (dried) . . .	30	1 1
Salt	15	0·5
Pepper	2	(31 grammes)
Total	1·447	51·00

550 grammes of biscuit are sometimes given in place of bread, and 250 grammes of salt beef or 200 of salt pork in the place of fresh meat. The dried vegetables consist chiefly of haricot beans.

Parkes calculates that the French soldier gets a total of 51 ounces of solid food against the British soldier's 65 ounces; but when estimated as "water-free" food he gets 24·7 ounces against the British soldier's 23·2 ounces. This is due to the circumstance that the French soldier gets a much larger ration of bread, viz. 35 ounces against 24, which is the British soldier's ration. On the other hand, the British soldier usually gets 16 ounces of potatoes, which contain nearly 75 per cent. of water.

The French soldier gets too much bread and too little meat. Owing to the large quantity of bread in it, his diet calculates out much richer both in albuminates and carbo-hydrates than that of the British soldier; but it is, on the whole, a less nutritious diet.

In Algiers, 16 grammes of rice are added to the French soldier's rations; and when on the march, sugar, coffee, and ¼ litre of wine are issued. In time of war he gets—

Meat (without bone)	8·40 oz.
Bread (or Biscuit, 26·5 oz.)	35·30 ,,
Dried Vegetables	2·12 ,,
Salt	0·50 ,,
Sugar	0·70 ,,
Coffee	0·60 ,,
Total	47·62 ,,

Nine ounces of wine or 2¼ ounces of brandy are sometimes served out instead of the sugar and coffee.

Germain Sée calls attention to the excessive quantity of bread in the French soldier's ration, much of which, he says, is not consumed, and, if it were, it could not be digested. He also very properly points out that at the age when men enter the army as recruits it is a serious error to suppose that their growth is complete. Many parts of the body do not reach their complete and permanent state "till five-and-twenty years of age, or even beyond that period. The young soldier should then, from a nutritive point of view, be regarded as still in the period of growth and development, and his food should, therefore, not only be sufficient to maintain the integrity and activity of his bodily organs, but also contribute to his further growth." *

The German soldier receives a *small* and a *large* ration; the latter he gets when on marches or manœuvres, etc. They consist of the following food substances :—

	Smaller Ration.	Larger Ration.
	oz. av.	oz. av.
Bread	26·50	26·50
Meat (uncooked)	6·00	8·82
Rice	3·20	4·22
Or Unhusked Barley (Groats) .	4·21	5·28
Or Peas or Beans	8·22	10·60
Or Potatoes	53·08	70·50
Salt	0·87	0·87
Coffee	0·468	0·468

Parkes calculates that, when of best quality, these would furnish—

	Albuminates.	Fats.	Carbohydrates.	Salts.	Total Water-free Food.
	oz. av.	oz. av.	oz. av.	oz. av.	oz. av.
Smaller Ration	4·8	1·1	17·4	1·5	24·8
Larger ,,	5·7	1·4	18·0	1·6	27·3

* Germain Sée, "Du Régime Alimentaire. Régime du Jeune Soldat."

The German soldier gets a little more bread than the British soldier, but less meat. He also gets a ration of rice, which neither the British nor French soldier gets on home service.

During the Franco-German War the daily German ration (independent of certain extra issues, when possible, of bacon, preserved and smoked meats, peas, white beans, potatoes, etc., in order to change the diet) was :—

	Bread (or Biscuit, 17 oz.)	$26\frac{1}{2}$ oz.	
One of these	Fresh or Salt Meat	13 ,,	
	Salted Beef or Mutton	9 ,,	
	Bacon	$5\frac{3}{4}$,,	
	Rice	4·4 ,,	
One of these	Barley or Groats	4·4 ,,	
	Peas or Beans	8·8 ,,	
	Flour	8·8 ,,	
	Potatoes	3·3 lb.	
	Salt	0·7 oz.	
	Coffee	0·7 ,,	(unroasted).
		or 1 ,,	(roasted).

The Austrian soldier receives, in time of peace: bread, 31 oz., and meat (without bone), 6·6 oz.; suet, 0·6 oz.; flour (or vegetables), 2·5 oz.; salt, 0·6 oz.; with a little garlic, onions, and vinegar. In war time the diet is variable. On four days fresh pork is issued, $6\frac{1}{2}$ ounces daily; on one day, salt pork, 6 ounces; on another day, beef, 6 ounces; and another, smoked bacon, 6 ounces. There is also an issue of butter or fat in addition. He has also a weekly issue of biscuit ($24\frac{1}{2}$ ounces), flour ($176\frac{1}{2}$ ounces for bread and cooking), sauerkraut ($5\frac{1}{2}$ ounces), potatoes (9 ounces), peas ($5\frac{1}{2}$ ounces), and barley (5 ounces); also wine, brandy and beer. These diets yield—

	Albuminates.	Fats.	Carbo-hydrates.	Salts.	Water-free Food.
In time of peace	3·7	1·6	17·0	1·0	23·3
In time of war average.	4·5	3·2	22·8	1·0	31·5

The peace ration contains too much bread, too little meat and too little fat.

The Russian soldier has 196 meat days and 169 fast days in the year.

On the *meat* days he gets meat and *schtschi* (cabbage soup), and buckwheat gruel; on *fast* days the meat is replaced by peas, and, occasionally, fish. He has a daily issue of 42 ounces of rye bread. The nutritive value of this diet has been estimated as follows, in ounces av.:—

Albuminates.	Fat.	Carbo-hydrates.	Salts.	Water-free Food.
5·8	1·0	25·0	2·5	34·3

On the march he gets $24\frac{1}{2}$ ounces biscuit instead of bread. On rare occasions, brandy, 135 fluid ounces per annum in 5 ounce rations, is served out.

The following is the fresh meat ration of European armies, calculated in ounces avoirdupois,* extracted from a statement prepared by Surgeon-Major J. L. Notter, M.D.:—

England		12·0 oz.
France		10·58 ,,
Germany	smaller ration	3·80 ,,
	larger ,,	8·81 ,,
Austria		9·87 ,,
Belgium		8·81 ,,

* Report of the Committee appointed to inquire into the question of Soldiers' Dietary. Presented to both Houses of Parliament, June, 1889.

Holland	8·81 oz.
Switzerland	11·0 ,,
Italy	6·34 ,,
Denmark	8·74 ,,
Sweden	5·67 ,,
Russia	7·05 ,,
Turkey	9·06 ,,

It would be extremely valuable, in the case of long sea-voyages, and for armies campaigning, if food could be so concentrated that it might occupy but a small amount of space and yet lose none of its nutritious qualities. It would appear, however, to be impossible to procure the food necessary for maintaining unimpaired the work and activities of the body in a digestible form in a less bulk than 22 or 23 *water-free* ounces. Concentration, according to Parkes, cannot be carried beyond this, and practically has not even reached this extent. "Life, however, and vigour may for some days be preserved with a much less amount; and the total amount of food has been reduced to 11 water-free ounces daily, with full retention of strength for seven days, though the body was constantly losing weight. For expeditions of three or four days, if transport were a matter of great difficulty, soldiers might be kept on 10 or 12 ounces of water-free food daily, provided they had been fully fed beforehand, and subsequently had time and food to make up the tissues of their own body, which would be expended in the time, and would not have been replaced by the insufficient food."

In the British Navy, when fresh provisions can be procured, a seaman's full daily allowance consists of 1 lb. of fresh meat, $\frac{1}{2}$ lb. of vegetables, $1\frac{1}{4}$ lb. of biscuit, or $1\frac{1}{2}$ lb. of soft bread; 2 oz. of sugar, 1 oz. of chocolate, $\frac{1}{4}$ oz. of tea, and $\frac{1}{8}$ pint of spirit. He also has *weekly* 3 oz. of oatmeal, $\frac{1}{2}$ oz. of mustard, $\frac{1}{4}$ oz. of pepper, and $\frac{1}{4}$ pint of vinegar. When fresh provisions cannot be procured, he gets daily either 1 lb. of salt pork, or salt beef, or $\frac{3}{4}$ lb. of preserved meat; and in addition on certain days $\frac{1}{3}$ lb. of split peas, with celery seed to flavour the soup made from them. On other days he gets flour 9 oz., raisins $1\frac{1}{2}$ oz., suet $\frac{3}{4}$ oz., to make into a pudding; and on other days either 4 oz. of preserved potato, or 4 oz. of rice, or 2 oz. of each.

CHAPTER X.

THE ORDER AND FREQUENCY OF TAKING FOOD.

It has become an almost universal custom in civilised life to appropriate certain fixed times in the day for taking food. Not only does this practice appear to be well suited to our physical organisation, and, therefore, most consistent with health, but it is, obviously, a necessary condition of a life full of physical and intellectual activity and occupation, such as the great majority of civilised human beings lead.

Reference has been made by various authors to the habits of feeding of other animals, and attention has been directed to the long periods during which the carnivorous animals are accustomed to go without food as compared with the almost continuous feeding of some of the herbivora. But none of these animals in their natural state lead an existence at all analogous to that of civilised human beings, and when such herbivorous animals as the horse or the ox are applied to the service of man, the same mode of feeding, viz. at regular, fixed intervals, is found to suit them perfectly well. The carnivorous animal usually consumes an enormous quantity of food, if he can obtain it, at each meal and then passes into a condition of torpor and lethargy, and the human being who attempts to imitate his habits of feeding, will be found to be affected with the same kind of languor and incapacity for exertion after meals.

In fixing the intervals which should occur between meals, it is necessary to bear in mind that the rate of digestion varies considerably in different persons and at different ages, and that it is also greatly influenced by habits and occupation.

It has been estimated that it requires from four to five hours to digest an average meal; but some meals and certain kinds of food require a longer time than this, while for some kinds of food a shorter period is sufficient. In a growing active youth or a healthy child, fed on appropriate and readily digested food, the digestive process is comparatively rapid, and the intervals between meals should therefore be shorter than in the case of adults. So also in adults leading an active out-of-door life, the food taken at each meal will be digested more rapidly and completely than in the case of persons of middle age following a sedentary occupation.

In Great Britain (with the exception of boys and girls at school who are often required to go too long without food) the tendency no doubt is to eat at too short intervals, and in many cases indigestion arises from the stomach being frequently called upon to commence the digestion of a fresh meal, before it has completed that of the preceding one.

The first meal of the day is *breakfast*, and it is a very important one. In the case of active persons leading wholesome, regular lives, it should be taken as soon after rising as possible. Persons who require to take exercise before breakfast are either dyspeptic or overfed; and, except in such persons, any considerable exertion, without having first taken food, after so long a fast as usually occurs from the preceding meal, is unduly exhausting and calculated to be injurious.

The unfed organism at this period of the day is also very susceptible to morbid influences, and especially prone to take harm from exposure to cold, to infection, or other injurious and depressing agencies.

Of course, for those who prefer to take a substantial meal at noon, or a little earlier, as is the custom to a great extent on the Continent, a cup of good *café-au-lait*, with a little bread and butter or dry toast, or biscuit, taken immediately on rising, is sufficiently stimulating and supporting to carry one over the interval between rising and the midday breakfast or *déjeuner à la fourchette.*

But in England a substantial early breakfast is popular, and accords well with the business and other habits of average Englishmen. 8 or 9 a.m. is the usual hour for this meal. The quantity and kind of food proper to be taken at this meal must depend on what may be the custom with regard to the food taken at luncheon, or at an early dinner. Those who take a substantial meal in the middle of the day do not require a large breakfast; a cup of tea, coffee, or cocoa, with a little bread or toast and butter, a boiled or poached egg and a rasher of bacon, is ample in this case. But when only a very light luncheon is taken between breakfast and late dinner—a plan which suits many busy professional and business men exceedingly well —then the breakfast should be as substantial as the appetite and digestion are equal to. A little well-made oatmeal porridge to begin with, then some fish, such as sole, whiting, haddock, a fresh or kippered herring, a poached or lightly-boiled egg, with a little broiled ham or bacon, bread and butter, or dry toast, and marmalade, or some fruit *compôte;* tea, coffee, or cocoa.

With a substantial breakfast such as this, and a good vigorous digestion, the organism is well furnished to begin the work of the day, and only a very light luncheon will be required. This should consist of the lean of a small mutton chop, or a little cold chicken, with bread or a potato, or a small basin of good soup with a little toast. Nothing more! Half-past 1 or 2 o'clock is a good time.

Those who take a light breakfast, and find it convenient to practically dine in the middle of the day, must, if they are engaged in active intellectual work in the afternoon, be careful not to make a large meal at this hour, as it is almost certain to make them heavy and dull for an hour or two after.

An early dinner of this kind should consist simply of a chop or steak, or a cut or two of some good joint, hot or cold, with a small quantity of bread and vegetables, a little bread and cheese, or butter; or, if preferred, a little light pudding or some cooked fruit.

The widely-spread custom of taking a cup of tea about 5 o'clock is consistent with either of the above methods. For those who have lunched lightly, it affords that little necessary stimulus and support to carry them on to the dinner-time; and for those who have dined early, it favourably influences the process of digestion, and rouses the mental and physical energies for the completion of the day's work.

A substantial dinner at 7 or half-past (it should not be later) is appropriate for those who lunch lightly. It should consist of soup or fish, or both, an entrée, or some joint, poultry or game, according to choice; some cooked fruit or light pudding, biscuit and cheese, and fresh vegetables and salads of the season.

Those who take an early dinner should take a light supper about half-past 8 or 9: a little white fish, or chicken and ham, or other cold meat and salad, with a little bread and cheese or butter.

Considerable variations in the manner, frequency, and time of taking meals appear to be not inconsistent with health and convenience.

There are, as Sir Henry Thompson has pointed out, certainly three different systems extensively practised.

First, there is the Continental system of two meals a day. The *déjeuner à la fourchette*—which corresponds with our lunch or early dinner—is usually taken between 11 a.m. and noon. This is a substantial but not a heavy meal, and frequently consists of some white fish, or cutlets, or a made dish of some kind, then an omelette and some fruit or cheese. Wine and water is usually drunk with this meal. The only food taken before this meal is a cup of *café-au-lait* or chocolate, with a little bread and butter or a rusk, which is served in one's bedroom on first getting up. This accords perfectly with the earlier hours of the professional classes on the Continent. Their work begins often at 8 or 8.30 a.m., and they are not delayed by a formal meal, but go directly from their bedrooms to their work.

By 11.30 they have done three hours' work, and then their first *formal meal* or *déjeuner* comes as an agreeable break or rest in the day's labours. They usually take plenty of time over this meal; and a cup of coffee leisurely sipped, together with a cigarette, occupies the following half hour. The second meal or dinner is taken when the day's work is over, usually between 6 and 7 p.m. This is a substantial meal of soup, fish, one or two meat dishes, sweets, and dessert; black coffee follows. Nothing more in the way of solid food is taken. On the whole, less food appears to be taken in this way than on the English system; more attention is, however, paid to the cooking, and the food is on that account more stimulating and supporting, and less oppressive. What, perhaps, seems most remarkable to an Englishman, in this system, is that it is adopted by all classes of the community in France and elsewhere on the Continent; whereas, in Great Britain the time of taking food is almost a class distinction.

Secondly, there is the system prevalent amongst a large part of the middle classes in England—Sir Henry Thompson calls it "the provincial system"—of taking four meals a day. It is, no doubt, adapted, to some extent, to their earlier hours and longer day's work.

The first meal or breakfast is taken about 8 a.m., and usually consists of tea or coffee, bread and butter, some bacon, or salt or smoked fish, or an egg. Dinner is the next meal, usually at 1 or half-past. This commonly consists of a joint and plain vegetables, some pudding, and bread and cheese. Soup or fish may be added to this meal on occasions.

Tea follows at 5 or 6. This is not infrequently made a somewhat heavy meal—what is called a "heavy tea"—and is the great defect in this system. It is much too soon after the substantial midday dinner for *another substantial* meal, and these "heavy teas" are responsible for a great deal of the dyspepsia prevalent amongst this class.

There would be no harm in drinking tea at this hour, but the taking of solid food (except with young growing girls and boys) should be postponed to the next meal or *supper* at 8, if the dinner is at 1; at 9 p.m., if the dinner hour is 2 o'clock.

This should consist of a moderate meal of fish or meat, cold or hot, with bread or potatoes.

This system of four meals a day is well adapted to young growing people whose digestions are active and vigorous. They require food more frequently, and in larger quantities, than adults. It is similar also to the German system; but the Germans dine almost universally at 12.30, not later, and their supper is regularly served at 7.30 or 8 p.m.

Thirdly, there is the system, already described, adopted by the professional and upper classes of breakfast, lunch, and late dinner, with 5 o'clock tea. In this system it is the lunch which is the difficulty and danger; it should be, as Sir Henry Thompson observes, sufficient to *support* activity, not so considerable as to impair it. Again let it be said, that solid food should not be taken with the 5 o'clock tea, and it is better not to take either sugar or cream with the tea at this hour. A thin slice of lemon added to the cup of tea, which should be made of China tea of *good* quality, is best. Children should not be allowed to partake of the late dinner; the four meals system is, as has been already stated, more suitable to their needs.

The order of the courses at dinner, *i.e.* of soup, fish, entrée, roast and sweets, cannot well be improved upon. Soup at the *beginning* of dinner has been objected to on the ground that it diminishes digestive power by diluting the gastric juice, and this objection is valid if a *large* quantity of badly-made soup is taken. But it does not apply to a small quantity, 4 to 8 oz., of well-made clear soup. Such a fluid disappears quickly on reaching the stomach, as it is rapidly absorbed by its blood-vessels and interferes in no way with the gastric juice. Its value at the commencement of a meal depends on the fact of its rapid absorption and entrance into the blood, so that the hungry man is quickly refreshed. "Soup introduces at once into the system a small instalment of ready-digested food and saves the period of trial, which, in the absence of soup, must be spent by the stomach in deriving some portion of nutriment from solid aliment, and thus the organ of digestion itself is indirectly strengthened for its forthcoming duties;" by filling the vessels of the stomach itself it really assists in the secretion of the gastric juice. A certain interval should be allowed to elapse between the last meal of the day, whether it be called dinner or supper, and the time of going to bed. The functions of the body pass into a state of inactivity during sleep, and all the organs of the body should "rest from their labours." If the chief work of the stomach is not completed or nearly completed on retiring to rest, that rest is likely to be imperfect or disturbed. An hour and a half or two hours is sufficient to allow between a light supper and bed time, but at least two and a half or three hours should elapse between a heavy dinner and retiring to bed. It would be an error, however, to suppose that a perfectly empty stomach contributes to repose ; on the contrary, it frequently is the cause of wakefulness. A certain sense of repletion, a sense of all the wants of the body being completely satisfied, conduces greatly to repose ; this is strikingly manifested in the tendency shown by nearly all animals to fall asleep after a full meal. Many persons who of necessity retire to bed late, and who do not dine very late or eat very largely at dinner, find that they sleep much better if they take a breakfastcupful of clear soup with a little toast or the same quantity of arrowroot before going to bed.

It is scarcely necessary to say that the habit of taking food between meals or other than at the stated meal times is most injudicious and hurtful.

A meal should not be commenced immediately after active or violent exercise. The half hour devoted to leisurely dressing for dinner—and after violent exercise half an hour's perfect rest before this—is the best preparation for the principal meal of the day. The stomach requires to have at its disposal the best and freshest energies of the body for its important work—the work, it must not be forgotten, upon which every other energy and function of the body is absolutely and entirely dependent. For the same reason violent exercise after a meal is to be carefully avoided.

The taking of strong tea and strong black coffee after dinner should be avoided by those whose digestions are not vigorous; they act as retarding agencies and tend to prolong the period of digestion, not hasten it; it may, however, be, as Sir W. Roberts has suggested, that the slightly retarding effect they exercise on digestion may not be altogether a disadvantage in the strong and vigorous. A cup of hot water sipped slowly an hour or two after dinner, instead of coffee or tea, or a hot and very weak infusion of the latter, will sometimes be found a material aid to feeble digestion.

CHAPTER XI.

FOOD IN RELATION TO AGE AND CONDITION—FOOD IN INFANCY AND CHILDHOOD—FOOD AT SCHOOL—FOOD IN ADULT LIFE—FOOD IN ADVANCED AGE.

In considering the proper relations that should exist between the nature and amount of the food taken, and the age of the individual and the particular conditions under which he is living, we shall have to bear in mind that, as to age, there are three great and principal divisions in human life. First, the *age of growth and development*, which extends from birth to about eighteen years of age, and this we shall consider as consisting of two parts—(*a*) the period of *infancy and childhood*, terminating at the tenth year of life; and (*b*) the *period of school life* or adolescence. It is especially characteristic of this division of human life that, while it lasts, the individual is to a great extent dependent on others for his food supply, and its selection—more so, at any rate, than at any subsequent period of his existence.

Secondly, there is the *period of adult life*, the age of completed growth and perfect development. The age of the full and varied employment of all the functions, physical and intellectual, of the organism. It will be convenient to consider under this division the influence, in relation to his food, of the different *conditions or circumstances* of life to which the individual may be subject.

Thirdly, there is *the period of advanced age*; the period of declining powers and progressively weakening functions.

According to the investigations of what is called "The Munich School" the following table gives the *minimum amount* of food necessary for different ages, stated in grammes :—

Age.	Nitro-genous.	Fat.	Carbo-hydrates.
	grammes.	grammes.	grammes.
Child under 18 months .	20 to 36	30 to 45	60 to 90
,, from 6 to 15 years.	70 ,, 80	37 ,, 50	250 ,, 400
Men (moderate work) .	118	56	500
Women	92	44	400
Old men	100	68	350
,, women . . .	80	50	260

It will be necessary in the first place to consider, and to consider at some length, on account of its *initial* and intrinsic importance, the subject of

Food in infancy and childhood. — The feeding of infancy may be dealt with under three heads—

1st. When the babe is suckled by a healthy mother with a sufficient milk-supply.

2nd. When it is entrusted to a wet nurse.

3rd. When it is "brought up by hand" and has to be fed by means of what are termed "substitutes for mother's milk."

1st. When an infant is suckled by a healthy mother, its food for the first seven or eight months of its life should be entirely restricted to the mother's milk. This is the only food that is perfectly adapted, by its characters and composition, to the digestive capacities of the young infant. For some time after birth the salivary glands are not developed and the pancreatic secretion, for the first three months, has no power of digesting starch, so that the young infant is not provided with any means of digesting farinaceous food, even in small quantities, and none should therefore be given. At birth the digestive organs are in a comparatively immature state, the alimentary canal is short and the cæcum very small.

It usually happens that the secretion of milk in the breasts of the mother is not fully established until the third day after the birth of the child; but if the babe is perseveringly applied to the breast, every two hours, while the mother is awake, there need be no fear of starvation.

During the first six weeks the child should be put to the breast every second hour from 5 a.m. to 11 p.m. It should be removed from the breast as soon as it shows an inclination to discontinue sucking; and it should be remembered that at birth the child's stomach is of very small capacity, and the breast should never be forced upon it, so long as it sleeps well, and thrives well, and is content.

Feeding every three hours will be often enough, with many children, after the third week and up to the end of the second month. It must be remembered that these, as well as the periods to be subsequently stated, are only average intervals, useful for general guidance, but which may need modification according to individual peculiarities, some infants feeding much more eagerly than others and taking more at a time. From the second to the seventh or eighth month the infant should be suckled every three or four hours.

The composition of human milk varies somewhat, according to the period of lactation and other circumstances, for the first few days. After delivery it is of greater consistence and of a yellow colour, and is known as *colostrum.* It contains large cells filled with fat-granules termed colostrum corpuscles. The regular secretion of milk begins after three or four days. The casein and fat increase in quantity up to the end of the second month, the salts up to the fifth month, and the sugar from the eighth to the tenth month. The greater the quantity secreted, the more casein and sugar and the less fat it contains. The milk of a primipara is richest in solids.

The diet of the mother, no doubt, influences somewhat the composition of the milk, especially as to the amount of fat it may contain. It should be simple, nutritious, ample, and regular. Rich and stimulating foods should be avoided. She may be permitted, for the purpose of increasing the flow of milk, the free use of animal broths, chocolate, milk, gruel, and sometimes a moderate quantity of porter or stout; beer is not suitable.

Oatmeal porridge at breakfast is excellent, and tends to obviate the constipation which often attends this period of relative physical inactivity.

"Fortunate," says an American writer,* "is the babe that, in our day of advanced civilisation and city-living, can draw from the breast of a robust mother an abundant supply of pure, health-giving, tissue-building food." In such a case the child should be nursed *solely* by the mother up to eight months, and after that *partially* to the end of the first year, if possible.

The date of weaning must depend, to some extent, on the health of the mother and the development of the child. If both are doing well, between the tenth and the twelfth month the breast should be gradually withdrawn.

After the seventh or eighth month, when the teeth begin to appear and the salivary glands to be developed, some other food may be introduced, once or twice a day, instead of the breast-milk. The following have all been highly recommended:—

* Dr. Louis Starr, of Philadelphia, to whose admirable article on "The Dietetics of Infancy and Childhood," in Sajous' "Annual of the Universal Medical Sciences," vol. iv. (1888), we are much indebted.

Chapman's Entire-Wheat flour. This contains some "cerealin," which has the property of converting starch into dextrin and maltose; it is rich also in albuminates, fats, and the necessary mineral substances, as in its preparation the *pollard* or outer parts of the grain are retained.

Liebig's Food, Mellin's Food, Benger's Food, Savory and Moore's Food, and Nestlé's Food are all appropriate, as they contain starchy matter in a readily assimilable form, with some preparation of malt. A small tablespoonful of any of these foods may be given for the midday meal.

Mutton broth or jelly made from the shank of mutton is also admissible. But after weaning, and up to a year and a half, milk should still be the chief article of diet. Cow's milk, with about one-fourth water, or the following mixture, is good:—Cream, ½ oz.; milk (cow's), 4 oz.; sugar of milk, a dram; and water, 1½ oz. This should be warmed in a water bath. A little custard-pudding may also be given daily, made by mixing one egg with half a pint of milk, and adding a little sugar.

The egg usefully supplies a certain amount of albuminates and fats.

After eighteen months the following articles of diet may be gradually and occasionally introduced:—

A little pounded chicken, mutton, or beef, and especially mutton *fat*, which may be pounded and mixed with a little mealy potato, and a little red meat gravy added to it.

Mashed potato and cauliflower carefully passed through a sieve may also be used, as well as stale bread-crumb, soaked in milk or broth.

As soon as the teeth are fully developed, some food requiring mastication should be given.

The foregoing dietary applies to a healthy child brought up by a healthy mother on breast-milk. But it often happens that the mother's milk is defective both in quality and quantity, and in that case it is necessary to change it; or it may be defective only in quantity, and then it must be *supplemented.*

2nd. The best substitute for the mother's milk is that of a young and healthy wet-nurse, when she can be obtained.

As to the qualities of a wet-nurse: she should be robust and strong, and rather spare than fat; free from all inherited tendency to mental or physical disease, and presenting no trace of syphilis, tuberculosis, or scrofula. She should be cheerful, good-natured, active, and temperate; she should be between twenty and thirty years of age, and her infant should be of nearly the same age as that of the one to be suckled. She should have an abundance of good milk, the best test of which will be the aspect of her own child. It is better, if possible, that she should be a multipara, as she is, in that case, more likely to understand her business. But there is no objection to a primipara, if otherwise eligible; nor can we see any reason for adopting the suggestion, repeated by many authors, that she should be a brunette, healthiness, and not complexion, being the point of chief moment. It has been said that *brunettes* yield richer milk than *blondes*; but this is far from certain, and not necessarily an advantage; whereas dark women are certainly more liable than fair ones to bilious derangements and headaches.

It has been said that it is wise to select as wet-nurse a woman whose infant is three months' old, as her milk is then of uniform quality, and there is then time to see if there is any syphilis in the infant or mother.

If the milk of the wet-nurse is found to disagree with the infant, it may be necessary to change the nurse; but the diet of the wet-nurse should first be carefully investigated.

On this subject some valuable observations have been made by Zaleski (St. Petersburg) on the influence of diet upon the functions of milk-secretion, whether of mother or wet-nurse.*

After a careful analysis of the proximate constituents of human and animal milk under various dietetic conditions, he has arrived at the following conclusions :—

1. Milk containing an undue proportion of *fat* may have a very injurious effect upon the infant.

2. Highly nitrogenous food produces a marked increase in the fat of the milk, and reduces the proportion of milk sugar, but has little influence on the other constituents. The same results are produced by alcohol.

3. Milk of good quality is secured by proper food. And he points out that wet-nurses are usually and unwisely overfed with butcher's meat, and ale and porter, and are in the habit of taking far too little exercise. Their health is liable to suffer from a rich and an over-albuminous diet, especially as they have probably been under-fed in their immediately antecedent life. He cites a case in which he found on analysis over 6 per cent. of fat in the wet-nurse's milk, and the infant had ailed ever since it had been nursed by this wet-nurse, who had been, previously, a poor girl, and her whole course of life was altered on becoming a wet-nurse. Her own child, as well as the nursed child, suffered in health. "An immediate return to the previous mode of life was ordered with the best results."

As might have been expected, the influence of fasting, in countries, as in Russia, where it is commanded or followed as a religious observance, has an

* See article on "Dietetics of Infancy and Childhood," in Sajous' "Annual of the Universal Medical Sciences," 1889.

injurious effect on the milk-secretion. Kolesinsky found that the milk becomes thinner and more watery, and contains less proteids and fats, the sugar remaining about the same.

The following table gives the average of observations on five women :—

	Restricted Diet.	Ordinary Diet.
Sp. gravity . . .	1·0312	1·0280
Water	88·34 per cent.	85·80 per cent.
Dry residue . . .	11·66 ,,	14·20 ,,
Proteids . . .	1·86 ,,	2·29 ,,
Fats	3·41 ,,	5·17 ,,
Sugar	5·72 ,,	5·60 ,,

Dr. W. J. Thayer, of Brooklyn, New York, offers a valuable suggestion as to the food most appropriate to the expectant mother. "Early in gestation she should begin to eat, at least three times a day, some form of coarse cereal foods, such as oatmeal, Graham, rye, or Indian breads. These articles being made from the *unbolted* products of the grains used, contain a much larger proportion of lime salts than the preparations of fine bolted flour of ordinary employment. The result is that the mother supplies her offspring, first through the umbilical cord, and afterwards through the mammary glands, with a pabulum containing essential elements for the nutrition of a very important set of organs, viz. the teeth." This should be supplied from the commencement of the development of the teeth, *i.e.* about the sixth week of intra-uterine life.

It should also be remembered that certain drugs pass more readily than others from the nurse through her milk to the suckling; this is the case with iodoform and atropine, and it is said that salicylate of sodium greatly increases the secretion of milk, and after the administration of a dose of thirty-five grains becomes dangerous to the infant.

Other "substitutes" for mother's milk and bringing up "by hand" must next be considered. On this point the American author already quoted* observes: "There can be no doubt, though the statement is a bold one, and seemingly contrary to nature, that, taking the average, infants properly brought up by hand are better developed and enjoy more perfect health than those completely breast-fed. Of course, there is no artificial food equal to the natural—the sound breast milk of a robust woman; and a child fed upon this must thrive, if other circumstances are favourable. Unfortunately the woman who has sufficient health and strength to furnish an abundant supply of good milk during the ten or twelve months of normal lactation is unique in our day, and the great bulk of those who do nurse children, grow pale, thin, and feeble, and give milk which, though sufficient in quantity to fill the suckling's stomach and satisfy the craving of hunger, does not contain enough pabulum to meet the demands of nutrition. Such mothers always complain that their children are puny, peevish, and always ailing, and wonder why their neighbour's babies fed upon the bottle are so round, jolly, and healthy. The explanation lies in the simple fact that good cow's milk is better than bad breast milk!"

Besides cow's milk, ass's milk and goat's milk have been proposed as substitutes for mother's milk.

Ass's milk is a good substitute, but it is costly, and, compared with human milk, is defective in albuminates and fats. It has also laxative properties. Goat's milk is richer in albuminates and fats than human milk, and even than cow's milk, and it has also

* Dr. Louis Starr.

a strong and peculiar odour, but infants do not seem to object to this. One of the advantages of goat's milk is that the animal yielding the milk can be kept on the premises, and its health and feeding carefully superintended, and it can be trained so that the infant can suck the milk directly from the udder.

Either of these milks may be boiled, and this process removes the strong odour of goat's milk and the laxative property of ass's milk.

The reason why the milk of the ass and even that of the goat will agree with the human infant when cow's milk disagrees, would appear to be owing to their different manner of clotting when they come into contact with the gastric juice.

Cow's milk has a tendency to coagulate in the infant's stomach into large, firm, cheese-like masses, which are apt to cause much gastro-intestinal irritation, whereas ass's and goat's milk form a loose flocculent curd like human milk.

But in the vast majority of instances it is upon cow's milk we must rely as a substitute for mother's milk ; it has the enormous advantage of being plentiful and cheap, and its defects can, with a certain amount of care, be easily remedied. A comparative study, therefore, of human and cow's milk is an important duty in connection with infant feeding. It must be borne in mind, as has already been pointed out, that mother's milk varies in composition at different periods of lactation, and in different individuals, so that considerable discrepancies may be discovered in the published analyses. The nitrogenous constituents are the most changeable, and may vary in different specimens from 4·86 to 0·85 per cent., next the fats, and next the salts, the maximum being about three times the minimum. The sugar is the least variable constituent, and maintains a nearly uniform standard of 7 per cent.

The following table gives the average normal composition of human and cow's milk :—

	Human Milk.	Cow's Milk.
Water	86·766 per cent.	87·7 per cent.
Total solids . . .	13·234 ,,	12·3 ,,
,, (not fat) .	9·221 ,,	8·48 ,,
Fat	4·013 ,,	3·75 ,,
Lactose . . .	6·997 ,,	4·42 ,,
Albuminoids . .	2·058 ,,	3·42 ,,
Ash	0·21 ,,	0·64 ,,

The specific gravity of human milk is about 1031, and its reaction is persistently alkaline ; that of cow's milk is on an average 1029, and it has a slightly acid reaction if not quite fresh from pasture-fed cows. It is richer-looking, whiter, and more opaque than human milk. A further very important difference is that its nitrogenous constituents are differently affected by coagulating agents. According to König, the total amount of albuminoids in cow's milk which is coagulated by acids is far greater—perhaps four times greater—than the non-coagulable portion. In human milk the reverse is the case, and the non-coagulable portion much exceeds, is perhaps twice as great as, the coagulable part. Again, with rennet cow's milk coagulates into large firm masses ; with human milk it forms a light loose curd. The acid gastric juice in the stomach has the same effect, producing in the case of cow's milk a coagulum most difficult to digest, and in the case of human milk one which is readily attacked and broken down by the gastro-intestinal solvents.

All artificial food should conform as closely as possible to human milk, and should, like it, clot in fine flakes. If cow's milk is used, its chemical composition and physical properties must be modified in order to make it a fit substitute for mother's milk. It should also be noticed that the albuminates and carbo-hydrates in the infant's diet are in nearly equal proportions, whereas in the diet of adults the proportion of carbo-hydrates to albuminates is as 3 to 1. The proportion of fat is also relatively twice as great as in the standard adult diet. The albuminates and fats are, therefore, largely in excess in the infant's diet as compared with the diet of adults, and this is necessary in order to minister to the very rapid growth which takes place in infancy and childhood, and food has also, on this account, to be taken more frequently. The brain is said to nearly double its weight in seven years. The liver is notably larger in childhood, on account of the greater activity of its metabolic functions.

Much difference of opinion exists as to the suitability of "condensed" milk as a substitute for human milk. It certainly has the advantage of keeping better than ordinary cow's milk, and it is said by some to be more readily digested by young infants, and that they thrive on it. Others assert that this is a delusion, founded on the circumstance that condensed milk is largely diluted with water, and cow's milk not sufficiently; that the infant appears to thrive because condensed milk contains a large proportion of added sugar, which forms fat and makes large babies, and also counteracts the tendency to constipation, but that it does not contain enough nutrient constituents to supply the wants of a growing infant. In the following table A. Y. Meigs has compared the composition of condensed milk diluted in the proportion usual for the first week or so of infant life, with some average specimens of human and cow's milk :—

	Human Milk.	Cow's Milk.	Condensed Milk (Eagle Brand).	Mixture of 1 Part of Condensed Milk with 24 of Water.
Water . .	87·163	87·012	27·942	92·673
Fat . .	4·283	4·209	10·335	1·095
Casein . .	1·046	3·222	9·522	·868
Sugar . .	7·407	5·000	50·861	5·206
Ash . .	·101	·527	1·340	·158

It will be seen that the amount of fat and of casein are much less than in either human or cow's milk, and that of sugar less than in human milk. "The addition of a larger proportion of condensed milk would remove these faults, but at the same time would increase the quantity of sugar to a point incompatible with perfect digestion. Again, more than one-half of the saccharine ingredient of this preparation is *cane-sugar*, added for the purpose of preservation, and this material is very liable, when in excess, to ferment in the alimentary canal, giving rise to irritant products that impede digestion. . . . Infants fed upon condensed milk, though fat, are pale, lethargic, and flabby; although large are far from strong; have little power to resist disease; cut their teeth late; and are very likely to drift into rickets before the end of the first year." This is the opinion of Dr. Louis Starr of Philadelphia, who concludes that it is never safe to bring up a child solely on this food, but that it may be used occasionally as a convenience, such as in travelling, etc. This view of the value of condensed milk appears to be shared in England by such authorities as Dr. Eustace Smith and Dr. Angel Money. Ashby and Wright, however, in their work on the "Diseases of Children," express a doubt as to the value of the evidence brought against the use of condensed milk; they have seen many unquestionably healthy children brought up on it from birth; it is undoubtedly convenient; it does not readily turn sour, and it may often, they think, be substituted with good effect for fresh cow's milk when the latter disagrees and causes vomiting, or at those times when cows are being fed on turnips or other watery food, or during hot weather, when milk is apt to turn sour.

The deficiency in casein may be compensated for by the addition of a little white of egg or raw meat juice, half a teaspoonful of either to every other meal, and the addition of a little cream will supply the deficiency in fat.

We have received strong testimony in support of this favourable view of the use of condensed milk as a substitute for breast-milk, especially when the "*unsweetened*" kinds are used, such as Loeflund's.

Farinaceous foods are never admissible before the fourth month, and rarely advisable until after the seventh. It must not be forgotten that they differ widely in composition from human milk. In arrowroot, which is one of the most digestible, the proportion of albuminates to carbo-hydrates is as 1 to 20; whereas in human milk it is as 1 to 5. Moreover, the starch has to be converted into sugar before it can be absorbed, and the digestive secretions which effect this conversion are not fully established until the fourth month.

The so-called "infants' foods"* usually contain some malted farinaceous substance, and they are of value as additions to, not as substitutes for, milk. Their nutrient value has not been perfectly determined; but they are especially useful as "mechanical attenuants," and as such tend to prevent the coagulation of cow's milk into firm, indigestible curd. They

* "Liebig's food for infants is composed of equal parts of wheaten flour and malt flour mixed with a little potassium carbonate, and cooked with ten parts of milk. The wheat and malt flour are usually cooked and sold in powder ready to be boiled with the milk." (*Parkes.*)

have also a food value of their own, rendering them more serviceable than the starches.

Another important point is the *quantity* of food that should be given to an infant brought up by hand. It must of course vary with the age and appetite of the child, and it must be remembered that too frequent feeding is liable to set up gastro-intestinal catarrh. A good practical rule is to let the infant take as much or as little as it likes, *provided it thrives!* Infants, as a rule, are overfed in quantity. Rotch has ascertained by actual measurement that the stomach of an infant five days old contains only $6\frac{1}{4}$ fluid drams. At the end of the 4th week it is one and a half times, or twice as large. By the end of the 8th week it is $3\frac{1}{5}$ times as large. This rapid increase in size corresponds with the rapid growth of the first two months. At the end of the 12th week it is $3\frac{1}{3}$ times as large, at the end of the 16th week $3\frac{4}{7}$, and at the end of the 20th week $3\frac{3}{5}$; so that during the 3rd, 4th, and 5th months the increase is slight. The quantity of food should be rapidly augmented during the first six or eight weeks, and then kept at about the same quantity up to the 5th or 6th month. There is another considerable increase between the 6th and 10th months. "The greater the infant's weight the larger the gastric capacity." * Assuming the average initial weight to be from 6 to 8 lb., it is estimated that during the first five or six months the infant will gain from $3\frac{1}{2}$ to 4 oz. weekly (Louis Starr says 1 oz. per diem), and at the end of the sixth month will weigh about 16 lb., or double his initial weight.

The next three months he will gain on an average from 3 to $3\frac{1}{2}$ oz. weekly, and by the end of the ninth month should weigh about 20 lb. During the remainder of the first year he will gain from $1\frac{1}{2}$ to 2 oz. a week, and at the end of the year usually weighs over 22 lb.

* Sonitkin of St. Petersburg.

The following is considered an excellent rule for the earlier weeks of infant feeding, viz. one hundredth of the initial body-weight should be taken as the starting quantity of food for each meal, and to this should be added 1 gramme (fifteen minims) for each day of life. For instance, if the initial weight is 3000 grammes (6 lb.), then 30 grammes (about 1 oz.) should be given at a meal; at fifteen days it would have increased to 30 + 15 grammes or 45 grammes (about $1\frac{1}{2}$ oz.), and at eighty days to 30 + 30 or 60 grammes (about 2 oz.).

Ashby and Wright estimate 5 oz. of good cow's milk (of course, properly diluted and prepared) to be sufficient daily for the first two or three weeks. Starr calculates for the first four weeks an allowance of $12\frac{1}{2}$ to 16 oz. of food daily; 24 oz. for the 2nd and 3rd month; 2 to $2\frac{1}{2}$ or 3 pints from the 3rd to the 12th month. Ashby and Wright consider $1\frac{1}{2}$ to 2 pints daily sufficient between six and twelve months.

After this period it is advisable rather to increase the strength of the food than the quantity.

Dr. Louis Starr gives the following table as a guide:—

GENERAL RULES FOR FEEDING.

Age.	Intervals of Feeding.	Average Amount at each Feeding.	Average Amount in 24 Hours.
1st week	2 hours.	1 oz.	10 oz.
1st to 6th weeks . .	$2\frac{1}{2}$,,	$1\frac{1}{2}$ to 2 ,,	12 to 16 ,,
6th to 12th weeks, and possibly to 5th or 6th months . . .	3 ,,	3 to 4 ,,	18 to 24 ,,
At 6 months . . .	3 ,,	6 ,,	36 ,,
At 10 months . . .	3 ,,	8 ,,	40 ,,

The next point to be considered is the method of preparing the food, the object being to make cow's milk resemble human milk as closely as possible in chemical composition and physical properties. In order to effect this we must reduce the proportion of casein, and increase the proportions of fat and sugar; we must also remove the tendency of the casein to coagulate in the stomach into large, firm, indigestible masses.

By dilution with water the casein may be brought to the proper level, and by the addition of cream and sugar of milk in proper amounts we can restore the level of these constituents. Sugar of milk has the advantage of not having the same tendency as cane-sugar to acetous fermentation, and it also contains some of the salts of milk. Ashby and Wright have, however, failed to satisfy themselves that milk-sugar is in any way superior to cane-sugar, while they complain that it is expensive, and tends to pass into lactic acid.*

Frankland has suggested the preparation of artificial human milk from cow's milk by the following method:—Allow $\frac{1}{3}$ of a pint of new milk to stand twelve hours, remove the cream, and mix it with $\frac{2}{3}$ 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 egg-cup 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

* "Diseases of Children."

boiling in a small tin pan placed over a spirit or gas lamp. During the heating a further quantity of casein, technically called "fleetings," separates, and must be removed by straining through clean muslin. Now dissolve 110 grains of powdered sugar of milk in the hot whey, and mix it with $\frac{2}{3}$ 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.

In order to prevent the firm clotting to which cow's milk is prone, some alkaline solution may be added, or some prefer to use a small quantity of a mucilaginous or other thickening substance, such as barley-water, a solution of gelatin, or one of the prepared foods, which act mechanically in obviating the formation of firm clots.

When lime-water* is used for this purpose, it acts by partly neutralising the acid of the gastric juice, so that the casein is coagulated gradually in small masses, or passes on into the small intestine where the secretions are alkaline. It must be in the proportion of 1 to 2 of the milk mixture.

Or a few grains of bicarbonate of soda may be used, or an equivalent quantity of the saccharated solution of lime. Thickening substances or attenuants act purely mechanically by, as it were, getting between the particles of casein during coagulation, and so preventing their running together and forming large compact masses.

The best for this purpose is barley-water or "barley-jelly." It may be used in the same proportions as water.

* Lime-water is easily made at home for nursery use by taking a piece of unslaked lime the size of a walnut, and putting it into two quarts of filtered water in an earthen vessel, and stirring it up thoroughly; allow it to settle, and pour off the clear solution as required for use, replacing with water and stirring up as consumed.

Or a solution of isinglass or gelatin may be used. To make this put about an inch square of plate gelatin into half a tumblerful of cold water, and let it stand for three hours; turn the whole into a teacup, and put this into a saucepan half full of water, and boil until the gelatin is dissolved. When cold this forms a jelly, of which one or two teaspoonfuls may be added to each bottle of food. Or Mellin's Food may be used; in this the starch has been converted into dextrin and maltose; a teaspoonful dissolved in a tablespoonful of hot water when added to each portion of food makes a very easily digested mixture.

A schedule has been drawn up by Dr. Louis Starr of the diet of an infant from birth upwards. It may serve as a useful guide :—

DIET DURING 1ST WEEK.

For each feeding.

Cream	2 fluid drams.
Whey	3 ,, ,,
Water (hot)	3 ,, ,,
Milk-sugar	10 grains.

To be given every 2 hours from 5 a.m. to 11 p.m., and once or twice during the night if necessary. This will give 12 oz. of food per diem.

To make the whey, take half a pint of fresh milk heated to about 140° or 150° F., and $1\frac{1}{2}$ teaspoonful of wine of pepsin, or one teaspoonful of Fairchild's essence of pepsin, and stir just enough to mix. Let the mixture stand in a warm place until firm coagulation has taken place. Next beat up the curd until it is finely divided, and strain. Whey contains in solution the sugar and the salts of the milk, and holds also in suspension a considerable portion of casein and fat, which passes through the strainer.

During the same period Dr. Angel Money* recommends ½ an oz. of thin barley-water with ½ an oz. of cow's milk and 15 grains of milk-sugar, to be given every two hours, night and day.

Diet from the 2nd to the 6th Week.

For each feeding.

Milk (Cow's)	½ fluid oz.
Cream	¼ " "
Milk-sugar	15 grains.
Water	1 fluid oz.

To be given every 2 hours from 5 a.m. to 11 p.m. = 17 oz. per diem.

Diet from the 6th Week to the End of the 2nd Month.

For each feeding.

Milk (Cow's)	1¼ fluid oz.
Cream	½ " "
Sugar of Milk	30 grains.
Water	1¼ fluid oz.

To be given every 2 hours = 30 oz. per diem.

Dr. Angel Money's diet is cow's milk, 9 drams; barley water, ¾ oz.; cream, 2 drams; milk-sugar, 30 grains; and water, 3 drams; every 2½ hours.

Diet from the Beginning of the 3rd Month to the 6th Month.

For each feeding.

Milk (Cow's)	2½ oz.
Cream	½ "
Sugar of Milk	60 grains.
Water	1 oz.

To be given every 2½ hours = 32 oz. per diem.

* "Treatment of Diseases of Children."

DIET DURING 6TH MONTH.

Six meals daily, from 6 or 7 a.m. to 9 or 10 p.m.

Morning and midday bottles, each.

Milk (Cow's)	$4\frac{1}{2}$ oz.
Cream	$\frac{1}{2}$,,
Mellin's Food	60 grains.
Hot Water	1 oz.

Dissolve the Mellin's Food in the hot water and add, with stirring, to the previously mixed milk and cream.

The other bottles, each.

Milk	$4\frac{1}{2}$ oz.
Cream	$\frac{1}{2}$,,
Sugar of Milk	60 grains.
Water	1 oz.

Making a total of 36 oz. of food per diem.

For this month Dr. Angel Money's diet consists of cow's milk, $2\frac{1}{2}$ oz. ; barley water, $\frac{3}{4}$ oz. ; cream, 5 drams ; milk-sugar, 60 grains ; and water, $1\frac{1}{4}$ oz. every 3 hours.

In the 7th month the Mellin's Food may be increased to two teaspoonfuls, and given three times a day.

Throughout the 8th and 9th month five meals a day will suffice.

1st meal,	7 a.m.—	Milk	$6\frac{1}{2}$ oz.
		Cream	$\frac{1}{2}$,,
		Sugar of Milk .	60 grains.
		Water	1 oz.
2nd ,,	10.30 a.m.—	Add to the foregoing 1 tablespoonful of Mellin's Food.	

3rd meal at 2 p.m., and 4th meal at 6 p.m., same as 2nd. 5th meal at 10 p.m., same as 1st. Equivalent to 40 oz. of food per diem.

Barley jelly may be substituted for Mellin's Food.* It is made by putting two tablespoonfuls of

* Eustace Smith.

washed pearl barley into a pint and a half of water, and slowly boiling down to a pint; strain, and let the liquid settle into a jelly. Two teaspoonfuls of this, dissolved in 8 oz. of warmed and sweetened milk, are enough for a single feeding, and such a meal may be allowed twice a day.

DIET FOR THE 10TH AND 11TH MONTHS.

1st meal,	7 a.m.—Milk	$8\frac{1}{2}$	fluid oz.
	Cream	$\frac{1}{2}$	"
	Mellin's Food or Barley Jelly	$\frac{1}{2}$	"
	Water (only when Mellin's Food is used) .	1	"
2nd "	10.30 a.m.—8 oz. of warm milk.		
3rd "	2 p.m.—The yolk of an egg lightly boiled, with stale bread-crumbs.		
4th "	6 p.m.—Same as 1st.		
5th "	10 p.m.—Same as 2nd.		

On alternate days the third meal may consist of 6 oz. of beef-tea, with a few stale bread-crumbs. Mutton, chicken, or veal broth may be occasionally used instead of beef-tea. Infant's beef-tea is not made so strong as that for adults. ($\frac{1}{2}$ lb. of beef to a pint.)

To remedy a tendency to vomit the milk in firm clots, each bottle at the age of six weeks may consist of either

Milk	$1\frac{1}{4}$ oz.
Cream	$\frac{1}{2}$ "
Sugar of Milk	30 grains.
Lime Water	$1\frac{1}{4}$ oz.

or

Milk	$1\frac{1}{4}$ oz.
Cream	$\frac{1}{2}$ "
Sugar of Milk	30 grains.
Barley Water	$1\frac{1}{2}$ oz.

Boiling sometimes makes the milk more digestible, and tends to arrest diarrhœa if it exists.

If it should be necessary to have recourse to ass's milk, it should be used fresh from the udder. One ass is capable of nourishing three children for the first three months of life, two children for the fourth and fifth months, and one child after this period to the ninth month.

If all these foods disagree, *predigested* milk must be used. *Complete* peptonisation has the disadvantage of giving a bitter taste to the milk, and children will refuse to take it. Partial peptonisation is better. The process should be stopped the instant the slightest bitter taste appears.

"Peptogenic Milk Powder," made by Fairchild, can be conveniently used for this purpose. It contains pancreatin, bicarbonate of soda, and milk-sugar. It can be used as follows :—

Take of	Milk	2 oz.
	Water	2 ,,
	Cream	$\frac{1}{2}$,,
	A measure of peptogenic milk powder.	

Heat this over a brisk flame to about 140° to 150° —*i.e.* pleasantly warm when sipped. Keep at this temperature for six minutes. When properly prepared this contains the albuminoids in a minutely coagulated and digestible form, has an alkaline reaction, contains the proper proportion of salts, milk-sugar, and fat, and has the appearance of human milk.

By shortening the time of heating, the degree of predigestion can be diminished.

When milk in any form, and however prepared, yet disagrees, it is best to omit it entirely, and try some other food, such as

Mellin's Food	60 grains.
Hot Water	3 oz.

for each feeding—given every 2 hours at the age of 6 weeks; or

Veal or Chicken Broth ($\frac{1}{2}$ lb. of meat to pint) .	$1\frac{1}{2}$ oz.
Barley Water or Jelly	$1\frac{1}{2}$,,

or

Whey	$1\frac{1}{2}$ oz.
Barley Water	$1\frac{1}{2}$,,
Sugar of Milk	$\frac{1}{2}$,,

A teaspoonful of raw beef-juice every two hours will often be retained when all other food is rejected. As soon as milk food can be resumed, it of course should be.

Ashby and Wright recommend a trial of Biedert's cream mixture for the first few weeks when the child cannot digest cow's milk. It is made by mixing 4 oz. of cream with 12 oz. of warm water, and adding $\frac{1}{2}$ oz. of milk-sugar. It contains 1 per cent. of casein, 2·5 per cent. of fat, and 3·8 per cent. of sugar. As the child grows older, milk is added till it reaches equal parts. Most infants digest cream exceedingly well. Meigs' modification of this is as follows:—Make a solution of milk-sugar ($2\frac{1}{4}$ oz.) in water (1 pint); put it in a cool place. For each feeding mix 1 oz. of cream, $\frac{1}{2}$ oz. of cow's milk, 1 oz. of lime-water, and $1\frac{1}{2}$ oz. of the solution of milk-sugar. The same authors strongly commend Savory and Moore's peptonised milk as very palatable and easily prepared by mixing with warm water. Much of the casein in it has been converted into peptone. It keeps well for a few days, being preserved by the addition of cane-sugar, and is concentrated to $\frac{1}{6}$ or $\frac{1}{7}$ of its bulk of milk. We can also testify to the value of this preparation. Whey is a very useful food, when milk disagrees, and is not so much used as it merits to be; shaken up with a little white of egg and cream it forms a highly nutritious mixture. *Oatmeal water* made by boiling two tablespoonfuls of oatmeal with a quart of water for four hours or longer, and straining through muslin, is useful alone, or mixed with peptonised milk or cream.

If the food calculated for the various periods of infant life should appear to be in excess of the child's wants, the quantity can be reduced to that proper for the period next below it.

Food containing barley jelly, or made with oatmeal, arrowroot, baked flour, etc., either with or without milk, can be readily predigested, or partially so, as follows:—

Barley Jelly	¼ oz.
Sugar of Milk.	60 grains.
Warm Milk	8 oz.

Add 3 grains of Fairchild's Extractum Pancreatis and 5 grains of bicarbonate of sodium, and keep warm for half an hour before feeding.

Peptonised beef-tea may be given when the child is of an age to take meat-broth.

After the first year far less change is needed in the food from month to month.

DIET FROM 12TH TO 18TH MONTH.

Five meals a day.

1st meal, 7 a.m.—A slice of stale bread, broken and soaked in 8 oz. of new milk.
2nd „ 10 a.m.—6 oz. of milk with a soda biscuit, or thin slice of buttered bread.
3rd „ 2 p.m.—6 oz. of beef-tea, with a slice of bread. One good tablespoonful of milk and rice pudding.
4th „ 6 p.m.—Same as 1st.
5th „ 10 p.m.—One tablespoonful of Mellin's Food, with a breakfastcupful of milk.

As an Alternative Diet.

1st meal, 7 a.m.—The yolk of an egg lightly boiled, with bread-crumbs. A teacupful of new milk.
2nd ,, 10 a.m.—A teacupful of milk, with a thin slice of buttered bread.
3rd ,, 2 p.m.—A mashed boiled potato, moistened with 4 tablespoonfuls of beef-tea. Two good tablespoonfuls of junket.
4th ,, 6 p.m.—A breakfastcupful of new milk, with a slice of bread broken up and soaked in it.
5th ,, 10 p.m.—Same as 2nd.

The fifth meal is not always necessary, and sleep should not be disturbed for it. A cup of warm milk should, however, be available during the night if required.

Diet from 18 Months to $2\frac{1}{2}$ Years.

1st meal, 7 a.m.—A breakfastcupful of new milk, the yolk of an egg lightly boiled, 2 thin slices of bread and butter.
2nd ,, 11 a.m.—A teacupful of milk with a soda biscuit.
3rd ,, 2 p.m.—A breakfastcupful of beef-tea, mutton or chicken broth; a thin slice of stale bread; a saucer of rice and milk pudding.
4th ,, 6.30 p.m.—A breakfastcupful of milk with bread and butter.

As an Alternative Diet.

1st meal, 7 a.m.—Two tablespoonfuls of thoroughly cooked oatmeal or wheaten grits, with sugar and cream; a teacupful of new milk.
2nd ,, 11 a.m.—A teacupful of milk, with a slice of bread and butter.
3rd ,, 2 p.m.—One tablespoonful of underdone mutton, pounded to a paste; bread and butter, or mashed baked potato, moistened with good plain dish gravy; a saucer of junket.
4th ,, 6.30 p.m.—A breakfastcupful of milk, a slice of soft milk toast, or a slice or two of bread and butter.

If these diets at any time disagree, return to a plain milk diet, or milk with Mellin's Food.

The preceding tables must only be taken as indicating averages. Many children thrive best on a purely milk diet up to the age of 2 or $2\frac{1}{2}$ years. When a child is thriving and content on a milk diet, be in no haste to alter it.

It should not be forgotten, as is sometimes the case, that a child, however young, occasionally requires, and is better for, a drink of water. Pure water, not too cold.

The most scrupulous cleanliness must be observed with regard to all the vessels containing the infant's food. Each meal must also be prepared at the time it is wanted, and not taken from a stock on hand. The temperature of the food of young infants should be about 95° F.

Children who have cut their milk-teeth may be fed for a twelvemonth—*i.e.* up to the age of $3\frac{1}{2}$ years —as follows :—

1st meal, 7 a.m.—One or two tumblerfuls of milk, a saucer of thoroughly cooked oatmeal or wheaten grits, and a slice of bread and butter.

2nd „ 11 a.m.—(If hungry). A tumblerful of milk, or a teacupful of beef-tea, with a biscuit.

3rd „ 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 baked potato, thoroughly mashed with a fork, and moistened with gravy; a slice of bread and butter; a saucer of junket, or rice and milk pudding.

4th „ 7 p.m.—A tumblerful of milk, and one or two slices of well-moistened milk-toast.

For the rest of childhood, a chief point is to see that the child does not eat hastily, but masticates his food leisurely.

The diet should be plain, but varied, and the following lists of suitable dishes from which to select may serve as a convenient guide :—

BREAKFAST.

Daily.	*One dish only each day.*
Milk.	Fresh fish.
Porridge and cream.	Eggs, lightly cooked.
Bread and butter.	Chicken hash.
	Stewed kidney.
	" liver.

Thoroughly ripe sound fruit may be allowed with this meal in small or moderate quantity.

DINNER.

Daily.	*Two dishes each day.*
Clear soup.	Potatoes, baked and mashed.
Meat, roasted or broiled, and cut into small pieces.	Spinach.
Bread and butter.	Stewed celery.
	Cauliflowers.
	Hominy.
	Macaroni, plain.
	Peas.
	French beans.

Junket, rice and milk, or other light pudding.

SUPPER.

Daily.

Milk.
Milk toast, or bread and butter.
Stewed fruit.

As to quantity, if a child eats slowly and masticates thoroughly he may generally be trusted to satisfy his appetite at each meal. Fried food and highly-seasoned dishes should be avoided. Salt, but no other condiment, should be allowed, and pure water should be the only drink. Some feeble and thin children may, however, be allowed, from time to time, a little sound beer or porter.

Recently, in America especially, *Kefir*, the product of fermentation of cow's or goat's milk, has been highly extolled as a substitute for mother's milk. It is manufactured like koumiss, and has been used for ages in the Caucasus.

The kefir ferment contains three varieties of bacteria—bacillus caucasius, b. lactus, and saccharomyces mycoderma.

Good kefir is rather thick, of uniform consistence, and free from lumps; it contains more or less carbonic acid gas, which forms bubbles on the surface; it has a sour taste, but is less acid than butter-milk, which it resembles. It contains less casein and milk-sugar than fresh cow's milk; while alcohol (5 to 15 in 1,000), lactic acid, hemi-albumen, lacto-syntonin, and peptones are found as the result of fermentation. As the fermentation goes on more of the casein is digested, and the conversion of this sugar-of-milk into alcohol, carbonic acid gas, and lactic acid continues. The remaining casein is precipitated in fine flakes, the size of which is not increased by the action of the gastric juice.

Kefir is a partially-digested milk, and is believed to fulfil an important indication in infant feeding—viz. the breaking up of the curd of cow's milk without introducing indigestible matter into the infant's stomach.

As the casein of cow's milk is exactly the same as that of human milk, the difference in the curding must be due to something which is found in the one and not in the other. Schmidt has shown that this is due to the presence in human milk of hemi-albumen in proportionately larger quantities than in cow's milk. In order to impart this same quality to cow's milk, a common plan is to dilute it with some thick fluid. For this purpose solutions of gelatin, barley-water, ice-water, etc., are usually, but not always, successfully employed

In kefir we have the soluble forms of albumen due to the action of the ferment, and consequently the light, flocculent coagulation. "Theoretically, then, we should have in *kefir* one of the very best foods for infants, if lactic acid, carbonic acid gas, and alcohol are not counter-indications. Lactic acid is found in the stomach in the normal digestion of the sugar of milk, and its presence can but assist in the digestion of the casein. Carbonic acid gas rather increases the secretion of the glands, and alcohol in a dilute solution is a tonic, and stimulates digestion and nutrition."

Children do not like it at first, but the addition of a little sugar soon overcomes the distaste, and they prefer it to cow's milk. The sugar may be omitted after a day or so. A slight diarrhœa usually follows its first use, but quickly subsides.

Its effects are said to be as follows:—1. Increase in quantity of urine in proportion to fluid consumed. 2. Specific gravity of urine diminishes. 3. Nitrogenous changes are checked. 4. Digestion is strengthened and stimulated in even the worst forms of indigestion, and the nutrition of the body improved. 5. Gain in body-weight is rapid and enormous. 6. The number of red blood-corpuscles increases.

Rules for administration:—

1. If the infant be less than a month old, it should be given diluted $\frac{1}{3}$ with water; this proportion may be gradually lessened till at six weeks it is given pure.

2. It should be fed slowly from a simple, easily-cleansed nursing-bottle.

3. When used it should constitute the only food, up to a year old, when crackers, toast, etc., may be given with it; and one meal a day may consist of oatmeal-mash or other farinaceous food.

4. For young infants it is best in the fresh state. As the child grows older, fully-fermented kéfir may be used.

It is especially useful in infantile atrophy and chronic diarrhœa.*

Food at school.—Assuming that the period of school-life extends, on an average, from ten to eighteen years of age, it is scarcely necessary to say that this is one of the most critical and important epochs in the life of the individual as regards sufficient and adequate nutrition. It is a time of active growth and development both physical and intellectual, and it is a time when any serious check to the perfect and complete evolution of the organs and functions of the body may lead to ineradicable mischief, and severely handicap the individual in the subsequent "struggle for existence."

Those who are entrusted with the care of the young of both sexes during this period are, perhaps, sometimes apt to regard with too little attention and interest the *physical* development of those under their charge, and this from a too great eagerness to promote their intellectual culture. It should be remembered that the education of the mind is, and should be, a *life-long* process, there is no need of hurry; but that the development of the body is strictly limited to a certain period of existence, and becomes finally and irrevocably arrested at a given date.

It should, then, be ever present in the minds of those who undertake the education of youth that they are in a special and peculiar way responsible for their physical growth and development, and that these cannot proceed satisfactorily without a careful and intelligent arrangement and supervision of their food. And not only is this period of life one of continuous

* This account of kefir has been taken from the article on "Dietetics of Infancy and Childhood" in Sajous' "Annual of the Universal Medical Sciences," 1889. Some of the conclusions arrived at herein have been vigorously contested, and some physicians regard lactic acid as a dangerous substance in food.

growth and development; it is also one of remarkable physical activity. So that there is a constant and twofold demand for appropriate food—the demand of the growing organs, and the demand connected with muscular activity and mental training. At no period of life is it so necessary to be provided with a complete and liberal dietary.

Another point which is very constantly overlooked is the rapidity and activity of the digestive and assimilative functions in many growing youths of both sexes; and provision should always be made for some plain and wholesome food, such as bread and butter, or bread and cheese, to be accessible to the hungry boy or girl at other than the ordinary meal-times. The rate of growth in any individual cannot be controlled or regulated by general rules, and when this is taking place with exceptional rapidity exceptional quantities of food are needed.

The diet at school must not only be abundant in quantity; it must also be suitable in quality. It must contain a proper proportion of *albuminates*, to minister to the growth of the muscular and other tissues; it must contain *fats* and *starches*, for the development of heat and muscular energy, and the former is an important agent in tissue-growth; and it must contain the necessary proportions of mineral substances to furnish the materials necessary for the growth and consolidation of the hard tissues, as the bones and teeth, especially phosphates of lime.

In the remarks which follow we have to acknowledge our indebtedness to the valuable experience of Dr. Clement Dukes, the Medical Officer of Rugby School, as set forth in his excellent work on "Health at School," with whose views we are, with one or two exceptions, in entire accord. In considering the details of a school dietary he calls attention to the need of more variety, both in the kinds of food provided and the manner in which they are cooked and served. The likes and dislikes of young children should, he considers, be more consulted, as affording trustworthy indications of what suits their constitutions. Some cannot digest fats or starches—even the sight of fat will prevent their eating. This is, no doubt, greatly to be regretted, as both fats and starches are very important alimentary substances; still, they may nearly always be given in certain combinations, and many children who would not touch the fat of roast or boiled mutton will eagerly devour suet pudding with sugar or jam. The objections to certain important food substances which children develop should, if possible, be corrected, or the attempt made to correct them, in early childhood; it is often too late to do so at school, for the acquirement of certain strong distastes to particular articles of food often proves exceedingly embarrassing in after-life. What can be more troublesome to the physician in dealing with the food of invalids to find, as he sometimes does, a rooted distaste and objection to milk? It is difficult to believe that such a distaste is not often a fault of education. We are disposed to urge, as a qualification of Dr. C. Dukes's recommendation, that the likes and dislikes of school-children should be considered, that they should only be so after repeated judicious attempts have been made to overcome them.*

* With regard to the objection to take fats above alluded to, Dr. Lauder Brunton makes some useful suggestions. "The fine subdivision of fatty food is of great importance in regard to its digestion. Many people cannot bear to eat the fat of hot mutton, but yet they can eat the same when it is cold. If we try to pulverise a piece of hot mutton fat and a piece of cold mutton fat, we shall see that the difference is much the same as that between a piece of new and stale bread; and probably this is one reason, though there may be many others, why hot mutton fat is so liable to make people sick. But mutton fat may be eaten hot by persons with delicate stomachs if it is properly subdivided by admixture

Another suggestion that Dr. Dukes makes is that the craving of school-children for sweets should be gratified, that their clandestine visits to the confectioner's are the result of a natural craving which should be gratified in a regular and legitimate fashion. The cooking, also, he urges, should be more carefully looked after, as roast joints are often so imperfectly cooked and underdone as to be unwholesome, as well as unpleasant to look at; while the distaste often manifested for green vegetables too frequently originates in the careless manner in which they are cleansed and the peculiarly unattractive fashion in which they are served. The personal supervision of the master or his wife is invoked in these matters as well as in more *attractive carving.* Another highly important matter in the arrangement of meals at school is that the pupils should be allowed ample and sufficient time to eat them, and the master should see that the food is properly masticated, or, at any rate, that sufficient time is allowed for this process, as imperfect mastication is a common cause of indigestion, and may become an injurious habit, which, like other bad habits, should be corrected at school.

It seems that in certain schools, or with certain masters, boys are sometimes detained in school as a punishment during a portion of the dinner or breakfast time, so that the time available for feeding is seriously encroached upon. Such a system shows a lamentable absence, in the authorities, of the most elementary understanding of the conditions of health.

The number of meals, and the hours fixed for taking them, are also serious matters, and especially with growing girls.

It is undesirable, especially with the younger and

with farinaceous food. If, for example, it be cut up very small and mashed up with potatoes even children may take it without difficulty."

less robust pupils, that they should be given any task before breakfast. The practice of requiring a lesson at 7 a.m., on an empty stomach, and after a long fast, especially in winter, is indefensible. The pupils should be allowed hot milk, or hot coffee and milk, with a piece of bread, before going into school at all. This is most essential for the delicate or average boy or girl.

At 6.45 to 7.15 a.m. there should be, then, a provision of hot coffee, with plenty of milk—a beverage both nutritious and stimulating.

At 8.30 a.m.—Breakfast, after the 1st lesson; this should be a good meal, with some animal food—ham, bacon, cold beef, fish, or eggs. Some porridge. Bread and butter, or jam or marmalade. Hot milk and water, or coffee.

(Everything should be provided for the boys, and they should not be required to buy anything for themselves.)

At 1.30 p.m.—Dinner, which should be a good meal of meat, pudding, potatoes or green vegetables, or haricot beans, peas pudding, etc.

(School should cease at least 15 minutes before the meal, to give the boy time to wash and prepare himself for dinner.)

5 to 6 p.m.—Tea, with bread and butter, an egg, marmalade, jam, or potted meat.

As to supper, Dr. Dukes thinks boys should either not have any supper, so that they may go to bed without food in their stomachs, or that merely bread and butter, or bread and milk, or a glass of milk or water should be provided. He strongly objects to cheese, meat, beer or pastry at supper; he considers a meat supper with beer as most objectionable in growing boys, as tending to excite their passions and calculated to lead to immorality.

We cannot altogether accept these unqualified objections to supper. Our own view is that, instead of a meal at 5 or 6 p.m., only a few hours after a heavy dinner, it would be better to serve simply coffee or tea, or hot milk and water at that hour, and provide a fairly nutritious, but unstimulating, supper at 8 p.m. Porridge made with milk would be excellent; or tapioca, or rice pudding, with marmalade, or, in winter, some good soup with bread or other farinaceous substance, or any other light, but nutritious, food. The need for this seems to us obvious. We are dealing with a period of rapid growth when digestion and assimilation are active; and it is, surely, undesirable that a fast extending from a light meal at 5 or 6 p.m., to 7 a.m., and sometimes 8 a.m., the following day—a fast of thirteen or fourteen hours—should be inflicted on a rapidly-growing boy or girl.

This prolonged fast has appeared to us to be attended with, and often to be the cause of, serious loss of health, especially in girls' schools. For it must be remembered that girls between twelve and sixteen years of age often develop with amazing rapidity, and require ample and frequent supplies of food. We are fully convinced that the anæmia and constipation so commonly observed amongst young girls at the approach of puberty are frequently due to insufficient supplies of food, or to food of unsuitable quality. The constipation is probably due to a deficiency in fresh vegetables, and the want of a sufficiently bulky and stimulating diet; while the anæmia is, in many instances, the direct result of an imperfect supply of animal flesh—that is, of food which contains the maximum of iron and the material necessary for red corpuscle-making.

As to different articles of diet, we can coincide with most of Dr. Dukes's recommendations.

The bread should be wholemeal bread. This is no doubt the best bread for growing children and young people. There is little risk of their not being able to digest it, and it is certainly richer in the mineral substances they especially require than fine white bread. But what is of far more importance is that the bread should be well made—that it should be good and palatable, not sour, sticky or musty. The allowance of bread should not be limited, and butter should be given with it, as wheaten bread is deficient in fats.

Farinaceous and saccharine foods should be freely supplied as heat- and force- developing foods, and as more digestible than fats.

Milk should be abundantly provided for all adolescents as an essential part of their regular diet. It contains all the necessary elements of food in a readily assimilable form and is particularly fitted for nourishment during rapid growth. When there is any possibility of its serving as the medium of the conveyance of disease it should be boiled before consumption.

Meat should be provided twice a day—at breakfast and dinner—during the time of active growth. This may be in the form of ordinary butcher's meat, or fish, bacon, sausages, eggs, etc.

Dr. Dukes estimates that 1 lb. of uncooked meat should be the average ration, including fat: this would yield about $9\frac{1}{2}$ ounces of cooked meat, allowing a loss of 40 per cent. for bone and cooking.

All boys do not require so much as this, only the biggest and strongest.

Other recommendations which he makes are the following:—

Delicate boys who are small feeders should be allowed a little fish at tea time, or some beef-tea at lunch.

Fish should be more largely utilised.

Attempts should be made to overcome the distaste that exists for green vegetables. They should be cooked and served in a more attractive form; or soup with plenty of vegetables should be given once or twice a week in winter; or beet-root, pickles and salad should be more freely provided. This is of much importance, as eczema is prone to appear amongst boys at school who are kept on a too exclusively animal diet.

Pastry should be provided frequently at dinner, and visits to the pastrycook's *before* dinner should be strictly prohibited. "Hampers" are objectionable and a frequent cause of illness.

Beer and all alcoholic drinks are objectionable, as exciting the passions; milk is to be preferred.

We have, however, seen thin, delicate boys with small appetites greatly benefited by a glass of light, sound beer with dinner.

The greater relative defects in the diet of girls' schools was animadverted upon some years ago by the late Dr. Combe. He pointed out then that the system of diet "in female boarding-schools is often insufficient for due sustenance and growth, and, consequently, the natural expression of impaired health, if not actual disease, is a marked feature in the aspect of most of the pupils. So defective indeed is the common school management in this and other respects that we have the best authority for considering it as a rare exception for a girl to return home in full health after spending two or three years at an English boarding-school." Germain Sée also insists upon the urgent necessity of paying more attention to the feeding of young girls at school. We should understand, he says, "the absolute necessity of animal food, of abundance of meat plainly cooked, which contains all the principles of the blood, fibrin, hæmoglobin, and iron itself, in sufficient amount to enable us to dispense with ferruginous drugs. Such an albuminous diet, together with nitrogenous farinaceous foods and fish, and an abundant supply of oxygen and an open-air life, supplies all that is required." He mentions a provincial college for young girls (at Abbeville) which he regards as a type of what such an institution should be.

Every day there is a breakfast of *café-au-lait* or chocolate; four days in the week there is either leg of mutton, roasted or stewed, or roast pork, or beefsteak; and two days in the week boiled beef. There is also a second course of meat, consisting of veal or ham, as well as sardines, or German sausage. Haricot beans, pastry, rice, macaroni and cheese complete the repast. On Fridays they get fresh fish, milk, eggs, and cheese.

In a model French *lycée* at Paris he found the following arrangements as to food:—

For the 1st breakfast: Chocolate, milk soup, or *café-au-lait*.

As to meat, this is calculated as cooked meat from which fat and bones have been removed.

The oldest pupils get 100 grammes at each meal, *i.e.* 200 grammes (about 7 oz.) daily.

The older pupils of the 2nd and 3rd classes, 85 grammes at each meal, *i.e.* 170 grammes (about 6 oz.) daily.

The series of average pupils, 70 grammes, *i.e.* 140 grammes (about 5 oz.) daily.

And the smaller boys, 50 grammes, *i.e.* 100 grammes ($3\frac{1}{2}$ oz.) daily.

Three times a week, on Sundays, Tuesdays, and Thursdays, at the midday meal they get two courses of meat = 134 grammes (nearly 5 oz.) for the oldest, 112 (4 oz.) for the next, 94 (about $3\frac{1}{2}$ oz.) for the next, and the small boys 84 (3 oz.).

It will be seen that during three days in the week the eldest pupils get at the midday and evening meals together 234 grammes of cooked meat (8 oz.). This is about the quantity necessary; but the other quantities are much too small, and the great reductions made for the younger boys are quite unjustifiable.

On ordinary days the eldest boys get only 7 oz. (200 grammes) of meat, which is not enough, and the youngest only $3\frac{1}{2}$ oz. (100 grammes), which is a serious deficiency. This allowance of meat is what is given in one of the model *lycées*. Professor G. Sée states that in many others the feeding is far more defective.

Food in adult life.—The considerations which should guide us in determining the food appropriate to adult life have already been incidentally dwelt upon. In the first place we have to consider the circumstance that growth and development are for the most part over; but it must also be remembered that although, in young adults, the framework or skeleton of the body has ceased to grow, it is by no means certain that other organs of the body have, in all cases, reached their full development; and it is a very well-known fact that the body, especially in the male, commonly continues to increase in weight for some years after adult life has been attained. It is prudent, in many instances, to regard the young *man* as not having quite completed his physical development until he has reached his twenty-third or twenty-fifth year. Complete organic development is much earlier arrived at in the human female.

When, however, growth and development are completely over, it is clear there cannot be precisely the same food-requirements as exist when growth and development are in active progress. But throughout healthy and active adult life, although food is no longer needed for the purposes of growth, it is needed in due and sufficient amount to meet all the requirements attending the daily work of the organism, to supply the force developed in the various forms of energy which the human body normally displays, and to keep in sound repair all the various organs employed.

The food appropriate to adult life must thus depend very greatly on the conditions and circumstances which affect each individual—on sex, on physical development, on occupation, on climate, on habits, and other personal peculiarities.

The general principles which should govern us, in dealing with individual cases, may be gathered from what has been said in preceding chapters. A few points only in the application of these will here be dwelt upon.

Much has recently been written on the tendency to *over-feeding* in adults, and there can be no doubt that too much food is habitually consumed by great numbers of the rich and leisured classes; but we must be extremely careful not to apply this conclusion too generally, or to persons whose diets are fixed for them, and who have no choice in the matter. Too little food is probably more injurious than too much, and it is quite possible, as has been authoritatively asserted, that "the effects of casual repletion are less prejudicial and more easily corrected than those of inanition." It is not, however, *casual*, but *habitual* repletion that has been protested against. "A young fellow," says Sir Henry Thompson,* "in the fulness of health, and habituated to daily active life in the open air, may, under the stimulus of appetite, and of enjoyment in gratifying it, often largely exceed, both in quantity and variety of food, what is necessary to supply all the demands of his system without paying a very exorbitant price for the indulgence. If the stomach is sensitive or not very powerful, it sometimes rejects an extravagant ration of food, either at once or soon after the surfeit has been committed; but if the digestive force is considerable, the meals, habitually superabundant as they may be, are gradually absorbed, and 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

* "Diet in Relation to Age and Activity."

different persons, an undesirable balance remains against the feeder, and in young people is mostly rectified by a 'bilious attack,' through the agency of which, a few hours of vomiting and misery square the account. Then the same process of over-feeding recommences with renewed appetite and sensations of invigorated digestion, until in two or three, or five or six weeks, according to the ratio existing between the amount of food ingested and the habit of expending or eliminating it from the body, the recurring attack appears and again clears the system, and so on during several years of life. If the individual takes abundant exercise and expends much energy in the business of life, a large quantity of food can be properly disposed of. Such a person enjoys the pleasure of satisfying a healthy appetite, and doing so with ordinary prudence, not only takes no harm, but consolidates the frame, and enables it to resist those manifold unseen sources of evil which are prone to affect injuriously the feeble. On the other hand, if he is inactive, takes little exercise, spends most of his time in close air and in a warm temperature, shaping his diet, nevertheless, on the liberal scheme just described, the balance of unexpended nutriment soon tells more or less heavily against him, and must be thrown off in some form or other, more or less disagreeable. . . .

"After the first half or so of life has passed away, instead of such periodical attacks of sickness, 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, if a facility for converting appropriate material into fat is consistent with the constitution of the individual; for some constitutions appear to be without the power of storing fat, however rich the diet or inactive their habits may be. When, therefore, this process cannot take place, and in many instances, also, when it is in action, the over-supply of nutritious elements ingested must go somewhere, more or less directly, to produce disease in some other form, probably at first interfering with the action of the liver, and next appearing as gout or rheumatism, or as the cause of fluxes and obstructions of various kinds. Thus recurring attacks of gout perform the same duty, or nearly so, at this period of life that the bilious attacks accomplish in youth, only the former process is far more damaging to the constitution, and materially injures it."

It is impossible to indicate more clearly than is done in these few paragraphs how excess of food in adult age ministers to the development of disease in more advanced life. It is, however, true, and Sir Henry Thompson does not fail to notice this fact, that in youth, when the whole system abounds in vigour and strength, much superfluous food may be disposed of—first, by the greater activity of the functions of digestion and absorption; and secondly, by the capacity youth possesses for excessive muscular exertion, by which it can use up and eliminate such excess, almost at will.

"To him it is a matter of indifference, for a time, whether the quantity of material which his food supplies to the body is greater than his ordinary daily expenditure demands, because his energy and activity furnish unstinted opportunities of eliminating the surplus at all times. But the neglect to adjust a due relation between the 'income' and the 'output' cannot go on for an indefinite period without signs of mischief appearing in some quarter.

"A tolerably even correspondence between the two must by some means be maintained to insure a healthy condition of the body. It is failure to understand, first, the importance of preserving a near approach to equality between the supply of nutriment to the body and the expenditure produced by the activity of the latter; and, secondly, ignorance of the method of attaining this object in practice, which give rise to various forms of disease calculated to embitter and shorten life after the period of prime has passed."

Many methods of eliminating this excess of food are practised. The various forms of muscular activity involved in out-of-door games and exercises, so long as they can be adopted with safety, are as valuable as they are popular; but their pursuit is often unwisely protracted to a period of life when they are no longer safe or useful, and it is then that the eliminative effects of the Turkish bath or of an occasional course of purgative waters find their appropriate application.

Of late years a habit of drinking milk as a beverage at meals has been largely adopted, without, apparently, reflecting that milk is a highly nutritious *fluid food* which has the property of becoming *solid* when it meets the acid gastric juice; and a large excess of solid food may thus inadvertently be taken. "There are even some persons who must wash down their ample slices of roast beef with draughts of new milk!—an unwisely-devised combination even for those of active habit, but for men and women whose lives are little occupied by exercise it is one of the greatest dietary blunders which can be perpetrated. It is altogether superfluous and mostly mischievous as a drink for those who have reached adult age and can digest solid food."

The quantity of food, then, required in adult life will be conditional, to a great extent, on the habits of the individual with regard to physical activity.

"But there is a certain qualification, apparent but not real, of the principle thus enunciated. It is right and fitting that a certain amount of storage material, or balance, should exist as a reserve in the constitution of every healthy man. Every healthy individual, indeed, necessarily possesses a stored amount of force, which will stand him in good stead when a demand arises for prolonged unusual exertion, or when any period of enforced starvation occurs, as during a lingering fever, or other exhaustive disease. That undue amount of stored nutriment, that balance which has been referred to as prejudicial to the individual, is a quantity over and above the natural reserve produced by high health; for when augmented beyond that point, the material takes the form of diseased deposit, and ceases to be an available source of nutriment. Even the natural amount of store or reserve is prone to exceed the necessary limit in those who are healthy, or nearly so." *

And this brings us to the subject of "training" for athletic exercises, a process which has for its object the development of the highest degree of strength and activity attainable by the human body, so as to enable it to perform, without injury to itself, feats involving great or protracted exertion. In this process some loss of weight, some loss of stored-up redundant material, almost invariably takes place. If this is carried too far, the subject is weakened instead of strengthened, and is said to be "over-trained." If it is not carried far enough, and the subject remains encumbered and embarrassed with useless fat or other unnecessary material, he is said to be "under-trained." The competent and experienced trainer endeavours to hit off the happy medium, "the exact and precise balance between the two conditions."

Training usually involves a combination of diet and exercise, and a period of six weeks is usually

* Sir H. Thompson, "Diet in Relation to Age and Activity."

devoted to the process. When properly carried out, it is attended with a loss of fat and water and an increase both in bulk and firmness of the muscles; and this is accompanied by a feeling of lightness and freedom, and "fitness" for exertion. The skin especially improves in appearance, and should become "clear, smooth, fresh-coloured and elastic." It used formerly to be the custom, now abandoned as injurious, to begin a course of training by an emetic and repeated saline purges. The transition from the usual diet should not be too sudden, but duly graduated, and the food selected should be palatable and digestible.

Lean meat always enters largely into the diet of training, for it has been established that a meat diet leads to the removal of superfluous water and fat, lessens weight, and imparts firmness and endurance to the muscles. Beef and mutton, roast or grilled and "underdone," are usually preferred. Toast or stale bread, and a moderate quantity of potatoes and green vegetables, especially watercresses, are allowed. All entrées, all puddings and pastry are strictly forbidden, as are all sauces, pickles and condiments; the object being to preserve or develop a simple, natural appetite, and not provide food which may provoke to excess.

To meet the loss of water from the body involved in active exertions a certain amount of fluid must be taken, but it is usual to limit this with some care, and only sufficient to allay thirst should be taken, and that should be slowly sipped; any excess of drink being injurious. Barley-water, toast-and-water, tea, coffee and cocoa are permitted, as well as a little beer or light wine. *No* spirits,

Only three meals a day should be taken: one at 8.30 or 9 a.m.; the second, about 1 or 2 p.m; and a supper between 8 and 9 p.m. After the period of training is over the transition to the ordinary habits of feeding should again be easy and gradual.

Maclaren gives the following schemes of training as carried out at Oxford and Cambridge :—

A DAY'S TRAINING FOR THE SUMMER RACES.

Oxford.	*Cambridge.*
7 a.m.—Rise. A short walk or run.	A run of 100 or 200 yards as fast as possible.
8.30 a.m.—Breakfast of underdone meat, crust of bread or dry toast, tea (as little as possible).	Underdone meat, dry toast, tea, 2 cups (later on only $1\frac{1}{2}$), watercress occasionally.
2 p.m.—Dinner, meat (as at breakfast), bread, no vegetables (not strictly adhered to), 1 pint of beer.	Meat (as at breakfast), bread, potatoes, and greens, 1 pint of beer. Dessert—oranges, or biscuits or figs, 2 glasses of wine.
5 or 5.30 p.m.—Rowing exercise.	Rowing exercise.
8.30 or 9 p.m.—Supper, cold meat and bread, sometimes jelly or watercresses, 1 pint of beer.	Cold meat, bread, lettuce, or watercresses, 1 pint of beer.
10 p.m.—Retire to bed.	

A DAY'S TRAINING FOR THE WINTER RACES.

Oxford.	*Cambridge.*
7.30 a.m.—Rise. A short walk or run.	7 a.m.—Exercise as for summer races.
9 a.m.—Breakfast, as in summer.	8.30 a.m.—Breakfast as in summer.
1 p.m.—Luncheon, bread or a sandwich, and $\frac{1}{2}$ pint of beer.	A little cold meat, bread, and $\frac{1}{2}$ pint of beer, or biscuit and glass of sherry (sometimes yolk of egg in the sherry).
2 p.m.—Rowing exercise.	Rowing exercise.
5 p.m.—Dinner, meat as in summer, bread, same rule as in summer as to vegetables, rice pudding or jelly, and $\frac{1}{2}$ pint of beer.	5 to 6 p.m.—Dinner, as in summer.
10 p.m.—Retire to bed.	
Water strictly forbidden. As little liquid to be drunk as possible.	

Adults whose lives are necessarily and chiefly devoted to *intellectual* or other sedentary occupations should not attempt to consume the same amount of food as those whose duties or pursuits involve much physical activity in the open air. The kinds of food they take may also frequently be modified with advantage. The substitution of fish, to some extent, for butcher's meat, has much to recommend it in these individuals. It is not so rich in nitrogenous substances as butcher's meat, and does not throw so much work on the eliminating functions; and the lighter kinds are much easier of digestion. There is, however, no foundation for the popular view that fish contains elements which adapt it in a special manner to be a "brain-food" or to sustain and promote intellectual labour. "The value of fish to the brain-worker is due simply to the fact that it contains, in smaller proportions than meat, those materials which, taken abundantly, demand much physical labour for their complete consumption, and which, without this, produce an unhealthy condition of body, more or less incompatible with the easy and active exercise of the functions of the brain." (*Sir H. Thompson.*)

Brain-workers should live much on light food not demanding much effort of the stomach to digest, and they should remember that the digestion of heavy meals involves also a greater expenditure of nerve-force. Besides fish, eggs, milk, light porous *well-made* bread, fresh vegetables and fruit should form their chief sustenance. They should take only a small amount of butcher's meat, and that especially on those occasions when they are able to take more physical exercise. Some animal fat is, however, useful, such as fresh butter or cream; or a rasher or two of fat bacon at breakfast. It is a remarkable fact that whereas the muscles contain only three per cent. of fat the brain contains eight per cent., and the nerves twenty-two per cent.; and this "high percentage of fatty matters contained in nervous substances indicates the necessity of fat for the proper performance of the functions of the nerves."

Climate and temperature, as well as physical activity, influence also the quantity and quality of the food required.

It is well known that in tropical countries, as well as in countries where they have prolonged *hot* seasons, as in the south of Europe, the natives live much on vegetable foods and fruit, when these can be obtained, and consume much less animal food and fatty substances than the natives of northern Europe; whereas in Arctic regions, where, it is true, no vegetables can be obtained, the inhabitants consume enormous quantities of animal flesh and fat. The necessity of supplying the body with a large proportion of combustible food, such as hydro-carbons, when the external temperature is very low, is obvious; and it is equally clear that very little food of this kind is needed when the external temperature is high. In Britain during the heat of summer some modification of the habitual diet should be made; less animal food and fats should be consumed, and more vegetable substances and fruit should be taken in their place.

Many *idiosyncrasies* with regard to particular articles of food have to be considered, not only in adult life, when, however, they become more marked, but at all ages. Some persons cannot digest milk, others cannot take eggs in any form; some can eat no fat; some are made ill by certain kinds of fish, etc. All these peculiarities have to be reckoned with. These are sometimes due to inherited tendencies; sometimes they are the growth of habit.

Some persons do best with long intervals between their meals; their digestions are slow. Others with quick digestions require food more frequently. Long fasts are, as a rule, ill-borne by feeble persons who cannot eat largely at their meals, and such persons are often better for taking a small quantity of food between their late dinner and breakfast, which usually involves a fast of twelve or more hours. A little light food on going to bed, or, if they wake, as they are prone to do, in the night, is advisable. This may be simply a cup of clear soup, or beef-tea, or gruel, milk, or arrowroot.

It is to be noted also that *women* require less food than men, as their bodies are usually smaller, and they more commonly lead inactive, sedentary lives. They, however, pass through critical periods, which may require special care; *e.g.* after repeated profuse hæmorrhage at the menstrual periods, they may require a diet rich in albuminates to repair the losses caused thereby. It has already been pointed out that especial provision should be made in the dietary for the special calls upon the system which pregnancy and lactation involve.

Food in advanced age. — With advancing years the functional activity of the bodily organs diminishes, the capacity for physical exertion is considerably weakened, and the mental powers usually begin to flag; the functional activity in the digestive organs partakes in this general decline, so that while there is less need for food on account of lowered physical and mental activities, there is also less power of digesting and assimilating food on account of the slowly progressing degenerative changes in the secreting glands and the consequent diminished digestive and absorbent power in the alimentary canal. The circulation through the abdominal organs also tends to become languid, so that absorption is thereby delayed, and may be further hindered by degenerative changes in the blood-vessels themselves. Moreover, the muscular walls of the intestine lose their tone and contractile power, there is a tendency to dilatation, especially of parts of the large intestine, causing delay in the expulsion of the residual fæces, so that constipation and flatulence tend to add further to the embarrassment of the digestive functions.

All these inevitable changes necessitate appropriate and corresponding changes in the amount and kind of food taken.

In the first place the food must be diminished in quantity. "As we increase in age," says Sir H. Thompson, "less energy and activity remain and less expenditure can be made; less power to eliminate is possible at fifty than at thirty, still less at sixty and upwards. Less nutriment must, therefore, be taken in proportion as age advances, or rather as activity diminishes, or the individual will suffer. If he 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 certainly either 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. He must reduce his 'intake,' because a smaller expenditure is an enforced condition of existence. At seventy, the man's power has further diminished, and the nutriment must correspond thereto, if he desires still another term of comfortable life. And why should he not? Then at eighty, with less activity there must be still less 'support.' And on this principle he may yet long continue."* And in another work Sir Henry again comments aptly on this subject: "It is absolutely certain, contrary to the popular belief, that

* "Diet in Relation to Age and Activity."

while a good supply of food is essential during the period of growth and active middle life, a diminished supply is desirable in relation to health and prolongation of life during declining years, when physical exertion is small, and the digestive faculty sometimes becomes less powerful also. . . . The system of 'supporting' aged persons, as it is termed, with increased quantities of food and stimulants, is an error of cardinal importance, and without doubt tends to shorten or to embitter life. . . . As age increases the ability to eliminate food unnecessarily consumed notably diminishes. . . . The elderly man who desires to preserve fair health and to attain to longevity should gradually diminish his use of strong nitrogenous and much fatty food." *

In Professor Humphry's report on "Centenarians," published in the reports of the Collective Investigation Committee of the British Medical Association (vol. iii., 1887), it appears that their habits in the matter of eating and drinking tended, as a rule, to great moderation in both. The large majority were small or moderate eaters. Of animal food the majority took but little. Of thirty-seven, three took none, four took *very* little, twenty took little, ten took a moderate amount, and one only took *much*. The exact quantity is mentioned in nine instances: one took 12 oz., one 6, one 5, and six 4 oz. daily. In the use of alcoholic drinks we also find evidence of great moderation. Fifteen were either all their lives or in their old age or youth total abstainers; twenty-two took but little, two very little, ten a moderate amount of alcohol, and some who had taken a little alcohol formerly were taking none in their old age. It is remarkable how numerous, in the published records of centenarians, are the references to the great sobriety, temperance, and "abstemious" habits of the

* "Food and Feeding."

immense majority of persons who have reached great age, and especially frequent is the statement that they have partaken very sparingly of animal food.

It has been pointed out by several writers that the disappearance of the teeth in advanced life and the loss thereby of the powers of mastication seems to be associated with the fact that foods needing mastication, such as animal flesh, are inappropriate to this period of life, and that the softer and lighter kinds of food not needing mastication are more suitable and should be had recourse to. It is true that the dentist's art is capable of replacing the lost masticating organs, but if these artificial teeth are used for the purpose of continuing a diet largely composed of animal flesh, they will not prove an unqualified advantage.

"The typical man of eighty or ninety years, still retaining a respectable amount of energy of body and mind, is *lean and spare,* and lives on slender rations." *

Great caution, however, should be observed in making any radical change in the diet of an elderly person, and it should be introduced very gradually.

The proportion of animal to vegetable food should not be more than one part of the former to three of the latter, and it should be our aim to reduce even this proportion. As the amount of food taken at one time should be small, it is necessary, at this period of life, that the intervals between meals should be somewhat shortened, and the meals, therefore, more numerous. It is often an advantage, for this reason, for aged persons to have a little fluid food at hand during the night, to be taken when they awake, as they so often do, about three or four o'clock in the morning. A little food or stimulant taken at this hour will frequently enable them to fall asleep again.

Large heavy meals must, then, be carefully avoided,

* Sir H. Thompson's "Food in Relation to Age and Activity."

and meals consisting of a small or moderate amount of easily-digested food should succeed one another at not too long intervals.

Of the 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, etc.

Nutritious soups, such as chicken *purées*, 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, the bread at least a day old; rusks, for soaking in tea or milk and water.

Artificial foods, consisting of predigested starches; the digestive ferments are scantily provided by the digestive organs at this age, and soluble carbo-hydrates 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 advantageously be 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.

CHAPTER XII.

THE RELATIVE ADVANTAGES OF ANIMAL AND VEGETABLE FOODS — VEGETARIANISM (BENEKE'S DIET FOR CARCINOMA).

All the alimentary substances needed for the nutrition and sustenance of the body can be obtained either from the vegetable or the animal kingdom. Albuminates, carbo-hydrates, fats, and mineral substances, identical in nature and composition with those which are found in the animal body, are to be derived also, as we have seen, from vegetable products.

There is, however, a considerable difference in their assimilability in the alimentary canal. Albuminates (and fats also) derived from animal sources —as in flesh, eggs, milk, etc.—are almost entirely and rapidly absorbed in the stomach and intestine; whereas the albumen of vegetable substances is generally found in association with relatively large quantities of starch, and these are enclosed in a network of cellulose which is excessively resistant to the action of the digestive juices; and it has been calculated that while only 3 per cent. of the albumen of animal food escapes digestion and is lost in the evacuations, as much as 17 per cent. of the albumen of vegetable foods is thus wasted. If, then, a man were to consume only as much vegetable food as would afford the actual amount of albumen, salts, and starches necessary to cover the daily losses of the body, inasmuch as a large proportion would pass out of the body unutilised, because undigested, the portion appropriated would not suffice for the sustenance of the body. It is necessary to consume a much larger quantity of vegetable than of animal food in order to obtain the necessary amount of nourishment.

It has been said that the digestion of animal food "taxes the stomach" more than ordinary forms of vegetable food. It seems to us that this statement requires great qualification. Apart from individual peculiarities, which are prone to interfere in the consideration of a question of this kind, and assuming the existence of a normal *healthy* condition of the *adult* digestive organs, we believe the contrary to be the case, supposing the animal food to be taken only in *equivalent* quantity to such vegetable foods, calculated according to the amounts of nutritive constituents they respectively contain.

It is, however, generally admitted that the digestion of vegetable food is a much more complex process than that of animal food; and we accordingly find the alimentary canal in herbivorous animals to be of far greater extent than in carnivora.

It would seem also that the nutrition of the body undergoes certain modifications, according to the proportions in which animal and vegetable substances enter into the composition of the food. An excess of animal food appears to increase the amount of fibrin in the blood, to add to its richness in corpuscular elements, and to augment the proportion of phosphatic and other mineral constituents; it is also said to confer additional firmness and tone to the muscles, and to lead to the disappearance of superfluous fat. Vegetable food, in excess, tends, on the contrary, to increase the amount of fat deposited within the body, and to induce obesity.

The experiments of Lawes and Gilbert in the feeding of animals went to show that food rich in albuminates tended to the increase of muscle and bone ; and it is a matter of common knowledge that herbivorous animals show a far greater tendency to the deposition of fat than flesh-eaters. We especially select herbivorous animals for purposes of fattening ; and even carnivorous animals, if restricted, to some extent, to vegetable foods, become fatter.

The consumption of food rich in nitrogenous constituents appears also to promote oxidation within the body, and to be attended by a greater absorption of oxygen from the respiratory organs; and it is probably owing to its determining an increased oxidation of the fat deposited in the tissues that an exclusive diet of animal flesh has been found to act as a remedy for obesity.

The urinary excretion is increased in quantity by animal food, and the amount of urea, as is well known, is also increased, together with the phosphates and sulphates. An animal diet tends further to increase the acidity of the urine : a vegetable diet to render it alkaline. The urine of the herbivora is acid during fasting and alkaline after feeding. The urine of the calf while sucking is acid, but becomes alkaline as soon as it begins to feed on grass. Animal food is certainly more stimulating than vegetable food, and appears to satisfy and allay the cravings of hunger more completely and for a longer period. The reason of this probably is that animal albuminates are digested, and to a great extent absorbed, in the stomach ; they remain longer in that organ than vegetable foods (which are almost entirely digested in the small intestine), and enter more quickly into the general circulation, so that their sustaining influence is more quickly felt.

It is said with regard to animals that they are made more ferocious by animal food, and that the herbivora are less combative than the carnivora ; and Liebig has related of a bear kept in the Anatomical

Museum at Giessen that it was of quiet and gentle disposition while fed entirely on bread, but became vicious and dangerous after a few days' feeding on meat; and he mentions that even swine grow fierce and will attack men after having been given flesh food. But it must be remembered that the dispositions of animals, as well as their physical state, may be altered considerably by different kinds of food, although these may be *all* derived from the *vegetable* kingdom. A young horse, if fed wholly on oats and beans, is apt to display qualities of temper and disposition which it would not show if kept on bran mashes and hay!

There are few persons in the present day who advocate the practice of limiting the human dietary to substances of exclusively *vegetable* origin. The majority of the so-called "vegetarians" of modern times adopt no such exclusive diet, but take, together with the more highly nutritive forms of vegetable food, such typical animal foods as eggs, milk, cream, butter, and cheese. They object only to animal flesh. But those who take for their food the egg and the milk prepared by animals from the vegetable substances they feed on, and reject only animal flesh, have no claim to call themselves "vegetarians." They feed, as has just been said, on the most typical and concentrated of animal foods. They have a *sentimental* objection to killing animals for food, and they found upon it a scheme of diet which we believe to be utterly impracticable on an extensive scale, and irreconcilable with the existing state of civilised man, not so much on strictly physiological grounds as on general economical considerations. There can be no objection to individuals adopting any kind of diet which they may find answer their needs and minister to their comfort; it is only when they attempt to enforce what they practise on others that they must expect to encounter a rational opposition.

Nor is it safe to argue that a particular mode of diet is good for the race simply because it appears to answer the wants of certain individuals. As Sir W. Roberts has justly observed: "The effects of a vegetarian diet would only be gradually developed, and would, probably, not be fully impressed on the bodily and mental qualities of the race until after such habits had been continued through two or three successive generations," and he mentions having encountered at Salford, "where, some years ago, there existed a flourishing colony of vegetarians, a tradition to the effect that though vegetarianism might suit the parents, it was bad for the children;" and he testifies to having seen "some striking examples in that borough which appeared to indicate that this tradition was well founded."

But there exists also abundance of evidence that a purely vegetable diet is not the most appropriate for the production of either physical or intellectual effort.

Jules Béclard has recorded in his well-known text-book on Physiology that "the workmen employed at the forges of Tarn were for a long period fed with vegetable substances. It was then found that all the workmen lost, on an average, fifteen days' work a year on account of exhaustion or illness. In 1883, Mons. Talabot, deputy of La Haute Vienne, took charge of the forges. Meat was then made an important part of the diet. The health of the men afterwards improved so greatly that they did not lose more, on an average, than three days' labour a year. Animal food produced a gain on each man of twelve days' work a year."

It has also been stated that the Italian labourers from Lombardy, with their largely vegetable dietary, performed much less work when engaged in piercing the St. Gothard Tunnel than their Swiss co-labourers with a more richly animalised scale of diet. Soldiers campaigning have likewise been observed to lose health and fall ready victims to scurvy and diarrhœa if they have been compelled to live on farinaceous foods solely. The great Haller submitted himself for many days to an exclusively vegetable diet, with the result that he found himself more muscularly feeble, and suffered from general languor and a great disinclination to intellectual work; and we have been *authoritatively* informed that one of the most eminent of living philosophical writers restricted himself to vegetable food for three months, and then, when he had read what he had written during that period, he was so dissatisfied with the work that he burnt all the manuscript!

Professor Gubler believed that too exclusively vegetable a dietary tended to favour calcareous degeneration of the arteries, as they introduce into the blood a relatively larger proportion of mineral substance than animal food; and Dr. Raymond observed numerous cases of atheroma of the blood-vessels in a convent of *pulse*-eating monks; amongst others the prior, a man of only twenty-two years of age, presented considerable induration of the arteries. Dr. Treille, of the French Navy, observed a great many cases of atheromatous degeneration amongst the inhabitants of Bombay and Calcutta, whose food in many cases consists almost exclusively of rice. Of course, in these last instances other factors may have been operative besides the character of the food.

Too exclusively vegetable a diet has been charged with inducing premature old age by causing degeneration of the arteries; it is also said to cause accumulations of tartar on the teeth and a tendency to phosphatic gravel.

If we look to the history of the human race, we see that man has been guided in the selection of his food by the circumstances and conditions with which he has been surrounded. His physical organisation seems peculiarly adapted to enable him to accommodate himself to such food supplies as he may be able to procure, without regard to whether they are derived from the animal or vegetable kingdom.

In Arctic regions, where no vegetable can be procured, man lives entirely on flesh and fat, and in hot countries, where fruits and nutritious vegetables abound and are readily procurable, he consumes these largely. But it is a common error to suppose that the natives of all hot climates live to a great extent, or almost exclusively, on vegetable food; wherever animal food can be readily procured, it is, as a rule, taken as food. Of the Pampas Indians, who live in a "climate which is burning hot in summer," it is recorded that "they have neither bread, fruit, nor vegetables, but subsist entirely on the flesh of their mares;" and as to the effect of such a diet, Sir Francis Head testifies, "after I had been riding for three or four months and had lived on beef and water, I found myself in a condition which I can only describe by saying that I felt no exertion could kill me"!

The Chinese eat fish and pork with their rice, the Japanese eat fowls in great abundance, and the flesh of whales is a very common food in several places amongst the poorer classes.

The Arabs who inhabit the Nubian desert subsist entirely on animal food; the Abyssinians eat largely of raw flesh. As to the food of the East African, it is stated by Burton that "the Arabs assert that in these latitudes vegetables cause heartburn and acidity, and that animal food is the most digestible. A man who can afford it almost confines himself to flesh, and considers fat the essential element of good living." * Parkes also testifies that the "natives of some of the hottest countries in the world take immense quantities of both *fats* and starches."

Nothing can appear clearer than that man, by his organisation and by the varying circumstances and conditions in which he is placed, is destined to be a *mixed* feeder. He can exist, when absolutely necessary, exclusively on animal food, and he can also exist, when equally necessary and inevitable, exclusively on vegetable food; but in those parts of the world in which he reaches the highest degree of development and civilisation and culture we find him a mixed feeder, taking a portion of his food from the animal and a portion from the vegetable kingdom.

But although we regard man as essentially an omnivorous animal, we are by no means disposed to deny that at the present time and in England the due utilisation of vegetable foods is much neglected, and that there is far too great a tendency amongst the whole of the population to rely chiefly on animal products for food. It has been estimated that in a suitable mixed dietary not more than one-fourth should consist of animal food; if this proportion is greatly exceeded an undue tax is imposed on the excreting organs to eliminate the products of the transformation of the nitrogenous excess thus introduced into the body; or this eliminatory process may be imperfectly accomplished and the results of incomplete or abnormal metamorphosis of superfluous nitrogenous substances may increase a pre-existing tendency, or develop one, if it does not already exist, to gouty or other kindred disorders.

It would certainly be an unmitigated gain—and a

* Pavy gives many other curious statements about the food of different nations and races in "Food and Dietetics."

great advance in the domestic economy of the poor and labouring classes in England—if they could be taught to turn to better account than they do the abundant resources of nutritious and agreeable food to be found in some of the now greatly neglected vegetable products at their disposal. The absolute want of knowledge amongst the women of this class of the proper methods of cooking and preparing vegetable food of certain kinds, so as to make them into appetising, agreeable, nutritious, and digestible dishes, is undoubtedly the chief cause of their wasteful neglect of these foods—a wastefulness almost *peculiar* to the labouring classes of England, and traceable probably to their greater command of supplies of animal food. This waste is especially apparent in their treatment of green vegetables, vast quantities of which are thrown away—namely, all the outside leaves of lettuces, cabbages, etc.—which in another country would be cleaned and trimmed and entirely utilised as wholesome food.

Sir Henry Thompson especially calls attention to the value of the haricot bean, as one of the best of the pulses for the labouring classes, and exceedingly economical, as they can be obtained at a cost of 2d. per pound.

His directions for cooking the beans are as follows :—

" Soak, say, a quart of dry haricots in cold water for about twelve hours, after which place them in a saucepan, with two quarts of cold water and a little salt, on the fire ; when boiling remove to the corner, and simmer slowly until the beans are tender, the time required being about two or three hours. (If the water is hard, a little soda should be added to soften it.) This quantity will fill a large dish, and may be eaten with salt and pepper. It will be greatly improved at small cost by the addition of a bit of butter, or of melted butter with parsley, or if an onion or two have been sliced and stewed with the haricots."

Of the nutritive value of the haricot he justly adds:—"No product of the vegetable kingdom is so nutritious; holding its own in this respect, as it well can, even against the beef and mutton of the animal kingdom. The haricot ranks just above lentils, and is to most palates more agreeable. By most stomachs, too, haricots are more easily digested than meat is; and, consuming weight for weight, the eater feels lighter and less oppressed, as a rule, after the leguminous dish; while the comparative cost is very greatly in favour of the latter."

No one has done more than Sir Henry Thompson to disseminate correct views as to the relative value of animal and vegetable foods, or to enforce the truth, too little appreciated at present, that many of our more troublesome chronic maladies are traceable to the habitual consumption of food too rich in animal albuminates. His remarks on this subject are so just and pertinent that we reproduce them here.

"The vegetable eater," he observes, "pure and simple, can, therefore, extract from his food all the principles necessary for the growth and support of the body as well as for the production of heat and force, provided that he selects vegetables which contain all the essential elements named. But he must for this purpose consume the best cereals, wheat or oats (or maize); or the legumes, beans, peas, or lentils; or he must swallow and digest a large weight of vegetable matter of less nutritive value, and therefore containing at least one element in excess, in order to obtain all the elements he needs. Thus the Irishman requires for his support 10 to 11 lb. of potatoes daily, which contain chiefly starch—of which, therefore, he consumes a superfluous quantity—very little nitrogen, and scarcely any fat; hence he obtains, when he can, milk, lard, or bacon, or a herring, to supply the deficiency. The Highlander, living mainly on oatmeal, requires a much smaller weight, since his grain contains not only starch, but much nitrogen and a fair amount of fat, although not quite sufficient for his purpose, which is usually supplied by adding milk or a little bacon to his diet. On the other hand, the man who lives chiefly or largely on flesh and eggs, as well as bread, obtains precisely the same principles, but served in a concentrated form, and a weight of 2 or 3 lb. of such food is a full equivalent to the Irishman's 10 or 11 lb. of potatoes and extras. The meat-eater's digestion is taxed with a far less quantity of solid, but that very concentration in regard of quality entails in some stomachs an expenditure of force in digestion equal to that required by the vegetable-eater to assimilate his much larger portions. And it must be admitted, as a fact beyond question, that some persons are stronger and more healthy who live chiefly, or altogether, on vegetables; while there are many others for whom a proportion of animal food appears to be desirable, if not necessary."

"Englishmen consume too much animal food, particularly the flesh of cattle. For all who are occupied with severe and continuous mechanical labour, a mixed diet, of which cereals and legumes form a large portion, and fish, a little fat meat, bacon, or lard, eggs and milk form a moderate, but constant proportion, is more nutritious and wholesome than almost entirely animal food. For those whose labour is chiefly mental, and whose muscular exercise is inconsiderable, still less of concentrated nitrogenous food is desirable." *

* "Food and Feeding," pp. 21-27.

It has been suggested that, amongst other evils attending an animal dietary, one is that it favours the tendency, where it exists, to the development of cancer, just as it promotes gouty manifestations in those who are constitutionally predisposed to such maladies. Indeed, Dr. F. W. Beneke has introduced a special diet for the treatment of cancer, in which nitrogenous food is reduced to a minimum. This dietary is here given :—

BREAKFAST.

Bread, with plenty of butter.
Potatoes, cooked in their skins, and eaten with butter.
A strong infusion of black tea, with sugar and cream; or cocoa may be substituted for tea.

LUNCH.

Fruit, raw or cooked.
English biscuits, or a little bread and butter.
A glass of wine.

DINNER.

Potato soup, or fruit soup, or wine soup, with sago or Indian corn.
Meat, freshly minced, 50 grammes (rather less than 2 oz.).
Potatoes, mashed; *fricassée;* in *purée;* or plain boiled.
Vegetable roots of every kind (turnips, parsnips, carrots, etc.).
Fruit, stewed (apples or plums, with rice; or rice flavoured with rum).
Salads and fruit ices.
Wines (light Rhenish, or Moselle, or Champagne).

AFTERNOON TEA.

Black tea, with sugar and cream.
A little bread and butter, or some raw fruit and biscuits.

SUPPER.

Soup, as at dinner.
Potatoes, boiled and eaten with butter, or potato salad.
Sardines in oil, anchovies, or fresh herrings, *in small quantities.*
Buckwheat gruel, with wine and sugar.
Light wines.

Beneke maintains that by means of this diet he reduces the proportion of nitrogenous to non-nitrogenous aliment from 1 to 5, which is the common one, to 1 to 8 or 9. Moreover, there will be a distinct reduction of phosphates, for the necessary salts of potash will be taken chiefly in combination with the vegetable acids, malic and tartaric; the urine will consequently have a less acid reaction. He restricts the consumption of cereals and pulses as much as possible.

It has been questioned whether a person could subsist on a diet so defective in albumen and phosphates. Beneke replies that he has proved, by practical experience, that it is possible, and that persons so treated manifest no loss of strength or disturbance of functions.

It must be noted, however, that in this diet for carcinomatous patients, the predominance of vegetable foods is simply designed in order to supply the least possible amount of albumen and phosphoric acid, and is not founded on any strict vegetarian principles as to the *source* of the foods, whether from the *animal* or *vegetable* kingdom; regard is only had to the chemical composition of the food.

The value of a diet in which as little albumen and salts of phosphoric acid as possible is introduced into the system in the treatment of cancer is founded by Beneke on the following considerations. The protoplasm of the cells consists essentially and in general of water, albumen, cholesterin and lecithin, with smaller quantities of neutral fats and fatty acids, phosphates of potash and lime, and chlorides of the alkalies; that these constituents exist in different cells in relatively different quantitative proportion. Beneke believes the cells of carcinoma are relatively rich in cholesterin and in lecithin, and since cholesterin is a product of albuminates, which are, again, rich in alkaline and earthy phosphates, he concludes that the growth of the tumours in question may be checked by the use of a diet which, while just answering the needs of the body in other respects, shall contain as little as possible of the constituents specially required for cell-formation; *i.e.* cholesterin, lecithin, and earthy and alkaline phosphates; and with this object in view he avoids *vegetable* as well as *animal* foods which are relatively rich in these substances, and chooses those vegetable substances in which the carbohydrates largely predominate.

Part II.

FOOD IN DISEASE.

In almost every period in the history of medicine the importance of dietetics in the treatment of disease has been universally recognised; but at no period has the therapeutics of food obtained so careful a study and so wide an application as in the present day. Our more complete knowledge of the processes of digestion and metabolism as they occur in health, and of their disturbances in disease; our enlarged and more accurate acquaintance with the chemical composition of alimentary substances, as well as of their purposes in nutrition, have contributed greatly to the growth and development of this branch of therapeutics.

In the management of all morbid conditions a suitable adaptation of the food to the altered state of the organism is of the highest importance. In none is it of more consequence than in the treatment of acute diseases. There was a tendency at one time to injuriously limit the dietary of fever patients; the tendency, in the present day, has perhaps been to err in the other extreme. In no department of medical practice is *judicious discrimination* of so much consequence.

In the administration of food in disease we have to pay especial regard to the state of the digestive and assimilative organs as influenced by the existing pathological processes.

In many diseases, indeed in all febrile diseases, while the tissue-waste and the demand therefore for food are augmented, the capacity for digestion and appropriate nutriment is greatly impaired; and if in our eagerness to supply food to compensate for the waste of tissue we lose sight of the co-existing disability of the digestive and assimilative processes, we shall not only fail in the object we have in view, but we shall inflict positive injury on our patient.

In these cases, moreover, the eliminative processes are also frequently gravely disturbed and embarrassed, and the exhibition of food containing much that cannot, under the circumstances, be utilised and annexed, leads to still further eliminative difficulties.

In diseases of the digestive organs themselves, acute or chronic, we must ever keep present in our minds this disability, and consider that the essential conditions of alleviation and cure of such disorders may be the temporary withholding rather than the urging of food.

In other instances where progressive bodily wasting is one of the most alarming incidents of the disease, our ingenuity should be wisely directed to devising or adopting methods of feeding which, while they do not overtax the functions of the enfeebled digestive organs, tend to adequately restore the loss of tissue.

All these conditions, as they occur in connection with the various acute and chronic diseases, will meet with full consideration in the following chapters.

CHAPTER I.

FEEDING IN ACUTE DISEASE AND CONVALESCENCE.

It is scarcely necessary in the present day to enter into any protracted discussion as to the propriety of feeding or of withholding food from patients who are suffering from febrile maladies. Since the time when Graves claimed as his chief title to the gratitude of posterity that "he fed fevers," there has been little serious inclination to go back to the starving methods of some of his distinguished predecessors or contemporaries. To "feed fever" is now the popular practice, and, in some instances, it has, probably, been carried to an injurious excess.

The conclusion of some of the older physicians that the administration of food tended to increase the fever in cases of acute disease, rested, no doubt, on some basis of practical observation, and we are well aware now that the careless and indiscreet administration of food, unsuitable either in quality or quantity, or in both, is most harmful in febrile maladies.

Cautious and careful administration of food, based on the principles we are about to state, will, we believe, be found most in accord with practical experience, as well as with scientific experiment.

It is an universally acknowledged fact that all febrile states are accompanied by an increased waste or consumption of the tissues of the body, so that there occurs a considerable loss of body-weight, usually proportioned to the intensity and duration of the fever.

But the whole of this loss of substance is not necessarily due to the febrile process alone, whatever the intimate nature of that process may be; a portion of it is undoubtedly due to defective nutrition caused by the coincident disorder of the organs of digestion and assimilation which almost invariably accompanies fever. Not only is there absence of appetite and indisposition to take food, but if food in any considerable quantity is given it fails to be digested and assimilated, and only serves to intensify the febrile process and increase the discomfort of the patient. There are, therefore, two causes of waste cooperating in nearly all cases of acute febrile disorder: first, the abnormal increase of the metabolic processes, especially of the albuminous tissues, following as a direct consequence of the fever itself; * and, secondly, the defective nutrition dependent on the coexisting morbid changes in the functions of the digestive and assimilative organs.

In most acute and severe febrile conditions the activity of the secreting glands of the stomach and intestines is so gravely impaired that the digestive powers are quite unable to keep pace with the destruction of the tissues; while that much of the waste is due directly to the febrile process seems to follow from the observation that the excretion of urea by a fever patient, even when absolutely deprived of food, will sometimes exceed by 40 to 50 grammes that of a healthy man with an ample supply of food.†

It has also been remarked that in chronic forms of fever, attended by remissions and intermissions, there is less waste than in febrile diseases that have a continuous high temperature, and that in cases in which, from individual peculiarity, the digestive apparatus has maintained its activity (an exceedingly rare

* "A parasitic microbe is the cause both of the high temperature and the wasting."—Germain See.

† Bauer, "Dietary of the Sick."

circumstance in continued fevers) the loss of body-weight has been inconsiderable.

It had been suggested that the increased albuminous metabolism observed in fever was due wholly to the rise of temperature; but this seems negatived by the observation that in artificially induced septic fever an increased excretion of urea was observed before the temperature began to rise, nor has any constant parallelism been observed in cases of fever in the elimination of urea and the elevation of temperature. If a parasitic microbe is the exciting cause of the fever, it may, as Germain Sée states, be the cause both of the wasting and the high temperature.

After the decline of the temperature, especially in those diseases, like pneumonia, which end in a crisis, the increased excretion of urea not only continues, but may even rise still higher; and this circumstance is regarded by some as due to the accumulation of the products of albuminous metabolism in the body, during the fever, in such quantity that some considerable time is needed for their elimination; while others maintain that it is due to the causes which originally led to the increased metabolism continuing to act for some time after the critical fall of temperature has taken place.

Bauer mentions another plausible explanation that has been suggested of the large increase in the elimination of urea observed during the stage of resolution in cases of croupous pneumonia, viz. that it is, in part, due to the metabolism of the albuminates of the fibrinous exudation in the process of absorption. The liquefaction of the exudation is dependent on fatty degeneration, and the nitrogenous products of the splitting up of the albuminates are eliminated in the urine.

Experimental investigations appear to show that the destruction of fat does not keep pace with the destruction of albuminates in fever, so that the visible emaciation of fever patients is not an adequate indication of the waste and destruction of tissue that have taken place. It has been established by Salkowsky that during fever there is an increased elimination of potash salts in the urine, a fact which points to a relatively increased waste of the muscular tissues.

We may conclude, then, that one of the most important results of febrile disease is the augmented metabolism of the albuminous substances of the body which it induces, and in which the cellular elements of the tissues are themselves attacked and destroyed. It follows that after fever has existed for a considerable time, the voluntary muscles, and even the muscles of the heart, are found to have undergone a kind of degeneration; hence the great muscular debility which is so prominent a symptom in patients recovering from febrile maladies.

The principal facts to be borne in mind in approaching the consideration of the dietetics of fever are these :—

1. Associated with the high temperature of fever there is rapid wasting of the albuminous tissues; an augmented consumption (or combustion) of the structural elements of the body.

2. As a consequence of the preceding, there is an excessive excretion of urea, which is eliminated in the urine, but which may, for a time, accumulate in the blood. There seems to be, also, although to a less degree, an increased excretion of carbonic acid.

3. The fats do not appear to be used up to at all the same extent as the albuminates.

4. At the same time, the functions of the digestive and assimilative organs are gravely disturbed. There are morbid changes affecting the peptic and other secreting glands. These changes are usually accompanied by loss of appetite, and even disgust for food,

and inability to digest solid food, which, if administered, is often vomited.

As we have already said, it used to be taught that the administration of albuminous food in fever was injurious, and had the effect of intensifying the consumption of the tissues, and was, in short, "pouring oil on the fire;" and even within the last twenty years it has been attempted to support this view by experimental observations. As they were, however, altogether inconclusive, it is not necessary to quote them here. On the other hand, Bauer and Künstle, by careful observation of the diet of typhoid patients, have completely established the fact that by a due "supply of albuminous food to a fever patient a saving of albumen in the body may be effected; for, though the excretion of nitrogen is increased, the loss of the same element from the system is reduced."* But Bauer, while he maintains that the loss of albumen in febrile subjects is lessened by the administration of albumen, yet concludes that it is unlikely in highly febrile states it can be entirely prevented; "for," he argues, "while under normal conditions a sort of equilibrium is constantly maintained between the nutrient fluids and the tissues, any excess of nutrient material being speedily removed, partly by increased metabolism and partly by an accession of substance, this equilibrium appears to be more or less disturbed in fever.

"The circulating current of albumen is abnormally great in proportion to the mass of cells; but the heated cells cannot assimilate this excess, since they have lost, at least in part, the capacity for taking up and turning material to their own use. A nitrogenous equilibrium cannot be attained in patients with high fever, even if they were in a condition

* Bauer, "Dietary of the Sick."

to absorb large quantities of albumen. The possibility of compensating the loss of albumen by nourishment will be greater if the fever shows more or less marked remissions or intermissions, because, as it seems to me, the cellular elements recover during the intervals of remission the power of adding to their substance and of metabolising the excess of nutrient material."

There are two principal rules which we should always keep in view in feeding patients with febrile diseases :—

First, to endeavour to utilise food to the greatest extent that is safe and possible for the purpose of checking the waste of tissue which is associated with the febrile process.

Secondly, to be careful to administer no food that cannot be readily absorbed and assimilated ; for if we overlook the fact that the functions of the digestive organs are gravely impaired during fever, and if, in consequence, we give food that the patient is unable to assimilate, this undigested food will decompose in the stomach and intestinal canal, and cause irritation of the gastro-intestinal mucous membrane and augment the febrile movement.

It is clear, then, that there is need for great discrimination in dealing with individual patients. In cases where the febrile process is not severe, or where there are distinct remissions or intermissions, and where the disturbance of the digestive organs is not considerable, we may give food with much more freedom, and of greater variety, and in larger quantity than in cases of high and continued fever, with entire loss of appetite, and obviously great disturbance of the functions of digestion and assimilation.

Bauer especially insists that we should utilise periods of remission in febrile diseases, when they occur, for the more liberal administration of food, as the digestive powers are more active during these periods.

There is one other preliminary consideration we must also bear in mind, viz. that there is in some cases a tendency to accumulation in the body of the products resulting from the destruction of the tissues; and, as these act as poisons in the blood, we must be careful to administer such food as shall favour their elimination, and not lead to any increased accumulation in the body of nitrogenous waste.

Having thus passed in review the more important principles which should determine the alimentation of patients affected with acute febrile maladies, we may now pass on to the consideration of the best means of practically applying them.

If the febrile attack is an acute and short one—as is seen, for example, in a typical case of croupous pneumonia of moderate severity and with early crisis—there is no need for any anxiety as to the consumption of much food, unless old age or previous debility affords a special indication for actively supporting the bodily strength. By forcing the consumption of a considerable quantity of food in such cases, in the absence of all appetite and with obvious febrile disturbance of the digestive organs, more harm than good will be done.

All authorities are agreed that the food of fever patients should be in the *fluid* form,* such as can be

* Sir William Roberts observes:—"In forming a plan of dietary for the sick, distinction must be made between gastric and intestinal digestion. In healthy persons and invalids of the slighter sort, we must have regard mainly to gastric digestion; but in the seriously sick the stomach becomes often inoperative, and digestion becomes almost exclusively intestinal. The sympathy of the stomach with the general condition of the system is much more active and close than that of the intestine; the former organ approximates more nearly to the animal life of the body, the latter more nearly to the vegetative life. The seriously sick,

readily and immediately absorbed; that it should be given in small quantities and at short intervals.

Milk is the food that first suggests itself to our minds as most suitable for fever patients. It is a *complete* food, *i.e.* it contains all the elements needed for the nutrition of the body: albuminates, fats, carbo-hydrates, and salines; it is *fluid*, and it is relatively cheap, and always readily procurable.

There is, however, one great drawback to the use of this food which must never be overlooked. It is quite true that it is a fluid, out of the body; but it is apt to coagulate to a *firm solid* within the alimentary canal, and this solid curd may pass undigested through the whole length of the intestine, and set up much irritation and injury in its course, especially in cases of typhoid, where there always exists inflammation and ulceration of the mucous membrane of the intestine. Patients with acute disease fed mechanically and carelessly on milk will often be found to evacuate from the bowel masses of undigested curd!

You will find also, both in sickness and in health, that some persons digest milk with difficulty, while others digest it very readily.

The great convenience of milk as a food is in itself a snare, and tends to induce nurses and attendants to think no evil of that which is so handy and gives so little trouble. We should, therefore, always

and especially the febrile sick, are often quite unable to take solid food. When the appetite and power of taking food fails, it fails first with regard to meat, which is, so to speak, the speciality of the stomach, and next in regard to bread. Patients are then reduced to the use of liquid food: milk, beaten-up eggs, gruels, jellies, beef-tea, and the like. In this latter condition the stomach loses its normal office, and becomes merely a conduit to pass on the liquid food to the duodenum. Not, perhaps, that there is, except in extreme cases, an absolute abeyance of gastric secretion and gastric action, but they are reduced to so low an ebb that they count for practically nothing in the work of digestion."—"Dietetics and Dyspepsia," p. 57.

be on the watch for any signs of indigestion of milk in cases of acute disease; and in these cases milk should always be given with certain precautions. It should be previously boiled. It should be given *diluted*—either with water or, better still, with an effervescent alkaline water: equal parts of milk and Vichy or Vals water, or one part of milk to two of Apollinaris or soda-water; or ten grains of bicarbonate of soda and the same quantity of common salt may be added to every pint of milk and water (equal parts). Milk thus diluted and mixed with alkali can often be absorbed when pure undiluted milk would be undigested. As a fever patient necessarily requires, as we shall presently see, much water as a beverage, we need have no hesitation in freely diluting his milk. The diluted milk should be given frequently in small quantities at a time. Two ounces of milk with two ounces of alkaline water every hour would give the patient two pints and a half of milk a day, and a fever patient requires a drink every hour. This quantity, of course, may be increased and the intervals lengthened in many cases. We are now speaking of cases in which the digestion of milk is difficult.

In instances where milk even thus diluted appears to disagree, it may be well to give an equivalent quantity of *whey*. This is milk from which the curd and much of the fat have been separated by previous coagulation and straining. It can readily be made by boiling a pint of milk with a teaspoonful or two of lemon juice, and then straining through muslin and expressing all the fluid from the curd.*

This may be made more nutritious, if necessary,

* If the curd be well broken up after coagulation and all the fluid thoroughly pressed out of it, much of the fat and some of the finely-divided casein of the milk will pass into the whey, and thereby much increase its nutritive properties.

by adding strong beef-tea or meat-juice to it, or by the addition of the yolk of an egg previously whipped up with a little hot water.

Bauer * recommends, in "cases in which cow's milk cannot be tolerated even in small doses and diluted," that it should be replaced by "Nestlé's Infants' Food and similar preparations, or Liebig's Food for Children."

Eggs form another complete food admissible in most febrile maladies. These should not be cooked, but beaten up with *hot* (boiling) water, strained, and added to a little light broth or clear soup (*consommé*). This forms a very nutritious food.

Or the yolk of an egg may be beaten up with a little hot milk and water; or with a little hot, weak tea, sweetened with grape-sugar; or eggs may be given in the form of the brandy mixture of the British Pharmacopœia. (This is ordered to be made by rubbing together the yolks of two eggs and half an ounce of refined sugar, and adding four ounces of Cognac and four ounces of cinnamon water. A more generally useful mixture may be made with half this quantity of brandy.)

Lightly-boiled eggs, or eggs beaten up in hot broth, have been given in typhoid by some German physicians, and with apparent advantage.

Most important and largely administered foods in febrile diseases are the various meat infusions, juices, extracts, etc., such as beef-tea, solutions of beef, meat extracts, mutton, veal, and chicken broths, clear soups (*consommés*), strong and weak, and variously flavoured with *vegetable* juices.

The value and usefulness of these foods have been almost universally admitted. As we have seen the contrary stated, especially with regard to beef-tea,†

* "Dietary of the Sick."

† *British Medical Journal*, Jan., 1889, p. 184.

it may be as well to quote a few authoritative opinions.

Germain Sée, who has been quoted in the paper referred to as if he were an opponent of beef-tea, mentions the following as "*one of the best fluid foods:*" *—Meat cut into small pieces, cold water added, and then gradually heated to 140° or 160° Fahr. He does not mention what relative quantity of water, but whether much or little it is essentially the same as beef-tea. He points out also that it contains important salts—important as mineral foods—especially chlorides and sulphates, combined with potassium.

Subsequently he speaks of beef-tea as made by placing fragments of beef in a hermetically sealed vessel, and exposing it for several hours to a water-bath; this is a means, as he points out, of extracting all the *gelatin* of the meat. "It is true," he goes on to say, "gelatin by itself has not the same nutritive value as the albuminates, and in any case it is necessary to prescribe it in considerable quantities to attain the same end. *We may do so with impunity, for jellies are well tolerated and easily digested.* But in reality these are only auxiliary means of *conservation of our organic tissues—des moyens d'épargne*" [a *means of saving the tissues*—what could be more important in diseases in which the tissues are being destroyed?]. "*From this point of view gelatin* cannot *be too strongly recommended*, prepared in the most various forms, and with a variety of flavours."

Again, in the same paper, G. Sée is quoted as depreciating beef-tea to the advantage of milk. This is what Prof. Sée says of milk in fevers:—"As soon as the functions of the stomach are disturbed *milk digests badly*, it forms clots in the stomach accessible with difficulty to the gastric juice, and often leaves that organ unpeptonised. . . . . Although we may then

* "Du Régime Alimentaire: Régime des Fiévreux," p. 385.

attempt to give it mixed with water, or Vichy water, or aërated water, or even with some alcohol, or cold, or hot, or boiled, or raw, the *patient ends by refusing it, and the physician by forbidding it!*" *

We fear the author of the paper in question can only have consulted Prof. Sée's works with the desire to find therein opinions conformable to his own.

Bauer † also expresses his approval of beef-tea and strong gelatinous soups as food for fever cases. "By the addition of gelatin in proper proportion the nutritive value of the soup is greatly increased, without the risk of imposing any further burden on the digestive organs. Instead of clear broth we may use beef-tea, which always contains a certain amount of albuminous matter" (p. 228). "That broth and meat extract contain but very small amounts of actual nutriment in no way lessens their value in the dietary of the sick" (p. 84).

Dujardin-Beaumetz maintains that the most suitable diet for febrile maladies is one that contains only a very small quantity of albuminous matter, and that it is the possession of *saline* and tonic principles, dissolved in a large amount of water, which constitutes the chief recommendation not only of broths and beef-tea, but also of milk. "For my part," he says, "I consider the value of milk in febrile maladies is due to the water and the saline substances it contains." ‡ And again, "The milk and broth (*bouillon*) we give to typhoid patients enable us to administer a great quantity of water, and also a notable quantity of saline matters;" and he refers to the observations of Robin to the effect that in typhoid cases there is a true "*mineral inanition* resulting from the daily

* "Du Régime Alimentaire: Régime des Fiévreux," p. 384.

† "Dietary of the Sick." Von Ziemssen's "Handbook of General Therapeutics."

‡ "Du Régime Alimentaire dans les Maladies Fébriles," p. 225.

losses of potash, sulphuric acid, phosphoric acid, and chloride of sodium, which pass away in the urine to the amount of 3 or 4 grammes of chloride of sodium, 1·50 to 2 grammes of phosphoric acid, and 2·967 of sulphuric acid, and 1·730 of potash," and he compares this with the following analysis of "bouillon":—

Water	985·600
Organic solids left after desiccation in vacuo at 20°	16·917
Soluble Salts, Chlorides, Phosphates, and Sulphates of Potassium and Sodium .	10·720
Salts very slightly soluble—Phosphates of Lime and Magnesia	0·539
	1013·776

Practical experience seems to show that albuminous and gelatinous fluids, when they are not disagreeable to the fever patient—and it is an important matter to consult the inclinations and disinclinations of the sick—tend to support the bodily strength, and lessen the risk of exhaustion; and we may, therefore, recommend in such cases either well-made clear soups and broths, or the stronger beef-essences and beef-tea.

It has probably been an error to give these preparations of beef in too concentrated a form, in which they often prove repugnant to the sick; and seeing how needful it is to give considerable quantities of water to fever patients, there can be no good reason why some of the water should not be taken mixed with the other constituents of soups. Too little attention has also been given to the flavouring of the food of febrile patients. In the preparation of light clear soups it is easy, and indeed beneficial, to add some flavouring of aromatic herbs; and Sir W. Jenner long ago directed attention to the error that is committed in omitting to add to such soups some vegetable juices. It is quite practicable to give clear soups which shall contain a considerable quantity of the expressed juice of fresh vegetables. By cooking such vegetables as carrot, turnip, celery, parsnip, endive, lettuce, etc., together, with some aromatic herbs, such as parsley, mint, thyme, or tarragon, etc., cutting them fine, and placing them in a muslin bag, then boiling and expressing the juice into the soup—by doing this the soup or broth can be largely mixed with the juices of fresh vegetables, an important and wholesome article of diet.

The object of such a nitrogenous diet has been misapprehended by some of those who have argued against it; it has been said that it is useless to expect in acute fevers that albuminous foods can be utilised for the purpose of *tissue formation;* they are not given with that object, they are given to check tissue-waste—to *spare* the tissues or, to use the excellent French expression, as *moyens d'épargne*—and that they do act in that way practical observation has abundantly testified.

G. Sée recommends that in prolonged cases of typhoid we should add to the meat-soups some *pulp of meat,* made by taking raw meat, depriving it of all its fat and fibrous structures, *scraping it fine,* and pressing the pulp through a coarse sieve; from one-half to three-quarters of an ounce of this should be given at a time, mixed with a cup of broth or clear soup.

Cold meat jellies and calf's-foot jellies, when approved of by the patient, may be given in moderate quantities.

Farinaceous foods containing carbo-hydrates—starch, sugar, etc.—can be suitably administered in various fluid forms. Thin oatmeal or barley gruel, carefully strained from all gritty particles, and flavoured with salt or grape-sugar and any agreeable spice or aromatic—as lemon-peel, cloves, nutmeg, etc.—is perhaps one of the best, and is readily made fresh as required. It can also be mixed with milk, meat-essence, or beef-tea, and so forms a useful composite food.

Or a small quantity of arrowroot, ground-rice, or well-baked flour can be added to clear soup or to beef-tea. Great care must, however, be taken that these are not made thick, but kept quite fluid. Such food is easy of digestion when given in small quantities at a time, and, by supplying a certain amount of "fuel food," tends further to spare the tissue-waste.

Grape-sugar, which is the substance that results from the digestion of carbo-hydrates, forming, in short, a kind of predigested carbo-hydrate, has been strongly recommended by G. Sée and other writers on dietetics as a useful food in fevers, and it may, therefore, be added with advantage to farinaceous foods, and used also to sweeten beverages.

Barley- and *rice*-water are given more as beverages; but they also, especially if sweetened with grape-sugar, afford a certain small amount of carbo-hydrates.

Tea and coffee given with milk and grape-sugar, serving both as food and beverage, are approved of by Bauer and Sée, and no doubt may be usefully given, from time to time, to vary the repulsive monotony of the fever diet.

Bauer also commends chocolate, "fine, and as free as possible from spices, or cacao deprived of its fat and boiled with milk" as "well borne by most sick persons."

"Fruit-soups" are commended by Bauer as "agreeable and useful;" they are "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 pressing and straining. They are agreeable to some as beverages, and they contain a minute amount of albuminates, somewhat more carbo-hydrates, and some organic acids.

The diet suitable to fever cases is thus summed up by G. Sée :—A *mixed* diet composed of a small quantity of albuminates, and a larger proportion of non-nitrogenous food; broths, especially concentrated, gelatinous veal broths, or beef-tea (*bouillon de bœuf*) with jelly added to it; clear soups with yolk of egg; scraped meat, lightly grilled and mixed with broth; at times, milk well diluted; and frequently, during the less acute stages of the fever, farinaceous soups.*

The unpleasant taste and smell of *peptonised* foods are opposed to their general adoption, unless for the purpose of rectal alimentation.

We now come to the question of beverages in acute febrile diseases.

In the first place a fever patient should be allowed to drink freely of water or of some beverage consisting almost wholly of water: much water is needed not only to replace the loss of water from the heated body, constantly passing away by the cutaneous and pulmonary surfaces, but also to provide a necessary solvent medium to dissolve and carry away the waste products of the increased metabolism of the tissues. Such patients, even if they do not ask for drink, should be frequently offered it, either pure spring water, or effervescing water, or rice- or barley-water. When the temperature is high, *iced* water should be often given. Lemonade is highly commended by Dujardin-Beaumetz, who calls attention to the testimony of Maglieri to the decidedly febrifuge properties of lemon-decoction.

Wine, wine and water, even beer, and the use of alcohol in various forms are, more or less, commended in the dietetic treatment of acute diseases by most experienced physicians; our own opinion, however, is that alcohol is not absolutely needed in the *majority* of cases of acute diseases, viz. those cases that run an even, average course, without urgent or alarming

* "Du Régime Alimentaire: Régime des Fiévreux," p. 388.

symptoms. We do not consider that alcohol should be given, *as a matter of routine*, in all acute diseases, and in all stages of the disease ; we prefer to hold it in reserve for the graver cases, or for the terminal stages of the average cases when the exhausting effects of the febrile process become especially evident.

The use of alcohol is especially indicated in the *adynamic* forms of acute disease, in old age and also in infancy, as has been pointed out by Dujardin-Beaumetz. Those also who have been addicted to the habitual use of alcoholic drinks have more need of such stimulants when they are attacked with acute disease than those who have not been accustomed to their use.

But when young and robust persons of temperate habits become the subjects of acute febrile disease, they often do best with *no*, or with very little, alcohol, at any rate in the early stages of the malady. Dujardin-Beaumetz, who has carefully studied the question of the physiological action of alcohol, gives the following concise and judicious summary of the various opinions that have been held as to its mode of action in acute disease, together with his own conclusions :—"Some," he says, "see in alcohol a force-giving medicine which acts in febrile disease by sustaining and augmenting the strength of the patient ; others regard alcohol as an antipyretic which lowers temperature and prevents hyperpyrexia ; others maintain that alcohol hinders organic disintegration, while at the same time it augments the amount of oxygen inspired ; while others assert that it acts simply as a food."* All these opinions he considered true in their *ensemble ;* that alcohol acts, at the same time, as a food, as a tonic, and as an antipyretic, and it is this threefold action which accounts for its favourable effects in the treatment of acute febrile maladies. He

* "Du Régime Alimentaire dans les Maladies Fébriles," p. 227.

maintains that "alcohol is a food and undergoes in the organism more or less complete combustion: a combustion, however, which takes place at the expense of the oxygen of the blood, and in that way it diminishes the pyrexial phenomena and lowers the temperature; it is *un aliment d'épargne*" (*i.e.* it spares or saves the combustion of the tissues by offering *itself* for combustion in their stead). "It acts also on the nervous centres and affords them strength and tonicity, and is, therefore, a force-giver."

In England, when we prescribe alcohol in acute diseases, we are accustomed to give it either in the form of a strong spirit such as brandy or whisky diluted with water, or in the form of port wine or, occasionally, in the form of champagne. In Continental countries the lighter wines are far more commonly employed. "In the General Hospital at Munich 150 to 300 grammes [about 5 to 10 ounces] of a light red wine are generally given to a patient with severe fever, or, if preferred, the like quantity of light wine," * and in the hospitals of France the ordinary red wines of Bordeaux and Burgundy are used. Bauer recommends that the strongly alcoholic wines and concentrated spirits should only be employed when it seems necessary "to stimulate the heart to energetic action and to obviate a tendency to asthenia," and he points out that "restlessness and irritability, followed by a degree of stupor," have often been observed to follow too large doses of strong alcoholic drinks, and he calls attention to the fact, which should certainly not be overlooked, that the continued use of alcohol, in a concentrated form, injures the activity of the organs of digestion. With the partiality of a German for beer, he considers it preferable in some cases to wine: "it is not," he says, "merely a stimulant, but also contains a certain amount of nourishment," and is much less

* Bauer, "Dietary of the Sick," p. 232.

costly than wine. In many cases in which there is no marked disturbance of digestion it may, he thinks, "be allowed without hesitation."

It must be borne in mind that the light German beers are much more suitable for this purpose than the beers we are accustomed to in England.

Our own experience has led us to regard brandy or whisky, well diluted, as the best form of alcohol to give during the acute febrile stage, and that port wine or champagne is more useful during the period of convalescence; or, if the patient prefers a good claret or Burgundy at this time, there is no objection to his having an equivalent quantity of these wines.

During *convalescence* from acute febrile maladies great care is still needed in the supervision of the diet. This is especially the case in convalescence from typhoid fever, when great firmness is often needed in resisting the patient's urgent entreaties for a more liberal and varied diet. The appetite is often voracious, and the craving for food, after the prolonged period of inanition he has passed through, is almost irresistible. But it must always be remembered that the digestive powers are still very limited and that any solid food that escapes digestion in the stomach may act as an irritant in passing along the intestines, still the seat of slowly-healing ulcerative and inflammatory processes.

It has been, again and again, observed that the smallest indulgence in solid food during the first few days of convalescence from typhoid is frequently followed by a rise of temperature and sometimes by a serious relapse.

It is needful, therefore, that for the first week or ten days of convalescence a fluid dietary should still be maintained: a little well-soaked bread-crumb, rubbed through a fine sieve, may be added to clear soups or beef-tea, or these may be slightly thickened with ground rice or well-baked flour. The digestion of the patient must, however, be carefully watched for any symptoms of dyspepsia. More consistent farinaceous foods—rice, milk, sago, tapioca, arrowroot—may next be given in small quantities at a time, and small quantities of powdered meat may be mixed with clear soup or light broth. Custard puddings with fruit jelly are nutritious, and generally prove an agreeable change. Pounded *raw* meat is largely given by French physicians in convalescence from acute maladies, and is regarded by many as a most valuable restorative food. It is said by Fick to be three times as rapidly digested as cooked meat.

Robin, in his well-known work on the treatment of the complications and the convalescence of typhoid fever, gives the following *régime*, which English physicians will certainly regard as erring on the side of liberality :—"As soon as the morning and evening temperature have fallen below 100° F., give twice a day a soup with tapioca or semolina, or some panada. At the end of two days, if the urine is free from albumen and excess of urea, add an egg to the soup, and give a little meat jelly, but *no* bread. The fourth day increase the quantity of jelly or give some meat juice (essence of meat) and in addition three to six small oysters and a few well-cooked prunes (!) at dessert. The fifth day order some light fish, such as whiting and the pulp of a cooked apple. From the sixth to the eighth day you may permit a cutlet." Bordeaux or Burgundy is to be taken at meals, mixed with effervescing water, and milk may be drunk between meals.

CHAPTER II.

THE DIETETIC TREATMENT OF DISEASES OF THE DIGESTIVE ORGANS — ACUTE AND CHRONIC GASTRIC CATARRH—GASTRIC ULCER—CANCER OF STOMACH —DILATATION OF THE STOMACH—DYSPEPSIA— CONSTIPATION—DIARRHŒA.

Diseases or disorders of those organs which are actually concerned in the digestion and assimilation of food must necessarily and especially be greatly under the influence of appropriate dietetic treatment. The subject, however, of the dietetic treatment of diseases of the organs of digestion is a complicated and difficult one, as it involves some obscure and disputed points in connection with the physiology of digestion, and as it is associated with many controversial questions in which the general public take a prominent interest.

It will be our object here to avoid, so far as possible, the introduction of matters which are especially open to dispute, and to strive to make our teaching as simple and practical as possible, and in harmony with the ripe experience of competent, careful, and unbiassed observers.

It is most important also to keep in view the fact that we are now dealing with questions which are remarkably subject to individual peculiarities, and that the widest divergences of opinion may often be found to rest on the apparently indisputable basis of personal experience. So that after framing general dietetic rules, we must be prepared to exercise much discrimination in their mode of application; for food that is readily digested by one person will often prove hurtful to another; and even in the same person food which is found beneficial at one time will at another time cause acute digestive derangement.

Those instances of retarded or disturbed digestion which obviously arise from indulgence in an excessive quantity of food generally, or from excess in the consumption of some particular food, or food-accessory, suggest the equally obvious remedy of moderation or abstinence; while faulty habits of feeding, such as hasty and incomplete mastication and insalivation, or insufficient rest from other occupation before, during and after meals indicate their own remedy.

It will only be necessary, in the case of reasonable persons, to point out to them that the function upon the due and healthful performance of which the perfection of all the other physical and mental activities depends, deserves and should receive a proper amount of time and attention.

It has often been urged on those busy and energetic persons who appear to grudge every moment taken from their intellectual or mechanical labours, that when the stomach is called into activity by the presence of food, an increased supply of blood is needed by that organ to meet the increased demands on its functions, and in order to secure and maintain that needed supply the blood should not at that period be diverted strongly to other organs, which will be the case if they are then called into activity.

Another difficulty encountered in the consideration of this subject is one of classification. The word "dyspepsia" or "indigestion," so commonly applied to stomach disorders, is one of somewhat vague and indeterminate meaning, and is undoubtedly often employed to designate morbid conditions which differ considerably in their nature and origin—from states of slight temporary gastric disturbance, to those grave disorders which are connected with the existence of chronic structural disease.

Many dyspeptic states are, however, associated with quite definite morbid conditions of the stomach, and it will conduce to clearness of exposition if we treat of these first of all, and reserve the less well-defined forms of dyspepsia for subsequent examination.

Acute gastritis or *acute gastric catarrh* and *chronic gastritis*, or *chronic gastric catarrh*, are more or less well-defined maladies; so are cases of *ulcer* of the stomach and *cancer* of the stomach. We propose, therefore, to consider the dietetic treatment of these affections first, and afterwards to pass on to the consideration of those dyspeptic states which may be referred either to irritation of the sensory nerves of the mucous membrane or to some defect in the secretion of the digestive juices or to some impairment or alteration of the muscular movements of the alimentary canal or to other less obvious causes.

Acute gastric catarrh is a common disease, and is caused usually by the action of improper and irritating food on the gastric mucous membrane. Any local irritant may, of course, excite inflammation of this membrane if brought in contact with it, and acute gastric catarrh is an almost invariable accompaniment of irritant poisoning; but the common and familiar forms of this disease are most frequently the result of improper feeding. Some persons are, however, much more predisposed to suffer from this disease, from comparatively slight causes, than others.

It has been pointed out that too scanty a secretion of gastric juice, by retarding digestion and favouring abnormal decomposition of food within the stomach, predisposes to this malady, and hence it is necessary in febrile states when, owing to the high temperature, there is much loss of fluid from the skin and lungs, and therefore diminished secretion of gastric juice, to diminish, accordingly, the quantity of food. The common custom of urging such patients to take more nourishment than they wish is often injurious, unwise, and unphysiological.

Anæmic and feeble persons generally, and convalescents from acute disease, are also liable to attacks of acute gastric catarrh from taking more food than the small amount, or the altered and less active character, of their gastric juice is capable of dealing with, so that some of the undissolved ingesta decompose and set up irritation of the gastric mucous membrane.

It is indeed most important to bear in mind, that the over-anxiety manifested by the friends of such patients, that they should take large quantities of food, in order to quickly recover their strength, has often the opposite effect to the one desired.

Overloading the stomach with food, even in healthy persons, is a common cause of acute gastric catarrh, owing to the abnormal decompositions which the excess of ingesta undergoes. This is a frequent cause of gastric catarrh in young children, and especially in children at the breast who are allowed, for the sake of quiet, to suck until they overload their stomachs.

Imperfect mastication also may give rise to gastric catarrh, as the food then reaches the stomach in a comparatively undivided state, so that the gastric juice comes into very imperfect contact with it, and hence portions remain undissolved and undergo decomposition. Rich and fat sauces, and too much fat eaten with meat, may lead to the same result, by covering or soaking the meat with an oily fluid which prevents the gastric juice from thoroughly penetrating it.

Food eaten when it is already in a state of decomposition may similarly give rise to gastric catarrh; and this is especially noticeable in delicate and sensitive persons.

Game or fish kept too long, entrées made with meats that are not perfectly fresh, new beer and sour wine, and in young children milk that is not quite fresh, are fruitful sources of gastric catarrh.

Too free use of spices and stimulating condiments, but especially the habit of taking alcohol in a concentrated form, lead to the same result.

In *severe* cases of acute gastric catarrh, the indication with respect to food is to so limit it in quantity and quality that the acutely inflamed mucous membrane shall be spared all irritation or excitement from ingesta, and the whole organ be, so far as is possible, put in a condition of physiological rest. Entire abstinence from food, at least from food by the mouth, may often be enforced with advantage for a day or two, or so long as the taking of food excites nausea, or vomiting, or severe pain. This abstinence is usually well borne, except in cases where the strength has been exhausted by previous suffering, and long inability to digest a sufficient quantity of food; in such cases nutrient enemata may for a time be given, so as to secure the rest needed by the hyperæmic and irritated gastric mucous membrane; while small quantities of iced water may, from time to time, be taken into the stomach.

When, however, there is a great craving as well as a real need for food, fluid nourishment only must be carefully administered. In the selection of such fluid foods it must be remembered that the gastric secretion is alkaline, from admixture with mucus; that its digestive power is, therefore, greatly impaired, and that there is a great tendency to abnormal decomposition of food in the stomach. Milk, if given undiluted, or eggs, or any food requiring acid gastric juice for digestion, may be found to disagree. In such cases we should dilute the milk with an equal quantity of soda- or lime-water, and in some instances admixture with the alkaline Vichy water is preferable, as it seems to check the tendency to curdling of the milk, and the formation of an irritating coagulum in the stomach. In some instances, where there is an obvious inability to digest the casein of milk, *whey*, freshly prepared, should be substituted for milk, and its nutritive qualities may be increased either by the addition of a little beef-essence, or by shaking up the yolk of an egg with a little hot water and adding this in suitable proportion to the whey.

It is most important that all food used in these cases should be quite fresh and freshly prepared.

The *beef-essence* just referred to may be best prepared by cutting the lean of beef into small pieces and placing them in a wide-mouthed bottle, securely corked, and then allowing 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.

When we restrict patients to liquid food, it is best to give it in small quantities at short intervals, and, when there is much thirst, it is better to allow small pieces of ice to be sucked than to permit large draughts of cold water.

In many of the less severe cases, while still adhering to a fluid dietary, we may provide the patient with a certain variety of food. When milk is well borne, either pure or diluted, raw or boiled, it forms the most convenient and nourishing basis of our dietary; but we may also prescribe carefully prepared beef-tea, chicken- or mutton-broth, or *consommé*, containing the expressed juice of vegetables boiled in it, and we may thicken these fluid foods with a small quantity of arrowroot, ground rice, or cornflour.

In cases accompanied with diarrhœa, thickening the food with arrowroot will frequently be found very useful. When, owing to great physical depression, some stimulant is needed, small quantities of good brandy are the best to be given. It may be added to beef-tea, arrowroot, or milk, or given well diluted with soda-water. All wines are best avoided; occasionally, however, a little champagne mixed with soda-water agrees well with some patients; in other cases a little weak tea acts as a useful and refreshing stimulant.

Some of the artificially digested peptonised foods answer well in certain cases, and we have known peptonised milk* be retained and digested when the smallest quantity of unprepared milk would at once excite vomiting.

Upon the disappearance of nausea, vomiting, and pain after food, and with the return of appetite and digestive power, a small quantity of solid food may be cautiously added to the diet, which should, however, still consist mainly of fluid food, and the return to the ordinary diet should be very gradual, and carefully watched. It is best at first to add a little pounded beef or chicken to thin broths or clear soups, or to beat up the yolk of an egg with milk, or to add the yolk of an egg to a cup of warm *consommé*. Fragments of stale bread or toast may be soaked in hot milk, or may be added to broth or beef-tea; but above all we should be careful to discard at once any article of food which is observed to re-excite any uneasiness.

On recovery, care should be had to avoid any of the exciting causes of gastric catarrh which we have mentioned, and only the lighter and more readily digested meats should be taken, and those sparingly, and at sufficiently long intervals to allow of their complete digestion. Boiled chicken, or pheasant, the lean of boiled neck of mutton, well selected, the under-cut of the sirloin of beef, free from fat, boiled or soused sole, or whiting, or flounders; or, if grilled, they

* That prepared by Savory and Moore.

should be taken without butter or sauce, simply with a little salt and pepper or lemon juice.

Chronic gastric catarrh is sometimes a sequel of the acute affection, and it may be caused by the same dietetic errors which we have already referred to as favouring the development of the acute disease. But, probably, the most frequent cause of chronic gastric catarrh is the abuse of alcoholic beverages, and especially the habit of drinking ardent or but slightly diluted spirits. Chronic gastric catarrh is also an almost inevitable accompaniment of any disease which leads to portal obstruction and consequent congestion of the gastric mucous membrane; it is, therefore, common to find gastric catarrh existing as a complication of hepatic disease, and of those diseases of the heart and lungs which cause obstruction in the vena cava, and so hinder the outflow of blood from the liver and stomach.

It often accompanies pulmonary consumption, and it is always present in chronic organic disease of the stomach itself. It is important to bear in mind that in chronic gastric catarrh the mucous membrane of the stomach is commonly covered with a layer of greyish white, tough, strongly adherent mucus.

The chief symptoms of this disease are those which are usually described as symptoms of *indigestion* or *dyspepsia*—viz. fulness, uneasiness, and flatulent distension of the stomach after taking food. Gases are formed by abnormal fermentation and decomposition of the food, which is unduly delayed in the stomach, and these distend that organ, and are often eructated into the mouth together with fragments of undigested food and rancid sour fluids. Lactic and butyric acids are generated, chiefly from morbid transformation of starchy foods, and these acrid and sour fluids, when eructated, give rise to the uncomfortable hot feeling described as *heartburn.* In alcoholic cases there is often, especially in the morning, vomiting of stringy tenacious mucus, or of a quantity of insipid fluid, or of a fluid which is sometimes described as "oily." This symptom is sometimes spoken of as "water-brash." Much of this vomited fluid is considered to be composed of saliva swallowed during the night. The appetite is usually greatly diminished, or wholly lost; but sometimes there is an eagerness for food which, however, is very soon satisfied. Constipation is a common accompaniment of this malady, and so is a condition of mental depression.

The dietetic treatment of these cases should be strict and systematic. In some instances, and especially in those which follow an acute attack, an exclusively milk diet often answers well, and will, within a moderate period, effect a cure. But it is always necessary to have regard to individual peculiarities in the digestion of milk, and not to insist upon this diet in persons who obviously suffer discomfort after taking it. Before giving it up, however, it may be advisable to endeavour to promote its digestion and assimilation by various means. The milk may be skimmed and much of its fat removed, if that should be the difficulty; or it may be boiled or diluted with hot water; or, what often proves of great service in promoting its digestion, is the addition to it of some alkaline water, or one of the alkaline carbonates:—one-third of Vichy water and two-thirds milk is a good mixture; or a powder consisting of 10 grains of bicarbonate of soda, 5 grains of light magnesia, and 10 grains of common salt, added to every tumblerful of milk, or, better, of two-thirds milk and one-third hot water, will often secure its easy digestion. The object, of course, is not to allow a compact coagulum of casein to be formed in the stomach. Peptonised milk, as we have already mentioned, often agrees well. In difficult chronic cases only small quantities should be taken at a time, and it should be drunk slowly; about six ounces every three hours. In the gastric catarrh of alcoholism, when accompanied with great thirst, we have seen excellent results, in some persons, from a mixture of equal parts of milk and Apollinaris water, and this has been taken in considerable quantity without the least difficulty, provided the tendency to constipation, which commonly accompanies a milk diet, be corrected by a dose of Carlsbad salts every morning fasting. Such a dose has the advantage of unloading the often engorged portal vessels, and so tends to lessen the gastric hyperæmia. Many German physicians have found *butter-milk* suit some patients better than fresh milk, and we have ourselves observed the same in certain instances of chronic gastric catarrh.

Niemeyer quotes with approval the prescription: "When the patient is hungry, let him eat butter-milk; when he is thirsty, let him drink butter-milk"; and he suggests, as an explanation of the brilliant results that sometimes follow its adoption, that fresh milk is perhaps "not so well borne, because it readily curdles in the stomach, and forms large, firm lumps, while in the butter-milk the casein is already curdled, but finely divided."

The tendency to restrict patients who suffer from gastric catarrh to farinaceous foods is often a great error, for, in numerous instances, such foods lead to the formation of much lactic and butyric acids in the stomach, and help to aggravate the evil they are intended to mitigate. When, therefore, we prescribe farinaceous foods, we should carefully watch for any sign of acid fermentation, and, in that case, change to other food. In cases where they do not disagree they are valuable in moderate quantity, and light puddings made with arrowroot, sago, vermicelli, or ground rice;

or clear meat soups, slightly thickened with either of these, are useful articles of diet in such cases.

There is often a difficulty in digesting certain kinds of bread in persons with gastric catarrh, and it is not always easy to say why; but it will be found that bread obtained from the best bakers—bakers who are well known for the good quality of their bread, and who take pains in its manufacture—will often be readily digested, whereas bread obtained indiscriminately will disagree.

Some kinds of whole meal bread, and of brown bread, now so much in vogue, we have found produce gastric irritation and acid fermentation, in certain cases, when the finest and lightest and best-made wheaten bread has, in small quantity, agreed perfectly.

Thin dry toast will also often agree well when ordinary bread will not.

All fat meat and sauces must be avoided, all meat must be well masticated or mechanically reduced to pulp and taken in small quantities at a time. The digestion of animal food is certainly facilitated by being accompanied by a dose of Glycerin of Pepsin or of the Liquor Pepticus of Benger.

When solid animal food is not well borne, concentrated meat-soups containing a little of the crumb of stale bread may take its place with advantage. In some persons, very prone to the formation of acid, the lean of cold roast meat or fowl finely divided and taken with a very little white bread will sometimes suit better than any other food.

It has been noticed by many, and especially by Niemeyer, that some dyspeptics can digest salt and smoked meats better than fresh ones; and the explanation of this is that these preserved meats are less readily decomposed, and do not give rise to acid fermentation in the stomach. Niemeyer mentions that one of his patients who suffered from chronic gastric catarrh, with great tendency to acidity, knew exactly when he must abandon all other food and limit himself to the use of lean and smoked ham, sea-biscuit, and a little Hungarian wine.

Light-boiled eggs are a useful food in these cases. It is best, however, that they should not be quite raised to the boiling-point. They should be put in water that is just boiling, then removed from the fire, but allowed to stand near it so as to maintain the temperature of the water near the boiling-point, for three to five minutes. Cooked in this way the albumen will remain semi-fluid, though opaque.

One of the most important points, however, is to make the diet as spare as possible, so as to reduce the labour of stomach digestion to the minimum compatible with the adequate nutrition of the body. And as the process of digestion is slow in these cases, ample time should be allowed for the complete digestion of each meal. It is advisable also that the food, whether animal or vegetable, should be small in bulk, and this can be secured by carefully selecting the best portions of the lean of meat, chicken, game or fish, and, if necessary, causing them to be finely divided. A certain amount of sound ripe fruit and *purées* of fresh vegetables are useful to counteract the tendency to constipation.

As we have already pointed out, the gastric mucous membrane is, in these cases, covered with a coating of adherent ropy mucus, and it is on this account that a glass of warm alkaline water, like that of Vichy, taken half an hour before a meal, promotes its digestion, by loosening and washing away this tenacious layer of mucus, clogging, as it does, the orifices of the gastric glands. We may mention here that a course of the warm alkaline and sulphate of soda waters of Carlsbad, together with the strict diet there enforced, effects some brilliant cures in obstinate cases of chronic gastric catarrh. The employment of an *exclusively milk diet* in the chronic gastric catarrh induced by abuse of alcohol is strongly advocated by Dujardin-Beaumetz, who also insists on the value of the addition to the milk of some alkaline water or bicarbonate of soda.*

The rules that should direct the dietetic treatment of cases of **ulcer of the stomach** are few and simple.

In the first place, we must avoid all food that can, either mechanically or chemically, irritate the surface of the ulcer.

Secondly, we must avoid the use of food that is calculated to stimulate the acid secretions of the stomach, for this will act as an irritant to the raw, ulcerated surface.

Thirdly, we must avoid *distending* the stomach with much food at a time, for by maintaining the stomach in a contracted state, its mucous membrane is thrown into folds, so that the margins of the ulcer are relaxed and its extent diminished—conditions favourable to filling up and healing of the ulcer.

Fourthly, any excitement of the muscular movements of the stomach should be, so far as possible, prevented.

Lastly, in cases of perforating ulcer, where severe and dangerous hæmorrhages have occurred and may recur, keep the stomach absolutely at rest, for two or three days at least, and feed the patient with nutrient enemata, to which, if necessary, a little brandy or port wine may be added, allowing only a few fragments of ice to be sucked in order to allay thirst.

In most ordinary cases, restriction to an exclusively milk diet will answer the indications given above.

* "L'Hygiène Alimentaire," p. 211.

It is extremely desirable, however, that the stomach should not have to deal with any considerable mass of milk-curd, and to prevent any firm coagulation of the casein of milk in this organ, we should add some alkaline carbonate or alkaline solution to the milk. In many instances, mixing the milk with an equal quantity of lime-water is sufficient, or Vichy water may be used instead. A better plan, however, as we have already said, is to add to each cup of milk (4 oz.) a powder composed of 10 grains of bicarbonate of soda, 5 grains of light magnesia, and 10 grains of common salt, and a tablespoonful or two of water (iced, if necessary). This may be taken every two or three hours. If the patient's state seems to need it, the yolk of an egg may be beaten up with two tablespoonfuls of hot water and added to the cup of milk twice a day; or about an ounce of the crumb of a stale roll, well soaked previously in hot water, may be mixed with the milk two or three times daily.

To avoid the curdling of the milk in the stomach, some physicians give butter-milk; and some patients take this well, but others object to its sour taste. Niemeyer found Malt Extract a useful food in these cases; and, as a good form of vegetable food, *purée* of potatoes.

If there is a distinct intolerance of milk diet, small quantities of meat or chicken may be given, finely divided or reduced to a pulp (the lean only), and mixed with a little weak broth or *consommé*.*

In Germany, Leube's Soluble Meat is much used in such cases. "Its constituents are, for the most part, ready for absorption without any particular action of the gastric juice, so that in giving it there is no long-continued secretion of gastric juice—a

* In France *powdered* meat is a common article of invalid consumption, and the *poudre de viande* of Rousseau is one of the best known.

circumstance, doubtless, of no small importance for the healing of the ulcers."* Leube gives his patients some milk in addition, and also some well-soaked bread. The Soluble Meat is mixed with slightly salted broth and taken lukewarm.

A very nutritious food which may from time to time be given these patients consists of a small tea-cupful of *consommé* to which the yolk of an egg has been added and a little well-soaked bread-crumb.

In those serious cases in which, from fear of hæmorrhage, it is necessary to feed the patient by nutrient enemata, it is desirable to keep him in bed, in order to lessen the nutritive wants of the system as far as possible.

If, after a fortnight or three weeks of this strict feeding, the symptoms of the disease have disappeared, we should permit a gradual return to more solid food —the lean of tender boiled mutton or chicken, boiled sole or whiting, light milk puddings, and vegetable *purées;* but we should be careful to limit the amount taken, strictly, to that required to satisfy the physiological needs of the body.

Stimulating beverages taken by the mouth should be wholly avoided. A little weak tea, with milk, may be permitted in some instances.

Leube has pointed out that gruel made from coarse groats, or porridge, should be specially avoided, as the coarse particles, coming into contact with the ulcerated surface, may set up great irritation.

In **cancer of the stomach**, the comfort of the patient, and the prolongation of his life, are greatly dependent on judicious feeding.

The indications are to supply as much nourishment to the body as will adequately meet the nutritive

* "Dietary of the Sick," p. 251; Ziemssen's "Handbook of General Therapeutics."

demands and check the progressive emaciation, while at the same time we reduce to a minimum the work of gastric digestion and the pain that is usually attendant thereon. To do this we must give food in such a form that it can either be readily absorbed by the vessels of the stomach itself, and cause little or no irritation by its presence there, or food that can readily pass out of the stomach, and be absorbed lower down in the alimentary canal. But we must not underestimate the digestive capacity of the stomach itself in all patients with gastric carcinoma, for in some it is very considerable; and we have known cases of scirrhus pylorus in which a fair amount of solid animal food was taken and digested for many years, with only occasional attacks of digestive trouble. We have reported a very remarkable case of this kind;* and Dujardin-Beaumetz cites the case of a man whom he had under his care in the Hôpital Cochin with a large carcinomatous growth in the stomach who implored that he might be allowed a salad with hard-boiled eggs daily, and for a month that indigestible food formed his sole nourishment.†

One important point to keep in view in the feeding of cases of cancerous stricture of the pylorus is to give such food as can be digested and absorbed in the stomach (or predigested food), and that has not to pass through the narrowed pyloric outlet in order to be digested lower down. It is, therefore, necessary to avoid, in these cases, starchy, farinaceous foods, unless they are predigested, for they cannot be digested in the stomach, and there is difficulty in their passing out of that organ; the result is that they are retained there, and give rise to the development of lactic and butyric acids, set up much pain, and lead to troublesome nausea and vomiting.

* *Lancet*, Jan. 29th, 1876. † "L'Hygiène Alimentaire," p. 209.

We have seen such patients fed with soft farinaceous foods with the idea that they were bland and unirritating, the consequence being that frequent vomiting and much gastric distress were induced. Upon an entire suppression of the farinaceous foods and an absolute restriction to concentrated meat solutions and foods that could be absorbed in the stomach, or, on account of their perfect fluidity, that pass readily into the small intestine, the vomiting and distress have immediately ceased.

If the cancerous growth should involve some other region of the stomach, there is then not the same objection to the carbo-hydrates, because there is not the same risk of their being retained long enough to undergo abnormal decomposition in the stomach.

Food in cancer of the stomach, speaking generally, should be fluid, and sufficiently concentrated to supply the necessary nourishment in a *small* bulk. When milk is well borne, no better food can be taken. It is well, however, to dilute it slightly with some alkaline water; and peptonised milk will often be found to agree when ordinary fresh milk will not.

Should any considerable hæmorrhage from the stomach occur during the course of the disease, it may be necessary to limit the administration of food for a time entirely to nutrient enemata, so as to keep the stomach free from any irritation or functional excitement.

We are quite in accord with Professor Bauer in his contention that "in carcinoma of the stomach, animal, highly-albuminous foods—as milk, eggs, and tender meat—are decidedly preferable to those which, from the large amount of hydro-carbons they contain, are easily prone to abnormal and acid fermentation."* And we entirely doubt the accuracy of

* "The Dietary of the Sick," p. 253; Ziemssen's "Handbook of General Therapeutics."

Dujardin-Beaumetz's recommendation (which he appears to found on the controverted statement of Van Velden, that in carcinoma of the stomach there is an absence of hydrochloric acid in the gastric juice) that vegetable and farinaceous *purées* are better than nitrogenous food. We are satisfied, as we have already stated, that this is certainly erroneous when stricture of the pylorus exists.

All physicians are agreed that whatever food such patients take—and their own feelings may be to a certain extent consulted—it must always be in small quantity at a time.

As a beverage, a little red wine appears to be well borne; beer and spirits should be avoided, and all sweet and effervescing wines.

Oppolzer has advised the use of sour milk or butter-milk as less prone than fresh milk to form a hard, irritating coagulum in the stomach. In some few instances a dry diet has been found to agree better than a fluid one.

Each individual case must be carefully studied, and much, no doubt, of the facility with which different articles of food are digested, depends on the seat of the disease and the secondary changes it may have given rise to, such as dilatation, etc.

If the cancerous growth should have attacked the cardiac orifice, then nothing but fluid food should be given, as solid food would be arrested above the stricture and cause dilatation of the œsophagus. If the stricture is considerable, it may be advisable to introduce food into the stomach through the tube of a stomach-pump, or to have recourse to rectal alimentation.

We shall next consider the diet most appropriate to cases of **dilatation of the stomach.**

This condition of the stomach is most commonly due to the existence of stricture at or near its outlet, but it may also be produced by other causes ; it may depend on want of tone and loss of contractile power in its muscular coat, and this may be the result either of general debility, defective innervation, or long-continued gastric catarrh. It may exist as a part of that general exhaustion of the system that follows a long-protracted illness. It not unfrequently arises as the more or less direct consequence of habitual over-distension of the stomach with food and drink, and particularly from the excessive use of effervescing drinks; and it may also occur in connection with certain other less obvious morbid conditions. But our present purpose is not to investigate its mode of origin, but to consider what are the dietetic measures by which it may be cured or ameliorated.

Mechanically emptying and then washing out the stomach — *lavage d'estomac* — has been extensively advocated and practised in the treatment of dilatation ; but, apart from the circumstance that many patients have the strongest possible antipathy to this mode of treatment, there can be no doubt that it has been had recourse to in many slight cases where careful dietetic measures would have sufficed.

One of the first dietetic rules to be applied to the treatment of stomach dilatation is to rigidly forbid overloading the dilated organ. That is, of course, of the greatest importance. The food should, therefore, be concentrated and of small bulk. We should also limit the supply of liquids, especially in those cases where there is a tendency to take an excess. We need not, however, push the adoption of a "dry diet" to the extent that has been advocated by some German physicians, Bartels amongst the number. But we should strictly limit the quantity of fluid taken *with the food* to six or eight ounces. When there is a great craving for fluids, the best plan is to let the patient sip a teacupful or more of hot water half an hour before a meal; by this means we shall lessen the desire to drink during the meal, and at such periods fluid is rapidly absorbed by the stomach.

The quantity of fluid taken by various individuals differs within *very wide* limits, and is often greatly in excess of their physiological requirement.

As it is desirable that the food should be concentrated, it must therefore be chiefly animal. The lean of meat from which all fibrous and tendinous structures have been removed is the best.

Starchy foods, carbo-hydrates, should be taken only in small quantity; they are prone to linger in and set up abnormal fermentations in the dilated stomach. Most vegetable substances calculated to give rise to flatulence must be discarded; fresh vegetables must only be taken in limited quantity, and in the most concentrated and digestible form. Those that can be taken in the form of *purées* are the best.

A certain amount of carbo-hydrates is, of course, essential to a perfect dietary, and so also is a certain proportion of green vegetables; so that we must not altogether exclude a moderate proportion of white bread (not *new*), nor a little fresh vegetables. Some of the light farinaceous foods may also be taken in small quantity at a time as tapioca, sago, rice, and macaroni.

Only in severe cases, associated with troublesome vomiting, is it necessary to adopt for a time a strictly milk diet, and in these cases the milk should be given with crushed ice.

G. Sée protests against the rigidly dry diet advocated by some, and maintains that it is injurious when carried to an extreme, and remarks that he has seen it lead to great emaciation. He adds: "It is not water that dilates the stomach; it does not stay there, it is in part absorbed, but the greater part passes rapidly into the intestine,"—which is quite true of water taken, as we have suggested, by itself and when the stomach is empty; but it is scarcely true of fluids that are taken with food. He, however, admits that food containing much water, as fresh vegetables and fruit, should be abstained from, as they are cumbrous in bulk and contain but little nourishment. He prescribes the most nutritious forms of animal food—fish, not rich in fat, cheese, eggs, and such farinaceous foods as are richest in nitrogen.*

Huchard has advocated the strict limitation of liquids, and allows a glass and a half only at each meal; all food substances and fruits containing much water are to be rejected, and only *very thick* soups to be permitted: roast meat, eggs, and the drier kinds of vegetables he approves of.

Professor Bouchard allows 12 oz. only of fluid at breakfast and at dinner, and these must be non-fermenting; red wines he prohibits, but allows mineral (table) waters, water containing $\frac{1}{3}$ of beer (!), or a quarter pint of white wine, or a dessert-spoonful of brandy. No drink is to be taken between meals.

Fatty foods are to be abandoned; the crust of bread or toast only is to be eaten. The meals should be as far apart as possible; nine hours should intervene between breakfast and dinner and fifteen between dinner and breakfast! These rules are certainly much too absolute.

The dietary sketched by Dujardin-Beaumetz † for those suffering from dilated stomachs is far more liberal: he allows the usual early breakfast at 7 a.m., the *déjeuner à la fourchette* at 11 a.m., and dinner at

* G. Sée, "Du Régime Alimentaire."
† "L'Hygiène Alimentaire."

7.30 p.m.; but he forbids any eating between these meals.

He permits *all kinds* of food, but gives the preference to meat, fish, eggs, and farinaceous foods; and he does not prohibit green vegetables or fruit. He enters, however, into certain details, such as the following :—The meat should be well cooked and braised rather than roasted; fish should be simply boiled; eggs should be cooked very lightly.

The farinaceous foods should be in the form of *purées*—potatoes, haricots, lentils; also macaroni and vermicelli.

The green vegetables should be well cooked and served as *purées*—carrots, turnips, green peas, spinach, French beans, cress and salad, *cooked.* Fruit should be stewed, except strawberries and grapes.

Bread must be toasted; no fluid soups.

For beverage, at each meal, about 10 oz. of white wine very weak with water; no undiluted wine. Never drink between meals.

We now pass on to consider the most suitable dietetic treatment of those vaguer forms of stomach disorder which are grouped under the term **dyspepsia** or **indigestion,** and which cannot be referred to either of the definite morbid states of which we have been speaking.

These disorders frequently occur in the form of temporary attacks, and can often be traced to a definite exciting cause; and this will often be found to be some particular error in diet, or some faulty method of taking food, or perhaps over-work and mental anxiety, or some inattention to the action of the bowels, or the stomach disorder may be sympathetic with irritation of other organs, as, for example, ovarian and uterine irritation in the female, and over-sexual indulgence in both sexes.

The more chronic forms may be associated with either (1) a hyperæsthesia of the gastric mucous membrane; (2) insufficient amount or altered quality of gastric secretion; (3) imperfect disintegration of the food in the mouth; or (4) loss of tone in the muscular coat of stomach.

The symptoms are so well known as scarcely to need repetition here, and are much the same as those of chronic gastric catarrh already enumerated: a sense of weight and discomfort in the epigastrium coming on soon after taking food, and in some instances (hyperæsthesia of gastric mucous membrane) amounting to acute pain; flatulent distension of stomach and intestines, often accompanied with sighing, and by dyspnœa and palpitation on exertion, due to pressure upwards against the diaphragm of the distended stomach; eructations of the acid contents of the stomach, causing a burning pain about the cardiac orifice of the stomach, or "heart-burn." These symptoms are often accompanied either by headache and general lassitude, or by restlessness and irritability. Occasionally there may be vomiting.

In all such cases our first duty is to inquire carefully into the habits of the patient, both as to the food he takes and as to his manner of taking it.

Imperfect mastication, from haste in feeding, or from defective teeth, or from habitually taking food difficult of disintegration in the mouth, is, perhaps, one of the most common causes of dyspepsia in persons of feeble digestion or of advanced age. It is important to remember that the digestive function, the function of the solution of the food, *begins in the mouth*, with the very important acts of mastication and insalivation. The mechanical disintegration of the food by the action of the teeth and jaws is essential to its complete digestion lower down in the stomach and intestines; for without this reduction of the food into small fragments the digestive juices cannot come into close contact with all its parts, and so effectively exercise their solvent chemical power upon it. And it should be noted that, whereas if the food escapes solution by the chemical action of the gastric juice in the stomach, it encounters other digestive juices, after it has left the stomach, which can, to some extent, supplement its action: it is not so with *mastication;* once the food has passed out of the mouth there is no further opportunity afforded for supplementary mechanical disintegration. The importance of this initial act of digestion, as well as the necessity of a certain amount of attention being paid to the act of feeding, should be pointed out to all persons with feeble stomachs. Hence the value of *agreeably-flavoured food* which attracts the attention, and upon which it is willing to linger. When there is a difficulty in masticating food from defective teeth, or in any case where due mastication is obviously neglected, food should be given that does not require much mechanical effort for its disintegration, *e.g.* the crumb of stale bread, dry toast, some kind of biscuit, which crumble down and disintegrate readily, whereas new bread is apt to form tough coherent masses in the mouth. Vegetables should be mashed or reduced to the form of *purées;* potatoes, especially, unless very "mealy," are apt to escape thorough mastication, and to be swallowed in lumps which are likely to prove a source of irritation and abnormal decomposition lower down in the alimentary canal. Fat also should not be eaten in lumps, but should be finely divided and mixed with some other food which will keep the fragments apart. "Bread and butter" is an example of this. When, owing to defective teeth, mastication becomes painful, the meat taken should be first reduced to a pulp, or minced, or pounded (small machines exist for this purpose).

Persons with feeble digestions should prefer the *shorter-fibred* and more easily disintegrated meats and fish: mutton, chicken, pheasant, partridge, are better than beef, goose, duck, wild-fowl, etc. Veal and pork are notoriously difficult of digestion, and lamb and rabbit are not so easily digested as some persons believe. Of fish, the sole, whiting, and flounder, when plainly grilled or boiled, are far more digestible than the firmer-fleshed and richer fish.

Grilled (not fried) fat bacon eaten with dry toast often proves an easily digested and good form of fatty food. It disintegrates readily, is savoury, and mixes well with bread; accompanied by the yolks of one or two poached eggs, it forms a nutritious and compact meal.

As we have before had occasion to remark, any food saturated with fat, which prevents the penetration of the gastric juice, such as buttered toast, muffins, pastry, etc., and sweet dishes that are apt to undergo acid fermentation, and unripe acid fruits, nuts, and the hard coverings of vegetables containing much cellulose, are difficult of digestion and must be avoided.

It is exceedingly important that the food of the dyspeptic should be carefully and skilfully cooked and agreeably flavoured; if food is made palatable and appetising it stimulates the nervous system, and so promotes gastric secretion and digestion; *grilled* meats are perhaps the most digestible and savoury.

As to sauces, it is best for the dyspeptic to avoid all rich sauces entirely, and when butter is required, as with fish, to use plain fresh butter.

The indigestibility of bread, or rather of certain kinds of bread, and of too large a quantity of bread is often overlooked.

A bread which breaks "short," is porous, and crumbles easily, which is not too moist, and yet which does not dry too quickly, and which *does not mass* *together* in the mouth in mastication, is the best. It will be found that the bread of some bakers is far more digestible than that of others, although apparently of the same quality. It is owing to the indigestibility of baker's bread that so many persons eat dry toast. Some of the *whole meal* bread, now so largely advocated, although extremely pleasant to eat, and undoubtedly of high nutritive value, we have found very indigestible to persons of feeble digestion.

Another point of extreme importance to the dyspeptic is that the meals should be small, or very moderate in quantity. Our object should be to select a diet which, while it affords the necessary amount of nourishment to the body, imposes the smallest amount of labour on the stomach.

Small meals, slowly and deliberately eaten—that is a golden precept for the feeble of digestion.

A sufficient amount of time should also be allowed between the meals to permit of the complete digestion of one meal before the next is taken. When the patient is unable to take any solid food, then no doubt it is necessary to take small quantities of fluid food at short intervals; but when solid food is taken, as at an ordinary meal, it must be remembered that from five to eight hours,* according to the amount and nature of the food, are needed for its digestion, especially in advanced life, and in cases of feeble digestion.

We have had frequent occasion to observe how dyspeptic conditions have been excited, maintained, and aggravated by adhering to the habit of taking food at too short intervals.

* Leube has shown that the digestion of a meal, in health, takes from four to seven hours, and this has been confirmed by other observers; a light breakfast has been found to take four and a half hours, a full meal seven hours. But the time required to digest a meal varies greatly in different persons, and in the same person under different conditions, and may be sometimes longer and sometimes shorter than the time stated.

The dyspeptic should be cautioned to avoid sitting down to food immediately after severe mental or physical toil, or returning to work immediately after a meal; both nervous and circulatory energy should be free to devote themselves to the work of stomach digestion, and for that purpose they must be relieved from other labour.

Emotional disturbances are also equally to be avoided, but these are not usually so completely under our own control.

The existence of faulty habits with regard to the use of stimulating drinks—as alcohol, tea and coffee, or the consumption of an excessive amount of irritating condiments, or the abuse of tobacco—must be sought out and corrected.

The alcoholic cases are the most troublesome to deal with. Where there is a craving and fondness for alcohol, it is best to forbid it entirely; whereas in non-alcoholic cases of atonic dyspepsia, a small amount of good pure wine with or without water, or a little weak brandy or whisky and water (or, if preferred, some effervescing table-water), often serves as a useful stimulus to gastric secretion.

With respect to the use of tea and coffee by dyspeptics, much difference of opinion exists. That excess in either, and sometimes quite a moderate quantity, will excite dyspeptic states in some persons under certain conditions is absolutely certain.

We have had occasion to notice that both these beverages will cause dyspepsia in persons when suffering from mental worry, whereas they will not do so when this disturbed mental state has passed away. Much also of the dyspepsia occasioned by these beverages depends on the time at which they are taken. A person with a feeble digestion should not take them with or soon after food; they will often then retard digestion; but a small cup of weak unsweetened tea or light coffee three or four hours after a meal will, not unfrequently, be found to promote the final stage of stomach digestion; no food, however, should be eaten at the same time, as is so commonly done. In cases where even at this distance from a meal they appear to interfere with digestion, it is a good plan to sip a teacupful of hot water instead. Light China teas are much less likely to cause dyspepsia than the stronger Indian kinds.

Professor Sée is a vigorous advocate of tea as a beverage in dyspepsia.

"The best digestive beverage," he says, "is tea, provided a light infusion is made, and at least a demi-litre [about 16 oz.] taken at a time and at a high temperature; at the midday meal it will most advantageously take the place of wine. It does not ferment; it contains only traces of tannin, while coffee contains a great deal more." After referring to some opposing testimony, he proceeds:—"What a sad future is being prepared for us by the three daily cups of tea which I claim to be the best digestive and the surest means of sustaining intellectual energy. Amongst my best friends may be found patients who for years have followed strictly my counsel, and are remarkable for their physical and intellectual vigour!"*

Our own experience teaches us that there is truth on both sides. We *have* suffered in times past from tea-dyspepsia, but still we drink tea, and, we think, with advantage, and are able even to find in tea a stimulant to digestion; but we have learnt by experience when and how to take it, as well as when to abstain from it.

In anæmic and atonic cases a moderately stimulating dietary answers best, and animal food and soups, well selected and pleasantly flavoured with suitable condiments, are better digested than farinaceous

* "Du Régime Alimentaire," p. 321.

foods which have a tendency to undergo acid fermentation.

The meat should be tender and not overcooked. A purely milk diet, which often proves so beneficial in cases of gastric catarrh, is not sufficiently stimulating for the cases we are now considering.

In all these cases individual peculiarities must be carefully studied, especially as to the ease or rapidity with which particular articles of food can be digested.

The cooking should be as simple as possible, so that the natural flavour of the food should be preserved, and any agreeable condiment may be added in moderation ; all twice-cooked meats should be avoided.

Green vegetables, unless in very small quantity, especially of the cabbage tribe, should be eschewed, as they are very prone to give rise to flatulence.

Much has been written lately in Germany and France of the diagnostic value of direct examination of the gastric juice in disorders of digestion, and various methods have been devised for withdrawing the gastric juice from the stomach for this purpose. The stomach pump, aspiratory tubes, sponges swallowed and subsequently withdrawn from the stomach, and modifications of these methods, have all been adopted and described by Leube, Ewald, G. Sée, Dujardin-Beaumetz, and others ; and much stress has been laid on the proportion of hydrochloric acid thus found in the gastric juice. But to our mind it is extremely doubtful from the evidence produced whether any considerable advantage has attended this very troublesome and unpleasant mode of investigation.

Dujardin-Beaumetz has pointed out * the uncertainty of the conclusions drawn from the examination of the gastric juice, since in the same patient the acidity

* "Sur l'Examen direct du Suc Gastrique."—*Acad. de Médecine*, 24 Juin, 1888.

of the gastric juice will increase and diminish under the influence of many causes. This last author, as a guide to the construction of appropriate dietaries for the dyspeptic, divides them into three groups :—*

1. Those in whom the secretion of gastric juice *is abnormally abundant*, and for these he prescribes a purely *vegetable* diet : farinaceous substances, fresh vegetables, and fruits. Milk as a beverage and sometimes beer, but never wine.

2. Those in whom the gastric secretion is deficient. For these he orders meat and meat-broths ; but the meat should be reduced to pulp or powder, and the quantity carefully limited to the digestive capacity of the patient. Milk is also admissible, as it augments the digestive power of the stomach by the presence of lactic acid ; he also approves of the addition of milk to meat-broths. Wine or weak brandy-and-water he allows as calculated to increase the acidity of the gastric juice. Peptonised foods may be advantageous to certain individuals.

3. Those dyspeptics who are troubled with sympathetic affections, as giddiness (*vertige stomacal* of Trousseau). For this class he considers it important to lessen the possibility of any excitement proceeding from irritation of the gastric mucous membrane ; and to carry out this indication he urges the adoption of a purely vegetable dietary composed of farinaceous foods, fresh vegetables and fruits, permitting milk as a beverage.

The following is a detailed account of the vegetarian dietary, the adoption of which he considers so important in the case of many dyspeptics :—

Bread.—Crust of bread or dry toast,

Farinaceous Foods.—*Purées* of potatoes, of haricots, and of lentils ; revalenta ; maize flour ; chestnut-meal ; oatmeal ;

* "L'Hygiène Alimentaire." "Du Régime spécial dans les Maladies de l'Estomac."

pearl barley, macaroni, and vermicelli; these may be taken plain or with butter.

Fresh Vegetables also in the form of *purées*—carrots, turnips, and the other vegetables used in making Julienne soup; *purée* of green peas, well-cooked salads, spinach, sorrel, French beans.

Fruits should, with the exception of grapes, be cooked, and taken as *compôte*.

With such a *régime* he permits *lightly-cooked eggs*, and he does not forbid beer.

Professor G. Sée divides dyspeptic patients, somewhat arbitrarily, into two groups—those who secrete too much hydrochloric acid (*dyspepsie hyperchlorhydrique*) and those who secrete none (*dyspepsie achlorhydrique*). For the first he recommends a nitrogenous diet and the avoidance of starchy food; and for the second he advises a wholly vegetable diet. To the first he gives bicarbonate of soda after meals; to the second hydrochloric acid. *

Professor Sée advocates strenuously the value of the alkaline (bicarbonate of soda) water of Vichy, taken an hour or half-an-hour before a meal, in all cases of *dyspepsie chimique*.†

Leube, the celebrated German specialist for diseases of the stomach, has found the four following dietaries as applicable to the different degrees and stages of digestive disorders. No. 1 is considered to be the most easy of digestion, and is suitable, therefore, to the most severe cases of dyspepsia; No. 2, the next easiest; and so on up to No. 4.

No. 1.—Broth, or clear soup (*bouillon*).
Solution of meat (Leube's special preparation).
Milk.
Eggs, raw or very lightly cooked.

* "Des Maladies de l'Estomac jugées par un nouveau Réactif Chimique."—*Acad. de Méd.*, January, 1888.

† "Du Régime Alimentaire," p. 319.

As beverage.—Water, either pure or slightly charged with carbonic acid gas.

This diet is prescribed for cases of gastric catarrh at the outset.

No. 2.—Boiled calves' brains. Soups, etc., as in No. 1.
,, ,, sweet-bread.
,, chicken.
,, pigeon.
,, bread-and-milk (pap).

No. 3.—The articles in Nos. 1 and 2, to which may be added :—
Beef (rump) steak, very underdone, and raw ham (!).
The steak is to be thoroughly beaten, to make it tender, and the most tender portions scraped away with a spoon, and roasted quickly in fresh butter.
A small quantity of white bread.

No. 4.—Contains a variety of meats.
Roast chicken, pigeon, partridge, venison, underdone beef (especially cold), veal, macaroni.
A small quantity of wine is allowed with this diet, and also a very small quantity of green vegetables, salad, and stewed fruit.

The dietetic treatment of those morbid conditions of the intestinal canal which lead to chronic **constipation** must next occupy our attention.

A want of tone or a paretic state of the intestinal walls is a not uncommon consequence of chronic intestinal catarrh.

Sedentary habits and insufficient bodily exercise, by lessening peristalsis of the muscular coat of the bowels, are well-known causes of habitual constipation.

A too exclusively nitrogenous diet—a diet too entirely composed of easily-digested animal food—by leaving but little waste as a result of its digestion, may lead to constipation from the absence of the stimulus to the nerves of the intestinal mucous membrane which a normal amount of indigestible residue produces. Or by too exciting a diet and the repeated contact of *too* stimulating residue the excitability of the intestinal nerves may be exhausted, and constipation thus induced. Similarly it may be caused by the abuse of aperient medicines.

In dealing with all such cases, it is essentially necessary to make careful inquiry into the habits of each patient with regard to the quantity and nature of the food he takes, so that we may make such corrections as may seem necessary to overcome the morbid habit.

In some instances we may discover that too *dry* a diet is taken, and that not enough water is consumed to keep the contents of the intestinal canal in a fluid, a semi-fluid, or soft condition.

The freer the supply of water to the blood, the more fluid the intestinal secretions are likely to be; whereas if the supply of fluid to the blood be limited, less fluid is likely to be secreted from the intestinal glands, and the intestinal mucous membrane will become drier. It is, no doubt, for the reason here indicated that free draughts of cold water taken at bed-time and in the morning fasting will often succeed in overcoming habitual constipation.

Persons who lose much water from the surface by profuse perspiration should also remember this, if they find they suffer from constipation; and that it may be, to some extent, due to an abnormally dry state of the intestinal mucous membrane, brought about by an excessive loss of fluid from the skin.

Persons who avoid fresh vegetables and fruit should be induced to habitually add some of both to their diet.

Green vegetables, and ripe or stewed fruits—as apples, pears, prunes, figs, etc.—and the various kinds of brown or whole meal bread, are well known to have an aperient tendency. This is due to the mechanical irritation which the undigested residue of such foods exerts on the intestinal mucous membrane.

Eggs, milk, and most farinaceous foods, as they leave but little stimulating residue from their digestion, tend to aggravate the constipated habit.

Oatmeal and maize are reputed to be slightly aperient, and honey or treacle added to bread or other farinaceous food is believed to favour peristaltic action.

"Bran-bread, green vegetables, salads, spinach, sorrel soup (*soupe à l'oiselle*)"—these are the foods, containing much indigestible cellulose, which Dujardin-Beaumetz * recommends for the relief of habitual constipation, to which he adds "gingerbread (*pain d'épice*)—which, taken in large quantity, is very decidedly laxative"—grapes in quantity, oranges taken with alkaline (Vals or Vichy) water, and *linseed.* "Pour," he says, "a little water on a dessert- or table-spoonful of linseed, let it stand for an hour, and drink the whole immediately before a meal."

Spanish or Portugal onions, plainly boiled, will often be found to promote the action of the bowels.

In the opposite condition—viz. **diarrhœa**—if of a simple character (*i.e.* not a complication of some other disease), we have generally to deal with it in one of two forms—either as an acute and temporary illness, or a more or less chronic malady. The latter form is often intractable and difficult to remedy.

There is one general dietetic rule that applies to all cases of diarrhœa, which is to avoid all foods that leave much undigested residue behind, and which may, therefore, tend to maintain irritation of the intestinal mucous membrane. We should select and prescribe only such foods as leave a bland and unirritating residue as a result of their digestion, and which ordinarily have no tendency to undergo

* "L'Hygiène Alimentaire."

decomposition into irritating acid substances in the alimentary canal.

Especially to be avoided are green vegetables, raw acid fruits, nuts, potatoes (unless in the form of *purée*), coarse brown bread, and all rich, fat, or acid dishes; also all forms of animal food which are hard or tough and difficult of digestion, such as pork, veal, and beef —unless reduced to pulp or powder.

Milk, preferably boiled, is usually a good food in diarrhœa, unless we find some individual peculiarity rendering it difficult of digestion, and in such cases we must order unirritating farinaceous foods, such as arrowroot, tapioca, sago, rice, etc., prepared with water and flavoured with nutmeg, cloves, or cinnamon. An acute attack of diarrhœa will often be rapidly cured by restricting the food for twenty-four hours to water arrowroot, flavoured with the spices we have just named, and with the addition of two or three tea-spoonfuls of brandy, or a tablespoonful or two of port wine, to each teacupful. When beef-tea or clear soup is ordered in these cases, it should be thickened with arrowroot, sago, or tapioca.

Soda-water and milk, with a small quantity of brandy, is the best beverage in these acute cases; or port wine and water may be substituted when preferred.

After the subsidence of the acute attack, the return to the ordinary diet should be gradual, and for a few days clear soup or beef-tea, thickened with the substances we have named, boiled chicken, partridge, or pheasant with rice, or boiled whiting or sole and a little mashed potato, should be the chief articles of diet. All acid wines and beer must, during this period, be prohibited. The tannin wine of S. Raphael may, however, be permitted.

The dietetic treatment of chronic diarrhœa is a somewhat more troublesome matter. According to

Dujardin-Beaumetz,* the four following means are those chiefly to be relied upon:—1, Milk; 2, Raw meat; 3, Peptonised foods; and 4, Powdered meat.

A strictly milk diet, according to this author, if rigorously followed will cure all forms of chronic diarrhœa but one, and that is the diarrhœa of tuberculous ulceration.

After the diarrhœa has been overcome by a strictly milk diet, he allows raw meat, but prefers powdered meat, which is, however, to be given with great caution, and increased in quantity gradually and slowly.

Peptonised foods may also be tried, and in some instances they may be found to agree better than raw or powdered meat.

G. Sée † is also a strong advocate of the use of raw meat in the treatment of cases of chronic diarrhœa. He says the fibres are "less compact, softer, and less irritating" than meat cooked in any way; as to the value of milk in these cases, he speaks highly, but insists that it should be given in small quantities, and that it should be "skimmed, boiled, and diluted with water," for large quantities of *rich* milk will, he maintains, often augment diarrhœa.

As the cure becomes established, a gradual return to ordinary diet, especially selecting easily digested kinds of food, may be permitted.

In the diarrhœa of infancy, milk is also the proper remedy—pure fresh milk diluted with lime-water.

It has been shown by Hayem ‡ that the "green diarrhœa" (*diarrhée verte*) of infancy is microbic in character, and that it is necessary to disinfect the soiled linen in order to avoid its propagation to other infants. He recommends the administration of a 2

* Op. cit.
† "Du Régime Alimentaire."
‡ *Académie de Méd.*, 17 Mai, 1887.

per cent. solution of lactic acid, a teaspoonful to be given a quarter of an hour after suckling.

Dr. Stange advocates the koumiss cure in some cases of chronic diarrhœa, and he mentions one which persisted after an attack of epidemic dysentery, and in which different modes of treatment had been tried for four years, "but the slightest indiscretion in diet invariably brought on the diarrhœa. Six weeks after the commencement of the koumiss cure he had gained 4 kilos., and could take any kind of food with impunity." *

* Von Ziemssen's "Handbook of General Therapeutics," vol. i.

CHAPTER III.

FOOD IN DIABETES.

In the disease known as diabetes mellitus—or, more commonly, simply as diabetes—the chief and characteristic symptom is one which points to a serious disturbance in the processes of food digestion and assimilation.

The normal metabolism in the body of saccharine and starchy, and in some instances, it would seem, even of albuminous, food is, for some reason or other, disturbed, and the consequence is that sugar, in greater or less quantity, appears in the urine.

In a state of health, the starchy and saccharine substances, which form important constituents of our daily food, undergo complete conversion in the system. The starch is converted into sugar, and this, together with the sugar taken as such into the stomach, is, after absorption, wholly consumed and utilised in the body. None, or practically none,* passes out of the healthy body as sugar. In the disease known as diabetes it is otherwise. In this disease a more or less notable quantity of sugar escapes in the urine, and we find from observation that the amount of sugar which appears in the urine is proportioned to the amount of saccharine and starchy substances taken in the food. *In the more serious forms* of this disease it is found that sugar may be discharged in the urine, even when no starchy or saccharine substances are taken in the food, and it is, therefore, certain that in some instances of this disease sugar is formed within the body from other substances than the carbo-hydrates of the food;

* Pavy maintains that a minute quantity of sugar can always be detected in the urine, if we employ sufficiently delicate tests.

that, in short, nitrogenous matter can undergo transformations which result in the production of sugar.

In health the sugar which is taken into, or formed within, the organism is doubtless directly or indirectly utilised in the production of force; in diabetes it escapes from the body unconsumed. This is the essential feature of the disease.

Small amounts of sugar may occasionally and temporarily be detected in the urine in health by the ordinary tests, and, according to Pavy, as much as from 5 to 8 parts in 1,000 may be so formed; but this is a rare and temporary incident, and is usually referable to the consumption of an excess of saccharine or starchy articles of diet. The occasional and temporary presence of so small an amount of sugar in the urine has no serious clinical significance.

The normal presence of sugar in the blood in health was established long ago by Claude Bernard, and is now universally admitted. As to its source, amount, and destination, great differences of opinion exist. C. Bernard (whose name is associated with the remarkable discovery of what is known as the glycogenic function of the liver) taught that in man and other mammalian animals the blood was always found to contain sugar, and that this was a normal physiological condition, provided the sugar did not exceed a certain amount. If, however, the blood came to contain more than three parts of sugar in one thousand, then sugar appeared in the urine, and the appearance of sugar in the urine was a pathological phenomenon.

As to the source of the sugar in the blood, C. Bernard established the fact that the liver had the power of transforming the glucose absorbed by the blood-vessels from the alimentary canal, and brought to it by the portal veins, into an amyloid substance which he termed "glycogen," and this was, he believed, subsequently reconverted into glucose and restored to the blood.

And he maintained that the glucose resulting from the digestion of the starchy and saccharine principles of our food did not pass directly into the general circulation, but was transformed into a non-diffusible *colloid* substance allied to starch, viz. "glycogen," in which form it could be stored up in the liver-cells, and thence be reconverted and added to the blood as it was needed. According to this view, the liver acts as a great regulator of the glycogenic function, and stores up a quantity of carbohydrate substance, by the regular conversion of which into glucose a fixed and constant supply of this material to the blood is provided for, and not an irregular and intermittent one, as would be the case if the sugar derived from the food were to pass directly into the blood.

Also, as to the *destination* of the sugar of the blood, Bernard taught that it was consumed in the capillaries in the processes of nutrition or force-formation—such as, *e.g.* the development of animal heat—and that ultimately it was eliminated in the form of carbonic acid and water; and that, as a fact, there was considerably less sugar in venous than in arterial blood.

We can see how, according to this theory, *glycosuria* or *diabetes*, due to an excess of sugar in the blood, might arise in three different ways. First, it might be due to incomplete combustion, to incomplete nutritive transformation of the sugar of the blood in the capillaries; so that diabetes might be a disease of "retarded nutrition," as Professor Bouchard terms it; or, secondly, it might depend on a suspension of the glycogenic function of the liver, so that the sugar proceeding from the alimentary canal would pass directly into the general circulation, and not be fixed in the form of "glycogen" in the liver-cells; or, thirdly, it might arise from a disturbed activity of the glycogenic function, whereby the formation and transformation of glycogen became excessive, and glucose was thereby added to the blood faster than it could be consumed in the tissues.

The experimental researches of Pavy have, however, led him to conclusions which differ somewhat from the foregoing. He admits that sugar is always present in the blood in health, but only, he asserts, in very small and insignificant quantity; and he maintains that the presence of this small amount of sugar in the blood coincides with and is the cause of the constant presence of a small amount of sugar in the urine; in short, that whenever there is sugar in the blood, there is a proportionate quantity of sugar in the urine. As to its *source*, he contends that it simply represents the small quantity of sugar which may reach the thoracic duct through the absorbents from the alimentary canal during the digestion of saccharine and starchy food; and, as to its *destination*, that it is eliminated by the kidneys. He maintains that no combustion of sugar takes place in the capillaries, and that any difference between the amount found in venous and arterial blood is insignificant.

Pavy asserts that it is the function of the liver to arrest the passage of sugar into the general circulation; that it converts the sugar absorbed from the alimentary canal into an amyloid substance (Bernard's glycogen), which becomes fixed in the liver-cells, where it undergoes a change which forms one of the links in the series leading up to the final issue, viz. the utilisation of sugar as a force-producing agent in the system.

The further transformation of this amyloid substance is not clearly traceable, but Pavy believes it may be converted into fat.

According to this view, the liver exercises a *sugar-detaining* and a *sugar-assimilating* function which *prevents* us from being *diabetic!* The sugar derived, either directly or indirectly, from the food and absorbed from the alimentary canal is stopped by the *selective* or *secreting* action of the liver-cells, and in these is transformed into amyloid substance. When not so stopped it reaches the general circulation, and, as a result, gives rise to the presence of sugar in the urine in proportion to the amount of sugar absorbed from the alimentary canal; so that in *diabetes* the eliminated sugar stands in relation to the amount of sugar or sugar-forming material ingested; and this universally-admitted fact is the basis of all the dietetic rules which have been applied to the treatment of this disease.

In diabetes there is a failure in the assimilation of sugar. It may be that the sugar simply passes uninfluenced through the liver; or it may be converted into amyloid substance in the liver, and rapidly reconverted back again into sugar. At any rate, what is clear is, that the sugar derived from the ingestion of food is not stopped from reaching the general circulation, as it ought to be; and Pavy thinks that a simple passage through the liver is what occurs, and that diabetes is essentially due to a fault in the *assimilating* or *detaining* functions which the liver in health exercises on the sugar which reaches it from the alimentary canal.

We must also admit and remember that the liver exercises a true glycogenic action on *nitrogenous matters;* and that in certain grave forms of diabetes, even if lean meat alone is consumed, sugar is still found in the urine, although in greatly diminished quantity; and in carnivorous animals, fed only on lean meat, amyloid material in considerable quantity is found in their livers.

The difference in the views propounded by C. Bernard and those held by Pavy is simply as to the destination of the amyloid substance, the "glycogen," which both admit is formed in the liver, and which both admit is exceedingly prone, as one of its chemical properties, to pass into sugar.

Bernard taught that the glycogenic function of the liver was to regulate the supply of sugar to the blood, in which fluid it was consumed and applied to force-production; Pavy contends that *in health* the glycogen in the liver does not undergo any such conversion, that its probable destination is to form fat, and that the conversion of sugar into "glycogen' by the liver prevents the sugar from passing into the blood to any material extent, and so saves us from being *diabetic!*

We are here, however, only indirectly concerned in the discussion of the pathological theories that have been advanced to account for the diabetic state; our present purpose is the practical one of determining the most suitable kind of food for diabetics, so as to arrest or check their glycosuria; the amount and persistence of which may generally be taken as an indication of the gravity of the malady.

The principal rule which should govern the construction of a dietary for the diabetic is to exclude from it, as far as possible, all those articles of food that can be converted in the organism into sugar.

Having composed such a diet, and applied it to any particular case of diabetes, the prognosis of that case will, in a great measure, depend upon what we observe to be the result of that diet; if the amount of sugar in the urine diminishes rapidly in quantity, and ultimately disappears, the prognosis is favourable; if it persists, or diminishes but slightly in quantity, the prognosis is unfavourable.

In practice we certainly encounter cases of diabetes of such very different degrees of severity, and amenable to treatment in such very varying degrees, that many physicians have been induced to conclude that they are, probably, instances of two more or less distinct maladies. To the slighter and more curable form of disease they have applied the term "glycosuria," and to the graver and, for the most part, incurable form, they apply the term "true diabetes."

"In elderly persons," says Bristowe, "and especially in such as are gouty, the urine not unfrequently contains sugar, it may be in large quantities, and yet few or none of the other symptoms of diabetes are present. The glycosuria under such circumstances may persist for years, either uniformly or with remissions; the patient perhaps passing, at times, more water than is natural and suffering more or less from dyspepsia, yet presenting no emaciation, and no serious impairment of strength, and ultimately recovering, or dying, not of diabetes or its ordinary complications, but of some independent disease."

Other physicians, as Dujardin-Beaumetz * for example, classify cases of diabetes under three forms :—

(*a*) Slight cases;
(*b*) Cases of medium intensity;
(*c*) Grave cases;

and, so far as the results of feeding are concerned, this is a useful division.

The adoption of a suitable diet will often, in the "slight cases," bring about a rapid and remarkable disappearance of the *glycosuria*. Dujardin-Beaumetz states that he has seen a great number of diabetics who have been passing from 1,500 to 3,000 grains of sugar per diem, and after eight days of dietetic treatment the sugar has wholly disappeared. The slightest infraction of the prescribed diet would, however, be attended with a reappearance of sugar in the urine.

* "L'Hygiène Alimentaire," p. 176.

In the second group of cases, the cases of *medium intensity*, the application of a suitable diet will lessen considerably the quantity of sugar in the urine, but will not cause it to disappear completely ; from 150 to 300 grains, perhaps, being excreted daily.

These were termed by Bouchardat, *petits diabétiques*.

It is in the treatment of these two forms of diabetes that the natural alkaline mineral waters, in addition to a suitable dietary, prove of such remarkable value.

Seegen and Kraus of Carlsbad, and Schmitz of Neuenahr, have published numerous instances of the cure of diabetes at these spas, while similar evidence has been offered in abundance by the physicians practising at Vichy and Contrexéville. Dr. Debout-d'Estrées, of the latter place, has pointed out the frequent coexistence of glycosuria and uric acid gravel, and in such cases he has observed a complete cure of the glycosuria under the influence of the Contrexéville springs ; he states that "stout diabetic patients" and "gouty diabetic patients" rapidly lose their glycosuria there.

In the third group of cases, the "grave" form of diabetes, such as we usually find presented by young persons when attacked with this malady, the treatment by diet is not attended with such good results.

These patients are usually thin, and tend to emaciate rapidly, and even when deprived of all carbo-hydrates, and restricted to a purely nitrogenous dietary, they will still continue to excrete a considerable quantity of sugar in their urine. They appear to form sugar out of nitrogenous substances, and to transform even their own muscles into glycogen and urea.

These cases usually run a rapid course to an inevitably fatal termination.

The marked clinical distinction between the slight and the grave forms of diabetes, the curability of the one and the incurability of the other, seem to point to the probability that the occurrence of glycosuria may depend on two or more pathological states not necessarily always associated or interdependent.

First, in the slighter forms, the gouty diabetics, the pathological condition may simply be one of *depressed hepatic function*. The *liver* fails to exercise fully and completely its duty in the conversion of the alimentary glucose into "glycogen," and a portion only of the sugar conveyed by the portal vein to the liver is converted into amyloid material, a considerable part being allowed to pass on through the liver into the blood, whence it finds its way into the urine, and is eliminated thereby. With this we often find associated other evidences of depressed liver function, such as the excessive formation of uric acid and the occurrence of obesity.

It is these cases that are especially amenable to dietetic and other treatment, and especially to treatment by alkaline waters like those of Vichy and Carlsbad, when associated with an appropriate dietary.

Secondly, in the severe and grave form, in cases of so-called "true diabetes," in which we find not simply the symptoms of glycosuria, but other still more serious symptoms of disturbed nutrition, 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 wherever it may be formed, so that in these cases even nitrogenous matters may undergo transformation into sugar. In these cases all the remedial measures we at present possess prove but of little avail; and all we can hope for is to retard somewhat the progress of the malady.

Neither of these hypotheses is inconsistent with the occasionally observed occurrence of glycosuria from irritation of portions of the nervous system, as in C. Bernard's celebrated experiment of pricking the floor of the fourth ventricle.

For the effect of such irritation may be to disturb the innervation of the vessels of the liver, to cause dilatation of these vessels, and so to allow the blood to be, as it were, hurried through this organ at a rate which is inconsistent with the complete transformation of the alimentary glucose of the portal blood into the amyloid substance "glycogen," so that a portion of this sugar which should be detained and fixed in the liver-cells flows on into the general circulation, and is excreted in the urine.

Let us now pass on to the practical consideration of what is the best dietetic treatment that we can apply to these cases of diabetes.

In the case of the fat, well-nourished, gouty, glycosuric patient, we may apply unhesitatingly the strictest dietetic rules, and commonly with considerable success; but with the wasted, ill-nourished, *true* diabetic, the case is otherwise, and our difficulties in the matter of diet are great; for not only have we to consider how to check or arrest the amount of sugar that he forms and excretes, but we have to attempt the even more difficult task of maintaining and improving the seriously damaged general nutrition.

It is generally admitted that the *carbo-hydrates*—*i.e.* all food-stuffs containing glucose, or whatever can be converted into glucose in the organism—should be, so far as is possible, excluded from the diet of diabetics, and that they should be fed as exclusively as possible on albuminous foods and fat.

"In diabetes mellitus the sugar introduced with the food or formed within the organism is only imperfectly applied in the animal economy, since a greater or less proportion of it is washed out of the body with the urine, without having undergone the normal splitting up. The *sugar and the sugar-forming substance must, therefore, present in the body of the diabetic the character of useless ballast."** Clinical observation also shows that the amount of sugar excreted in the urine, so far as it is dependent on the diet, exercises a great influence on the patient's well-being.

The fearful thirst of the diabetic patient is determined by the amount of sugar in the blood, and we can only hope to relieve the former by a diet which will also tend to diminish the latter; and although it is true, as has been stated, that in severe cases sugar will still appear in the urine, notwithstanding the entire withdrawal of carbo-hydrates from the food, yet it does so in diminished quantity, and this result is so far a gain.

It would seem from the observations of Külz † that all the carbo-hydrates do not increase the secretion of sugar, and that it may be possible, as suggested by Bauer, to utilise some of them in relieving the dread monotony of the diabetic diet; and he states, on the authority of Külz, that mannite, fruit-sugar (levulose), *inulin*, and inosite have no effect in increasing the sugar in the urine. It is very possible that not quite enough attention has been paid to the individual peculiarities of diabetics in framing their dietaries, and that certain *carbo-hydrates* may be well tolerated by some and not by others.

Fothergill,‡ who, as is well known, was himself a diabetic, calls attention to this point, and he asks: "Are not sometimes slight divergences from the rule permissible? Though milk does contain sugar, is it

* Bauer, "Dietary of the Sick;" Von Ziemssen's "Handbook of General Therapeutics," vol. i.

† Quoted by Bauer in "Dietary of the Sick," p. 296.

‡ "Manual of Dietetics."

always advantageous to bar it? . . . Sometimes milk may be allowed freely, and the same may be said about ordinary bread;" and he mentions the case of a glycosuric patient who passed urine "absolutely free from sugar. Yet at that time she was living upon vermicelli pudding and arrowroot;" and he mentions another instance, that of a glycosuric physician who mended greatly on "raspberry jam."

Külz suggests that biscuits might be made of *inulin*, and he gives a recipe for making them; * he also suggests that *Lichenin*, or "moss starch," a principal constituent of Iceland moss, might possibly be suitable for making diabetic bread, as the Icelanders make a palatable bread from the meal of this lichen, after washing the bitter principles out of it.

He also found a great difference in the tolerance of milk-sugar by different diabetics; some bore it remarkably well, while in others it caused a considerable increase in the amount of sugar in the urine.

The inability of the diabetic to utilise the carbohydrates, which form so large a proportion of the ordinary mixed dietary of the healthy, makes it necessary, if his nutrition is to be maintained, to replace these by an equivalent amount of other foodstuffs; and in severe cases a portion even of these is wasted and excreted in the form of sugar; so that it becomes an exceedingly difficult problem, in dealing with the severe forms of this disease, to supply the patient with enough readily digestible food to

* "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 30 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 the four eggs are to be added, having first been beaten to a foam and carefully worked 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."

compensate for the abnormal waste, as well as to maintain the normal nutrition of his body. These considerations amply account for the craving for food which the majority of diabetics experience.

It has been noticed by many that diabetics, especially in advanced stages, excrete a large amount of urea—two or three times as much in some cases as persons in health; and it would appear that, in this disease, the metabolism of the albuminates differs also from the normal. According to Senator, it is only in the severer cases that there is increased destruction of the albumen of the organism; while in other cases, fed on an exclusively animal diet and excreting no sugar, the abnormally large elimination of urea is accounted for by the increased consumption of albuminous food and the large flow of urine.

But the chief principle to be kept in view in determining the dietary of the diabetic is this: that by an exclusively animal diet the excretion of sugar, in slight cases, may be entirely suspended, and even in severe and advanced cases kept at a lower figure. Speaking generally, albuminates and fats should form as far as possible the sole food of the diabetic; and the severer the case the more rigid should be the application of this rule. Some concessions will, however, have to be made to the feelings and wishes, and even occasionally to the actual well-being, of the patient. And it would seem, from some of Külz's experiments, that the power of utilising sugar in the system is not *wholly* lost in this disease; and he has stated that some of his patients were able, even in advanced stages of the disease, to metabolise large quantities of sugar; and he also ascertained that muscular exercise greatly increased the metabolism of sugar in the organism of the diabetic, and lessened its excretion to a corresponding extent.* Other observers have, on

* Bauer, p. 302.

the other hand, noticed that in the grave forms of diabetes, muscular exercise has been badly borne.

Besides, however, the objections which diabetic patients themselves make to a diet composed exclusively of meat and fats, it is highly probable that such an exclusive diet may be itself injurious to some of them. It certainly tends to aggravate the tendency observed in many diabetics to an increased excretion of the nitrogenous elements of the urine, and especially to the formation of uric-acid deposits to which some of them are prone. It has also been stated by Ebstein and others that an exclusively animal (meat) dietary favours the development of *acetone* in the blood.

Some years ago it was stated by Dr. Scott Donkin that he had obtained excellent results in the treatment of diabetes by an *exclusively milk diet.* His system was to limit the food to *skimmed* milk, of which the patient was ordered to consume at first four to six pints a day, which quantity was slowly increased to 12 pints. The milk was taken warm, and a portion of it, about one-third, was converted into curds and whey; and Donkin maintained that at the end of a fortnight the sugar entirely disappeared from the urine. Although this method was never largely adopted, and although it was found to be badly borne by many diabetics, yet there can be little doubt that it agreed well with a few.

Many physicians (Bouchardat, Germain Sée, Dujardin-Beaumetz) discard milk entirely from the diet of diabetics.

Sée says: "I consider milk to be counter-indicated at all periods of the disease, and, like Frerichs, I have always seen the sugar in the urine greatly augmented under its influence."*

Dujardin-Beaumetz testifies to the same effect:

* "Du Régime Alimentaire," p. 522.

"I reject," he observes, "milk entirely from the dietary of the diabetics. I have always seen in diabetics who have drunk milk the amount of sugar in their urine increased by it." *

There are, however, other physicians who have not found milk so injurious to all their diabetic patients. Bauer considers it may be permitted, but only in moderation; and he refers to the remarkably diverse results of Külz's observations, who found that in some of his diabetic patients milk-sugar caused a "relatively considerable increase" of sugar in the urine; while in others it was "borne surprisingly well." †

Sir William Roberts considers milk much less deleterious to diabetic patients than might have been supposed; but, he admits, it is better to replace it by cream.

He made the following trial in a girl with confirmed diabetes. For four weeks she was fed on animal flesh and bran cakes; for the next four weeks she had three pints of milk added to her daily diet, and for the next three weeks she had no milk.

The following table shows the result:—

	Average quantity of Urine Daily.	Average quantity of Sugar Excreted Daily.	Increase of Weight.
	oz.	grains.	lb.
Meat Diet and Bran Cakes, for 4 weeks	55	897	5
Meat Diet, Bran Cakes, and 3 pints of Milk, for 4 weeks .	49	1,260	5
Meat Diet, Gluten Bread, and Cabbage, for 3 weeks . .	41	1,020	7

* "L'Hygiène Alimentaire," p. 178.

† Bauer, "Dietary of the Sick," p. 296.

"The patient," Sir W. Roberts says, "continued to gain weight, and to improve in her general condition under the use of milk, although the density of the urine and the excretion of sugar somewhat increased. A limited supply of milk may therefore be allowed." *

There are, as might be imagined, great practical difficulties in constructing a satisfactory dietary for diabetics exclusively of albuminates and fat; indeed, the quantity of fat necessary to supply the requisite amount of carbon needed in the system is with difficulty appropriated by the organs of digestion; and to attempt to meet the demand for carbon by albuminates alone would necessitate a quantity of such foods altogether unmanageable.

We are, then, in the end driven to adopt a *mixed* diet, the different articles of which have to be selected with especial regard to the amount of sugar-forming material they contain, choosing of course those which contain the minimum, and always looking to the albuminates and fats as the chief nutritive elements of the dietary.

And, first, with regard to *bread.* This forms so important an article in the habitual daily dietary of the healthy, and the ordinary kinds of bread are so rich in carbo-hydrates, that the ingenuity of physicians has been greatly taxed to produce a bread for the diabetic which shall prove a satisfactory substitute for ordinary bread.

Bouchardat suggested gluten bread as a suitable food for the diabetic; this is a bread made of wheat flour, deprived by repeated washings of as much of its starch as possible.

But gluten bread is never entirely free from starch; and unless it is prepared with great care and by known manufacturers, may even contain a considerable

* "A Practical Treatise on Urinary and Renal Diseases." Fourth edition.

quantity. It is also by no means agreeable to the palate. Yet when well and carefully prepared it undoubtedly supplies a need.

Sir William Roberts speaks highly of a gluten bread made in the form of small, palatable buns by Bonthron, 106, Regent Street, London. They keep about a fortnight, and he found them nearly free from starch.

Gluten meal may be used for thickening broths and for making puddings.

Bran bread, introduced by Prout, made from bran washed as free from starch as possible, has also been largely used for diabetics ; but, unless very carefully prepared, it contains a considerable amount of starchy material and also a large proportion of indigestible cellulose, which with some persons sets up a great deal of gastro-intestinal irritation.

Dr. Camplin's formula for bran cakes is one of the best ; it is as follows :—

"Take a sufficient quantity (say a quart) of wheat-bran ; boil it in two successive waters for a quarter of an hour, each time straining it through a sieve ; then wash it well with cold water (on the sieve) until the water runs off perfectly clear ; squeeze the bran in a cloth as dry as you can, then spread it thinly on a dish and place it in a slow oven ; if put in at night, let it remain until the morning, when, if perfectly dry and crisp, it will be fit for grinding. The bran thus prepared must be ground in a fine mill and sifted through a wire sieve of such fineness as to require the use of a brush to pass it through ; that which remains in the sieve must be ground again until it becomes quite soft and fine. Take of this bran powder 3 oz. (some patients use 4 oz.), the other ingredients as follows :—3 new-laid eggs, 1½ oz. (or 2 oz., if desired) of butter, and about ½ pint of milk ; mix the eggs with a little of the milk, and warm the butter with the other portion ; then stir the whole well together, adding a little nutmeg and ginger, or any other agreeable spice. Bake in small tins (patty-pans), which must be well buttered, in a rather quick oven for about half an hour. The cakes, when baked, should be a little thicker than a captain's biscuit; they may be eaten with meat or cheese at breakfast, dinner, or supper; at tea they require rather a free allowance of butter, or may be eaten with *curd* or any of the soft cheeses.

"It is important that the above directions as to *washing* and drying the bran should be exactly followed, in order that it may be freed from starch, and rendered more friable. The bran in its common state is soft, and not easily reducible to fine powder. In some seasons of the year, or if the cake has not been well prepared, it changes more rapidly than is convenient. This may be prevented by placing the cake before the fire for five or ten minutes every day." These cakes are made by Blatchley, 167, Oxford Street, London. Sir William Roberts suggests the use of seven eggs instead of three, as an improvement, also the addition of a teaspoonful of bicarbonate of soda.

"Torrified" bread, made by toasting thin slices of ordinary bread before the fire until they are deeply and thoroughly browned—almost blackened—so that the starch and gluten are in great part destroyed by the heat, is a highly acceptable form of food to some diabetics.

Pavy introduced almond cakes as a substitute for ordinary bread, and it is, undoubtedly, a valuable one. By washing the meal of sweet almonds with acidulated water, the greater part of the sugar is removed, and the meal so treated may by careful preparation be made into a palatable cake or biscuit.

Seegen also advocates the use of almond cakes, and gives the following recipe for making them :—

Take of blanched sweet almonds $\frac{1}{4}$ lb., 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 3 oz. of butter and 2 eggs. Next add the yolks of 3 eggs and a little salt, and stir well for some time. Whip up the whites of these eggs and stir in. Put the dough thus obtained into greased moulds, and dry by a slow fire.

Almond cakes are not popular with the French authorities. G. Sée prefers a small quantity of ordinary bread—5 oz. daily—or the same quantity of potato-meal.

Dujardin-Beaumetz also objects both to gluten bread and to almond cakes; the former he maintains is often found to contain a considerable percentage of starch; and he warmly advocates the use of potatoes instead, for those diabetics who cannot do without some food of this kind. Potatoes cooked in the oven contain, he asserts, only 8·3 per cent. of sugar-forming material, while gluten bread contains 27 per cent. These figures, of course, apply only to the gluten bread prepared in Paris. We must also remember that potatoes have no claim to be considered as nearly approaching gluten bread in *nourishing* properties, as they only contain 2·8 per cent. of albuminates.

Quite recently Dujardin-Beaumetz has advocated * the use of "soya" bread for diabetics, of which he gives the following as the composition:—

SOYA BREAD.

Water	45·000
Proteids	20·168
Fats	9·350
Starch and Sugar	2·794
Phosphoric Acid	0·863

This bread, he states, keeps well, and has an

* "L'Hygiène Alimentaire." Second edition.

agreeable taste, and contains much less sugar-forming material than gluten bread, the best kind of which, he asserts, contains at least 16 per cent. of starch and saccharine substances.

Lecerf * was one of the first to call attention to the value of the meal of the *Soya hispida* in dietetics. It has a leguminous fruit like the haricot, and is a native of China and Japan, but is now cultivated in Austria. The Chinese extract from soya a fatty substance which they use as milk, and even make cheese with it. The meal is very rich in nitrogenous substances, more so than animal flesh, and the amount of starchy and saccharine substance is very small.

All kinds of animal flesh and fats are permitted to the diabetic (except liver), and all kinds of fresh meat and of preserved meat, provided that sugar has not been used in their preservation—ham, bacon, sausages, fowl, game, fish, fresh and smoked, crustacea (crabs, lobster, etc.), oysters. Eggs, cheese, butter, cream, and all animal fats and oils, *cod's liver oil*, olive oil, may also be partaken of by them.

In cooking any of these, as *e.g.* fish, it must be remembered that no flour or other starchy material may be used, or in the preparation of sauces; and when "melted butter" is used as a sauce it must not be thickened by flour.

As one great object in the diet of the diabetic is to supply the deficiency of carbon—owing to the exclusion of the ordinary carbo-hydrates—by an increased consumption of fats, we may make free use of such articles of diet as *pâté-de foie-gras*, sardines in oil, *thon* in oil, *filets d'hareng saure à la Norvégienne*; and Dujardin-Beaumetz extols the use of *caviare*: it excites appetite, and he states he has had patients in the last stage of diabetes who have owed their resurrection to the use of caviare.

* *Journal de Médicine Pratique*, 10 Juin, 1888, p. 923.

Green and fresh vegetables are freely allowed, and should enter as much as possible into the dietary of the diabetic—cabbage, spinach, sorrel, lettuce, dandelion, cucumber, watercresses, and those vegetables commonly used for salads; and some physicians allow a small quantity of such vegetables as green French beans, asparagus, celery, onions, leeks, and even carrots and truffles.

Carrots, turnips, beans, peas, and beet-root are, however, most commonly prohibited.

Fruits are altogether prohibited by some, and not so entirely by others. All agree in forbidding the sweeter kinds of fruits, and all candied and preserved fruits. But many authorities consider a moderate amount of fresh acidulous fruit permissible—gooseberries, apples, currants, cherries, etc.; they contain more *levulose* than grape-sugar.

All vegetables and fruits containing large amounts of starch and sugar must be strictly forbidden.

The question of *beverage* is a very serious one to the diabetic, for his thirst is, as a rule, urgent and constant, and his temptation, therefore, to drink when and what he ought not to, is very great.

All strong alcoholic and saccharine drinks must be forbidden, except in very small quantities and largely diluted with water or an alkaline mineral water.

A small quantity of the lighter acid wines, such as claret, hock, and still Moselle, may be allowed, mixed with water. Unsweetened spirits—brandy, gin, and whisky, mixed with water—may occasionally be substituted for wine.

Weak infusions of tea and coffee or cocoa, also made without sugar, are admissible; these may be sweetened if required with minute quantities of *saccharin* (not more than $1\frac{1}{2}$ grain of this substance should be taken daily, as gastric pains and disorder have been provoked by its constant use in larger doses).

As to wines, it is desirable to notice which kinds (of those generally permitted) are best borne by different diabetics.

All saccharine wines (ports, champagnes, Sauternes, etc.), liqueurs, and beer must be strictly avoided.

To resume : the following are the *indications* to be satisfied in fixing a *régime* for the diabetic, as formulated by Professor G. Sée :—

1. Reduce to a minimum or abolish altogether all sugar-forming foods, *i.e.* all substances containing starch or sugar.

2. Raise to the physiological maximum all flesh foods, *i.e.* give as much animal food — meat of all kinds—as can be well digested and assimilated.

3. Find suitable substances to replace the necessarily discarded *carbo-hydrates*—and these are to be found amongst the various animal and vegetable fats. Their richness in carbon renders them fitter for this purpose than albuminates.

4. Promote muscular activity in order to consume the excess of sugar in the blood.

This last indication must be applied with discrimination ; and it must be remembered that in the graver forms of diabetes—the thin, wasted diabetics —much muscular exercise is ill borne ; on the other hand, the stout, gouty, glycosuric patients are doubtless benefited by exercise.

I have already alluded to the value of alkaline water in diabetes. They often prove of so much use that they may be regarded as forming a fit part of the diabetic *régime.*

Their use is frequently attended by a diminution of the excessive thirst, a disappearance of the distressing dryness of the mouth, by a less frequent need to pass water, and by a removal of cutaneous irritation and eruptions.

The mode of action of these alkaline waters remains obscure; but their good effects are undoubted.

It is scarcely necessary to say that we must not expect to observe these good results of the use of alkaline waters as frequently in the graver as in the slighter, and especially in the gouty, forms of diabetes.

If we employ the stronger alkaline waters, like those of Vichy and Vals, we may direct the patient to drink from 3 oz. to 6 oz. half an hour before each meal; the weaker waters, like those of Neuenahr, Ems, Apollinaris, etc., may be taken in larger quantity, and may be used to mix with wine.

In diabetes, as in nearly every form of disease which we are called upon to treat, our guiding rule should be "*discrimination!*"

We must adapt our *régime* to individual cases, and we must observe carefully whether the measures we adopt are well or ill tolerated by different patients. We should, therefore, frequently examine our patients' urine, and notice what influence is exercised on the amount of sugar excreted by different articles of food; we should also weigh our patients frequently to ascertain the effect of the dietary adopted on the nutrition of the body.

If we follow this plan we shall discover that some diabetics may be permitted a much more liberal and varied dietary than others, and that measures which on theoretical grounds might appear necessary, often prove practically undesirable.

DIABETIC DIETARIES.

1.—Pavy's.*

Sanctioned:	*Forbidden:*
Butchers' meat of all kinds, except liver.	Sugar in any form.
Ham, bacon, and other preserved meats.	Wheaten bread and ordinary biscuits of all kinds.
	Rice, arrowroot.

* "Food and Dietetics." 2nd edition. 1876.

Sanctioned:	*Forbidden:*
Poultry and game.	Sago, tapioca.
Fish of all kinds, fresh and cured, including the crustacea.	Macaroni, vermicelli.
Animal soups, beef-tea, and broth (not thickened).	Potatoes, carrots.
Eggs, cheese, cream cheese, cream, butter.	Parsnips.
Almond, bran, or gluten substitutes for ordinary bread.	Beet-root.
Greens, spinach.	Peas.
Turnip-tops, watercress.	Spanish onions.
Mushroom, mustard-and-cress.	*Pastry and puddings of all kinds.*
Cucumber, lettuce, endive.	Fruits of all kinds, fresh and preserved.
Radishes, celery.	
And the following only in moderate quantity, after boiling in much water:	
Turnips, French beans.	
Brussels sprouts, cabbage.	
Cauliflower, broccoli, sea-kale.	
Asparagus, vegetable-marrow.	
Pickles, olives, vinegar, oil.	
Jelly, flavoured, but not sweetened.	
Savoury jelly.	
Blanc-mange, made with cream and not milk.	
Custard, made without sugar.	
Nuts of all kinds, except chestnuts.	

Beverages.

Tea, coffee, cocoa from nibs.	Milk, except sparingly.
Dry sherry, claret, hock.	Sweet ales, mild and old porter and stout, cider.
Dry Sauterne, Chablis, Burgundy.	All sweet and sparkling wines.
Brandy and spirits, unsweetened.	Port wine, unless sparingly.
Soda-water.	Liqueurs.
Burton bitter ale in moderate quantity.	

2.—Seegen's.*

Sanctioned:

In any quantity:

Flesh of all kinds: preserved (smoked) meats, ham.
Tongue, bacon.
Fish of all kinds.
Oysters and shell-fish.
Crabs, lobsters.
Animal jellies.
Aspic.
Eggs, caviare, cream, butter, cheese.
Spinach, cooked salads, endive.
Cucumber, green asparagus.
Watercress, sorrel.
Artichokes, mushrooms.
Nuts.

In small quantity:

Cauliflower, carrots.
Turnip, white cabbage.
Green beans.
Berries, such as *strawberries, raspberries, currants;* also oranges and almonds.

Forbidden:

Farinaceous foods of all kinds. (*Bread only in very small quantity according to the discretion of the physician.*)
Sugar.
Potatoes, rice, tapioca.
Arrowroot, sago, groats.
Peas, beans.
Sweet fruits, as grapes, cherries, peaches, apricots, plums, and all kinds of dried fruits.

Beverages.

In any quantity:

Water, soda-water.
Tea, coffee.
Bordeaux and Rhine and Moselle wines.
Austrian and Hungarian table wines.
In short, all wines that are not sweet, and that contain only a moderate amount of alcohol.

In very small quantities:

Milk, unsweetened.
Almond emulsion.
Brandy, bitter beer.
Lemonade, unsweetened.

Champagne and sweet wines and beers, must, fruit wines and fruit juices and syrups.
Sweet lemonade.
Liqueurs.
Ice and sorbets.
Cocoa and chocolate.

* "Der Diabetis Mellitus." Berlin. 1875.

3.—Sir William Roberts'.

Sanctioned:

Butchers' meat.
Poultry and game.
Fish.
Cheese.
Eggs.
Butter, fat, and oil.
Broths, soups, and jellies, made without meal or sugar.
Cabbage, endive, spinach.
Broccoli, Brussels sprouts.
Lettuce, spring onions.
Watercress, mustard-and-cress
Celery.

Substitutes for bread:

Bran-cake, gluten bread (and meal), almond meal, rusks and biscuits.
" Torrified " or charred bread.

Forbidden:

All saccharine and farinaceous foods.
Bread, potatoes.
Rice, tapioca, sago, arrow-root, macaroni, etc.
Turnips, carrots, parsnips, beans and peas.
Liver (contains much sugar-forming substances), and therefore

Oysters, Cockles, Mussels } containing enormous livers.

The "pudding" of crabs and lobsters.
All sweet fruits, as apples, pears, plums, gooseberries, currants, grapes, oranges, etc.

Beverages.

Dry sherry, claret, bitter ale.
Brandy and whisky (in small quantities).
Tea, coffee (no sugar), chocolate (made with gluten meal), soda-water, bi-tartrate of potash water.

Port and all sweet wines.
Sweet ales and porter.
Rum and sweetened gin.

4.—Germain Sée's.*

1.—He permits all kinds of animal flesh, boiled or roasted.
Ham, bacon.
All kinds of fish, crustacea, oysters.
Eggs, cheese (well-kept).
2.—Fats of all kinds, butter, lard, and sauces without flour.
3.—He permits 5 *oz. of bread or potatoes* daily.
4.—Also roots and green vegetables.
5.—Saccharin, to replace sugar.
6.—He forbids *milk* as a general rule.
7.—He considers the best beverages to be wines that are not sweet, and tea and coffee, without sugar.
8.—He recommends Vichy water before meals, especially in gouty cases.

* " Du Régime Alimentaire." Paris. 1887.

5.—DUJARDIN-BEAUMETZ'S.

He adopts with little modification the dietary of Bouchardat.

,, strongly recommends the substitution of potatoes cooked in the oven for bread, even gluten bread; *also the use of soya bread.*

,, prescribes *soups* made with fatty substances, and with poached eggs; also vegetable soups made with cabbage, onion, Julienne soup, but without turnips and carrots; and *soups made with potato and leek.*

,, allows all kinds of animal food, fish, molluscs, and crustacea, and cautions against the use of sauces containing flour.

,, recommends all kinds of fats.

,, allows such vegetables as spinach, sorrel, French beans, lettuce, cabbage, asparagus, celery, artichoke, dandelion, and all salads.

,, forbids beet-root, carrots, turnips, and allows only small quantities of onions and leeks.

,, rejects all fruits but *gooseberries!*

,, advises for beverages, wine mixed with a natural alkaline water; light infusions of tea and coffee, if required, sweetened with glycerin, but without sugar and milk.

Also to relieve the thirst, bitter infusions, as of quassia and cinchona.

Milk he forbids entirely.

As specialities he commends sardines in oil, *thon* in oil, *foie-gras, caviare*, and *Filets d'hareng saure à la Norvégienne.*

6.—BOUCHARDAT'S.

Sanctioned:

All kinds of meat (150 to 200 grammes of fat daily), cooked in any way, but without meal or sugar.

All kinds of fish.

Lobsters, crabs, oysters.

Snails.

Eggs.

Cream.

Cabbage, lettuce, spinach, artichokes, asparagus, green beans, etc.

Peaches and strawberries.

Substitute for bread: gluten bread.

Forbidden:

All substances rich in carbohydrates.

Milk.

Beverages.

Claret or Burgundy — For men 1 pint to $1\frac{1}{2}$ pint daily.

7.—Cantani's.

(*This is a very exclusive diet.*)

Sanctioned:	*Forbidden:*
Meat and animal fats of all kinds (at all meals).	*Liver.*
Fish of all kinds.	*Butter*, as it contains traces of lactose.
Lobsters.	*Cheese.*
Olive oil (instead of butter).	*Milk.*
Eggs (in *milder* cases).	*All farinaceous and saccharine foods* absolutely.
Substitute for bread: Pavy's almond cakes (only for convalescents who cannot entirely dispense with bread).	All fruits.
	All green vegetables and roots.

Beverages.

Pure water.	Lemonade.
Soda-water.	Chocolate.
Persons habituated to the use of strong wines and spirits may add to the water 10 to 30 grammes of pure alcohol daily.	Vinegar.
Red wine.	Rum, Cognac.
Tea and coffee in small quantity in *milder* cases.	Tea and coffee (in *severe* cases).

Cantani considers much salt injurious, as well as much pickled pork or salt fish.

He requires the adoption of this absolute meat and fat diet for three months—in very mild cases for two months, in very severe cases for six or nine months. If after two months the urine contains no sugar, he allows green vegetables; after another month, cheese and old red wine; and after another fortnight, almonds and nuts. A month or so after this, he permits juicy fruits, not too sweet, as strawberries, raspberries, peaches, apples, and sour oranges; still later, plums, gooseberries, green beans and peas, tomatoes, melons, cucumbers, and gourds. After another fortnight, milk and fresh milk foods may be used.

Finally, if after repeated examination no sugar be found in the urine, small quantities of farinaceous food may be cautiously permitted, but their use must be restricted for life. It is best to avoid altogether cane-sugar and *sweets* of all kinds.

Cantani urges the consumption of as much fat as possible, and especially of "pancreatic fat," as easy of digestion. It is prepared of pancreas, cut up into small pieces, well mixed with a certain quantity of melted bacon fat or lard, left to undergo an artificial digestion for about three hours, and finally lightly roasted before the fire. In mild cases he prescribes pure sugar-free cod-liver oil, in 20 to 100 gramme doses.

8.—Ebstein's.

He maintains that every case should be individualised. The food he prescribes depends on the age and individuality of the patient. For thin persons he prescribes more fat than for corpulent ones.

Early Breakfast.

One cup of coffee or tea (black), without milk and sugar.

White bread toasted, 30 to 50 grammes; or brown bread, well buttered—butter, 20 to 30 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). Some peptone may be added to the broth.

Meat (180 grammes, free from bone), roasted, boiled, or stewed—beef, mutton, pork, veal, fowl, or venison (fat meat preferred).

Gravies, with cream or yolk of egg, *not* flour.

Or *fish*, with melted butter.

Vegetables, prepared with much fat; *purées* of leguminous plants. *Salads*, dressed with vinegar and oil, and some cream.

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, ham or cheese, or an egg, or fish, caviare.

Bread, 30 to 50 grammes, with *butter*, 20 to 30 grammes.

Apples, pears, and stone fruit are allowed in small quantities.

Beverages.—He forbids absolutely the use of beer, limits the use of spirits, and allows about half a bottle of wine daily.

If the patient digests *milk* well, he allows it in moderate doses, and cream especially.

9.—DÜRING'S.

This dietary differs from most others, and is founded on the theory that the most important factor in the causation of diabetes is a faulty diet and disturbed digestion; Düring therefore insists only on a restricted diet and the selection of the most digestible foods.

FOR EARLY BREAKFAST.

Milk, with a little coffee, but no sugar (some lime-water to prevent milk from becoming sour in stomach).

Stale white bread, *ad libitum.*

Or oatmeal, barley, or rice-gruel, made with water, a little salt, but no butter (if bread cannot be borne).

FOR 2ND 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).

FOR DINNER (TAKEN BETWEEN 2 AND 3 O'CLOCK).

Soup, with rice, barley, or oatmeal.

Meat, roast, 250 grammes (game, ham, and smoked meats as free from fat as possible, are permissible), no condiments, *no fatty sauces.*

Compôte of dried apples, plums, cherries.
Dried peas or white beans, in some cases.
Green vegetables, asparagus, French beans, carrots, cauliflowers, cabbages (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.

For Supper (about 7 p.m.).

Gruel of barley, oatmeal, or rice, with salt (but no butter), and strained. In some cases may be made with milk.
Ice or iced water, to relieve thirst between meals.

He lays great stress on the mode in which these vegetable foods are prepared; especially the cereals used for making gruel and the legumes are, before being cooked, to be steeped for some time, and boiled long enough to make them more easily digested.

CHAPTER IV.

DIET IN ALBUMINURIA.

THE presence of albumen in the urine occurs under a variety of circumstances differing greatly in their significance and seriousness. Some of the abnormal conditions which give rise to the presence of albumen in the urine are temporary and comparatively unimportant, others are more or less permanent and of extreme seriousness.

It is to the latter that the term "chronic Bright's disease" is usually applied, and the morbid condition then associated with the albuminuria is the existence of organic structural changes in the kidneys themselves. These are cases of "chronic renal" disease.

The presence of albumen in the urine occurs also temporarily in the course of many acute febrile disorders, as, for instance, in the *exanthemata*, especially in scarlet fever, in diphtheria, and indeed in nearly all severe forms of acute febrile diseases in some part of their course.

Some of the instances of *chronic* Bright's disease no doubt originate in *acute* inflammatory affections of the renal organs, "acute Bright's disease," and these may occur without the coexistence of any other febrile malady.

Albumen may occasionally and temporarily be present in the urine in connection with dyspepsia, and from improper feeding, or from over-exertion, too rapid growth, and other debilitating influences.

Albuminuria from passive hyperæmia of the renal vessels, as a part of that general venous obstruction dependent on chronic heart and lung disease, forms a part of the clinical history of those affections, the dietetic management of which need not be examined here.

We are now only concerned with those instances of albuminuria in which appropriate dietetic treatment is called for, and of those the cases of so-called chronic Bright's disease are by far the most important.

The question whether a diet rich in albumen, or an excess of albuminous ingesta, can give rise to albuminuria has been investigated experimentally by many observers with somewhat conflicting results.

It is generally admitted that when albuminuria exists certain kinds of food will often cause a great increase in the quantity of albumen excreted in the urine ; but it is by no means so generally allowed that a temporary albuminuria can be produced by food in the same way as temporary glycosuria can be brought about.

Certain instances have undoubtedly been observed of persons who, when apparently in good health, pass albuminous urine after a large meal, or after prolonged muscular effort, but who do not do so when fasting or after repose.

It is, however, doubtful if it is strictly correct to call this "physiological albuminuria," and the explanation put forward by Leube of this circumstance is probably the true one, viz. that it only occurs in persons who inherit, or are born with, an abnormality of the renal structure in the form of a diminished resistance in the renal filter to the passage of albumen.

Prof. Grainger Stewart has instanced "cheese, pastry, and eggs," as forms of food which he has observed to be capable of inducing albuminuria in certain persons,* and he mentions the case of a medical colleague who whenever he indulged in pastry or cheese was pretty sure to suffer from albuminuria, with puffiness of the eyelids.

* "Lectures on Important Symptoms : Albuminuria," p. 145.

It has also been shown by several observers that egg-albumen injected into the veins of animals (Stockvis), or under the skin (Semmola), or into the rectum, is followed by albuminuria. There is nothing to be wondered at in this, seeing that the albumen injected in these experiments has not undergone any digestive changes, has not been peptonised, is, therefore, in an unassimilable condition, and is consequently excreted from the blood by the kidneys; whereas when serum-albumen—*i.e.* albumen which has undergone the digestive process and become assimilable—is similarly injected no albumen appears in the urine.

But it has been also asserted that egg-albumen taken *into the stomach* in large quantity will cause albuminuria.

Setting aside individual peculiarities (a few individuals can never take eggs in any form without suffering disturbances of health), great discrepancies occur in the observations made as to this point by different experimenters.

Stockvis and some others have stated that in animals and in themselves they have found that when egg-albumen (uncooked) was taken into the stomach in large quantity a portion of it was excreted in the urine. Stockvis suggested as an explanation of this fact that a portion of the uncoagulated albumen entered the blood unaltered, and was, therefore, eliminated as unassimilable. Nussbaum, Coats, and D'Arcy Power claim to have seen albuminuria produced in the same way. Lauder Brunton, however, failed to produce albuminuria by swallowing six raw eggs in succession; and Dr. Maguire swallowed the whites of twelve raw eggs without producing albuminuria.

Another observer* ate nineteen raw eggs in thirty-six hours without producing albuminuria.

* Dr. Dobradin quoted by Grainger Stewart.

The probable explanation of these discrepancies in the results which have been obtained from eating raw eggs is simple enough. We are familiar with the great variation in the rapidity of digestion and the capacity of digesting different articles of food in different individuals. In those in whom the digestion of albuminous food is slow and limited, if fed on raw eggs, some of the egg-albumen escapes digestion, and passes into the blood unaltered, just as it might do if injected into the rectum; while in others, whose capacity for the rapid digestion of albumen is great, a far greater amount of egg-albumen can be digested and assimilated in a short time.

It has also been stated that albuminuria can likewise be produced by eating an excessive quantity of cooked eggs, and the authority of Claude Bernard is quoted in support of this statement.

The results of some experiments instituted by Prof. Grainger Stewart * led him to the conclusion "that the introduction of raw egg-albumen into the stomach induces albuminuria; that the albumen is always in small quantity; that it disappears when ordinary diet is resumed; and that it is not egg-albumen but *serum-albumen* which is discharged."

If we examine Prof. Grainger Stewart's cases, we find one, a case of "locomotor ataxia," took ten raw eggs daily, *in addition to his ordinary diet*, for a period of nine days. Albumen appeared in the urine after two days.

One, a case of "mitral incompetence," took nine eggs daily for seven days. Albumen appeared in the urine on the first day.

One, a case "free from organic lesion," took ten eggs daily for three days, in addition to the ordinary diet, and albumen appeared in the urine from the first day.

* Op. cit.

And in the fourth, a case of chorea, "the eggs were not well borne by the stomach," and the albumen in the urine may, therefore, have been the result of dyspepsia.

We should be disposed to take exception to all but one of these cases.

The well-known digestive abnormalities of the ataxic should have rendered such a patient unsuitable for a test experiment; and the presence of "mitral incompetence" would give so great a tendency to venous hyperæmia, that the occurrence of slight temporary albuminuria might be readily provoked.

The occurrence of temporary albuminuria under circumstances like these has been explained by the suggestion that the blood, becoming surcharged with albumen, some of the excess escapes by the kidneys; but may not the true explanation be that the ingestion of so large an excess of albuminous material may throw upon the kidney such an excess of nitrogenous waste (to be excreted), that a temporary functional hyperæmia of the kidneys is excited, and that this leads to a slight escape of albumen 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 feeble or disordered constitutions, and not in the perfectly sound and vigorous.

Dr. Grainger Stewart also tested the effects of some other articles of food, as cheese and walnuts, and came to the conclusion that, although "particular articles of diet induce albuminuria in some people, yet the quantity of albumen is usually minute, and it has little tendency to persist after the resumption of ordinary food."

Pettenkofer's and Voit's observations * convinced these physiologists that albuminuria was never caused solely by excess of nitrogenous food. Voit gave a dog weighing 35 kilogrammes 2,600 grammes of meat

* Quoted by G. Sée, "Du Régime Alimentaire," p. 705.

in twenty-four hours, and found not the least trace of albumen in the urine; yet the animal had absorbed nearly six times the amount of dry albumen contained in the fluids of its body.

Professor Oertel also experimented on the effects of the ingestion of egg-albumen. He gave to his dog, weighing only $7\frac{1}{2}$ kilogrammes, the whites of 20 eggs in 24 hours by the stomach, and after various trials he never found albumen in the urine. He also gave to one of his patients affected with heart disease, besides 350 grammes (about $12\frac{1}{2}$ oz.) of meat, 190 grammes (about 7 oz.) of bread, and 200 grammes (rather more than 7 oz.) of vegetables, *six raw eggs daily for* 12 *days—i.e.* 72 eggs altogether—containing 460 grammes of dry albumen, without finding a trace of albumen in his urine. He obtained, moreover, the same negative result with a patient who ate, on an average, six boiled eggs daily.

It is, then, safe to conclude that the occasionally observed occurrence of albuminuria as a result of the ingestion of albuminous food in excess is an accidental peculiarity or idiosyncrasy, and not an ordinary physiological phenomenon.

With regard, however, to diet in albuminuria when connected with existing renal disease, there is, as has already been said, an almost general consent that richly-nitrogenised food is distinctly prejudicial, and more especially so if it consists of brown meats, of eggs, or of highly-spiced food.

Grainger Stewart has, nevertheless, expressed his belief that in the *cirrhotic* form of Bright's disease diet is a less important element in treatment than in cases of tubular inflammation; and he gives the particulars of cases in which he ordered eight raw eggs daily in addition to the usual "low diet," without causing any material change in the secretion.*

* Op. cit., p. 206.

But, as Dujardin-Beaumetz has well pointed out, in dealing with cases of advanced Bright's disease, it is not so much the quantity of albumen that appears in the urine that should be our chief concern, but rather the extent of the renal changes and the *consequent retention* of products of nitrogenous waste in the system; and it is to avoid or diminish the risks of this *intoxication* with urinary excreta that our dietetic rules should be directed.*

The clear indication, then, is to administer such food as is found to be readily assimilable, and which will least tax the digestive functions, and at the same time furnish the smallest amount of nitrogenous waste calling for elimination by the damaged kidneys.

To fulfil this indication it has been proposed to restrict the food of those suffering from both acute and chronic Bright's disease, *exclusively* or almost exclusively to *milk;* and it is certain that some of the most remarkable and best results in the treatment of these cases have been obtained from a strict adherence to milk diet—the *régime lacté* of French authors. In cases in which this plan of feeding has been well borne, it has been observed that the flow of urine has increased, the excretion of albumen diminished, the amount of urea and extractives has been augmented, and the anasarca has disappeared.

But great practical difficulties are often encountered in procuring the adoption of this method by the patients themselves, and in not a few cases a diet consisting exclusively, or even largely, of milk is not well tolerated.

It is, however, quite established that an exclusively milk diet can completely supply all that is needed to repair the nutritive wants of the organism.

As a food for adults milk is defective in the

* "L'Hygiène Alimentaire," p. 188.

amount of carbo-hydrates it contains, and which is required in the adult body for the development of animal heat and muscular energy.

According to Pettenkofer's and Voit's calculation, the daily ration for an adult should contain—

137	grammes	of dry albumen;
117	,,	of fat;
and 352	,,	of carbo-hydrates.

The invalid who takes little exercise and expends little in muscular exertion would require somewhat less, and it is reckoned that from 5 to 7 pints (*i.e.* 100 to 140 oz.) of milk daily will be sufficient for all the requirements of an adult.

Seven pints of milk are estimated to contain

216	grammes	(about $7\frac{1}{2}$ oz.)	of albumen and casein;
172	,,	(,, 6 ,,)	of butter;
and 161	,,	(,, $5\frac{1}{2}$,,)	of lactose.

If this quantity falls short in the relative proportion of carbo-hydrates, it makes up for this by the increased proportion of fat and albuminates contained in it.

Milk is also rich in chlorides and phosphates, salts essential to the due nutrition of the tissues. It has been suggested that the other saline ingredients contained in milk may exercise a diuretic action, but it seems more probable that the increase in the flow of urine observed to accompany an exclusively milk diet is due to the quantity of water ingested.*

The mode of applying this exclusively milk diet is as follows:—

If the patient's stomach will bear the sudden suppression of all other kinds of food, the full quantity of milk may be at once taken daily; but if the

* The diuretic action of *Lactose* has quite recently been established by G. Sée and Dujardin-Beaumetz.

stomach shows less tolerance of the change, it should be made more gradually, and half a glass or a glass of milk should be taken at suitable intervals, and other kinds of food slowly and by degrees replaced by it.

The milk should be as fresh from the cow as it is possible to obtain it, and drunk at the ordinary temperature, not boiled, and with no flavouring or addition whatever. It is better to take it in small or moderate quantities at short intervals—a glass (6 oz.) every hour during the day, and two glasses on getting up and on going to bed; or when it is inconvenient to take it so often, two glasses may be taken every two hours. When the patient is restricted entirely to milk, it must be remembered that he will require to take from 18 to 24 glasses of 6 oz. each in the twenty-four hours.

It is very important that at the commencement of this diet the doses should be small; dislike of the remedy and digestive troubles are much more likely to occur and interfere with the success of the treatment if the patient is allowed to begin by taking large quantities at a time.

If diarrhœa should occur, it is a sign that the milk is not digested, and the diet must be altered or modified; a reduction in the quantity may be all that is needed.

As soon as the tolerance of this milk diet is established and the patient is able to take from five to seven pints a day, an inconvenience arises in the form of obstinate constipation; and, at the same time, the patient often complains of an unpleasant taste in the mouth and a dirty tongue.

The state of the mouth may be improved by sipping a little soda- or seltzer-water after each glass of milk; and the constipation must be encountered by some suitable aperient—a little Gregory's powder or compound liquorice powder, or citrate of magnesia or a capsule of castor-oil, or a teaspoonful of Carlsbad salts or an aperient enema; either of these may be taken, according to the discretion of the medical attendant or the inclination of the patient.

In very troublesome cases of constipation, an addition to the daily diet of a few stewed prunes or the pulp of one or two baked apples may be permitted

The body-weight usually diminishes somewhat during this treatment; the urinary secretion is often increased to a remarkable extent, and this diuresis is generally accompanied by a disappearance of dropsy, if it exists.

The abundant urine is pale, clear, with a peculiar greenish-yellow reflection, said to be characteristic of the milk diet; usually of low specific gravity, on account of the quantity excreted, and of diminished acidity; the amount of albumen excreted will usually be observed to diminish gradually from day to day, while the proportion of urea and salts is progressively increased.

It has been noticed that during the night, when the ingestion of milk is necessarily interrupted, the urine is passed in less quantity and is more albuminous. Jaccoud, therefore, recommends that the patient should take advantage of any chance wakings during the night to drink a few doses of milk, so as to keep the urinary secretion constantly under its influence.

The period during which the treatment should be maintained cannot be fixed with any strictness. It must depend upon the nature of the case and the progress of the patient.

If we are treating a case of *acute nephritis*, and have adopted the exclusively milk diet from the commencement, three or four weeks may suffice to get rid of the albuminuria, and we may slowly and gradually return to the ordinary diet.

In *chronic parenchymatous nephritis* (inflammation of the tubules), the result of treatment will depend upon the age of the patient and the duration and extent of the kidney lesions.

In advanced cases, where cure is not possible, considerable amelioration in the general condition of the patient may constantly be observed, together with an increased flow of urine, disappearance of dropsy, a steady diminution, little by little, of the amount of albumen, which, although it may not entirely disappear, at the end of six or eight weeks, will be reduced to a minimum. The kidney lesions are irreparable, but the milk diet has lessened, in a great measure, the excretion of albumen, and has restored a due elimination of the nitrogenous and other urinary excreta.

In cases of *cirrhotic* or *interstitial nephritis* (gouty contracted kidney), an exclusively milk diet is less urgently indicated. When, however, the cardiac compensation begins to fail, and symptoms of uræmia are threatening, then great advantage may follow the adoption of this mode of treatment.

We are in ignorance at present as to the precise manner in which the milk acts on the organism or on the diseased kidneys so as to produce the beneficial results observed.

In those cases in which an exclusively milk diet is badly borne or absolutely rejected by the patient, we must fall back on some other method of feeding.

We should, in the first place, endeavour to induce the patient to accept a modified milk diet, and supply him with dishes largely composed of milk, but which have the advantage of agreeable flavouring, without which food of all kinds is so repugnant to many.

Milk may be made the basis of soups, to which various vegetable flavouring substances may be added, as onions, celery, and the usual aromatic herbs commonly employed for such purposes, together with a little salt and pepper; fragments of toasted bread may be served with these milk soups. Arrowroot, tapioca, rice, and vermicelli may be used to thicken milk, and a little grated lemon-peel or cloves or nutmeg may be used to flavour foods thus made; or a small quantity of fruit jelly, such as red-currant jelly, may be eaten therewith.

On leaving off the exclusively milk diet, the patient should be permitted, by slow degrees only, to return to the ordinary diet.

At first a little arrowroot, tapioca, or rice should be substituted for a portion of the milk; then a little fish, chicken, or other white meat, and a little green vegetable, cooked fruit, and a small quantity of good sound Bordeaux wine, mixed with seltzer-water, may be taken with the midday meal.

Should the attempt to return to a mixed diet be attended with an increase in the quantity of albumen excreted, the exclusively milk diet must again be resorted to.

It must, of course, be borne in mind that an irreparably damaged kidney cannot be made structurally sound by milk diet or by any other remedy; and in such cases, after the albumen has been reduced to a minimum by the milk diet, a return to a carefully-arranged mixed diet may not only be justifiable, but advantageous.

Oertel, Grainger Stewart, and others have shown that in many such cases a diet rich in albumen is well tolerated, and not attended with any notable increase in the amount of albumen excreted in the urine.

It is in acute cases, and especially in those cases which seem to be passing from acute to chronic, and before the structure of the kidneys has been hopelessly damaged by inflammatory and degenerative changes—it is in such cases as these that the exclusively milk diet is attended with such brilliant results.

In those cases in which, for some reason or other, the milk diet is inadmissible, we have to consider what is the best alternative.

It has already been pointed out that the subjects of albuminuria must carefully avoid any *excess* of nitrogenous food. Senator recommends that animal flesh should be altogether avoided, or limited to, at most, a little white meat, while all kinds of vegetables and fats are permissible. Dujardin-Beaumetz also testifies that he has obtained excellent results by restricting patients with albuminuria to vegetable food. Farinaceous food, fresh vegetables, and fruit, together with milk, butter, cream, and other fats, afford all that can be needed for the nutrition of the body.

Dujardin-Beaumetz commends the onion, especially, as an addition to soups; and he states that when he has found his albuminuria patients unwilling to relinquish meat, pork has appeared to him to increase the amount of albumen excreted less than other meats, and he is, therefore, in the habit of recommending them either ham or cold roast pork, and the fat in particular. He differs from Senator in not thinking well of *fish* in these cases; he believes it increases notably the amount of albumen in the urine. As cheese is a highly albuminous food it should be avoided altogether, or taken only in very small quantity.

As a beverage, he prefers milk, so long as the patient can tolerate it; all spirits and undiluted wines, and all kinds of beer, he forbids entirely; he allows, in certain cases, a small quantity of wine, especially tannin wine (St. Raphael), mixed with the weaker alkaline waters of Vals or Vichy.

Semmola of Naples has advocated the habitual use of the following drink for patients with Bright's disease :—

Sodium iodide	. . . . .	15 grains.
,, phosphate	. . . . .	30 ,,
,, chloride	. . . . .	90 ,,
Drinking water	. . . . .	36 oz.

He recommends that this should be drunk daily, either alone or mixed with milk, and states that he has obtained the best effects from its use.

CHAPTER V.

DIET IN GOUT AND CALCULOUS DISORDERS.

If gout is, as we have maintained elsewhere,* mainly due to disturbed retrograde metamorphosis of the nitrogenous constituents of food, it follows that it must be a disease greatly under the control and influence of diet.

Closely related to those morbid disturbances in the metabolism of nitrogenous food which give rise to the well-known manifestations of gout, are certain states of the blood and other fluids, which, owing to the abnormal amount or insoluble nature of the excrementitious solids contained in them, or to some other morbid, physical, or chemical change in these fluids, tend to deposit some of their solid constituents *within* the body. In the more common forms of gout this tendency is shown in the deposition of insoluble urates in and around joints. In what are termed gravel and calculous disorders we find solid deposits occurring in the urinary passages; and in this connection we may also consider the analogous deposits which occur in the biliary tracts.

From a dietetic point of view we shall find it convenient to consider these related conditions together, as they are capable of being influenced and controlled by much the same dietetic rules.

Too much stress has been laid on insufficient bodily exercise as a principal cause of the conditions adverted to, when associated with too liberal an animal dietary; for a careful examination of the habits of life of those who suffer from these affections will lead to the discovery that very many are persons of exceedingly

* "The Therapeutics of the Uric and Diathesis."—*British Medical Journal*, January 7th and 14th, 1888.

active habits, who are at the same time large feeders. Indeed, their habits of muscular exercise, as in hunting, racket-playing, etc., are often attended with profuse perspiration, and the excessive loss of fluid from the surface by cutaneous transpiration, together with a large consumption of nitrogenous and other food, and the production of an excess of nitrogenous waste, combines to produce a relative excess of solid matters in the blood and in the urinary and biliary excretions, and this directly favours the deposition of gravel and calculi. So that it is necessary to seek the remedy, in many instances, rather in a reduction or modification of the food than in an increase of bodily activity. And there are instances in which it may even be advisable to restrain, rather than promote, the latter, especially when we desire to lessen the amount of nitrogenous waste added to the blood.

There are, however, it must be admitted, certain rare forms and instances of these maladies which appear to have their origin in a deeply-rooted, often (but not always) inherited vice of nutrition, or perverted metamorphosis, in which these morbid disturbances in the metabolism of nitrogenous food and waste are almost beyond the reach of remedy either by food or medicine. I refer especially to those, happily somewhat rare, cases of crippling gout in which the digital articulations of both upper and lower extremities become the seat of large and multiple deposits of urate of soda, often producing great chronic deformity and helplessness. Such cases have not, perhaps, been so exhaustively studied as they deserve to be, but, so far as our own observations have extended, they are more commonly found amongst the examples of what has been called "poor man's gout"—*i.e.* cases in which the general nutrition is manifestly defective, and in which there has been no history either of generous living or of deficient exercise.

It is also necessary to bear in mind at the outset that gout is a general, constitutional, chronic malady, and that the attacks of acute arthritis so commonly regarded as the characteristic manifestations of gout may be entirely absent, and, even when present, may constitute by no means the most serious part of the morbid phenomena with which the gouty person is afflicted.

We must also, and more especially, look to disturbances in the assimilative functions, to disorders of digestion, stomachic and intestinal, to functional derangements of the circulatory and nervous systems, to changes in the coats of the superficial arteries, and particularly to the physical and chemical characters of the urine, as presenting important indications of the existence of the gouty state—*i.e.* of the presence of uricæmia, or other allied morbid states of the blood, calling for dietetic treatment.

If we accustom ourselves to look at gout with this wider and more general conception of its nature in our minds, we shall not fail to recognise its influential presence in connection with many vague morbid states often greatly misunderstood.

You will find in young children,* in the nursery even, but more commonly at school, who happen to be the offspring of intensely gouty parents, severe headaches, troublesome neuralgias, chronic skin affections, attacks of asthma, and various other disturbances of health connected with the inheritance of the gouty constitution, and dependent on morbid states of the blood which are capable of being modified and ameliorated by diet.

In women, and not only those who have passed the climacteric, but also in young women—although,

* G. Sée has stated that out of 200 gouty patients he found 30 per cent. under 20 years of age. "Du Régime Alimentaire," p. 429.

no doubt, the eliminative character of the menstrual functions saves them from much of the goutiness of the male sex,—it will be found that many of the vague affections of the nervous system, which are commonly, if we may be allowed the expression, cast into that *dust-bin* for ill-comprehended pathological states bearing the label "Hysteria," many of these troublesome, although apparently trivial, disturbances of health are of gouty origin.

Three facts have certainly been established (mainly by the labours of Garrod) in connection with gout: 1st, that in the gouty there is an excess of uric acid in the blood; 2nd, that during an attack of gout there is a diminution of uric acid in the urine often by one half; and 3rd, that at the end of an attack there is an excess of uric acid in the urine. And these facts are interpreted as meaning that *before* and especially *during* an attack the blood is surcharged with uric acid, and that at the end of the paroxysm this excess is discharged in the urine, and the patient is, for a time at any rate, set free from his uricæmia.

But although it is generally admitted that in gout there is an excess of uric acid in the blood, it is not certain whether this is due to an abnormally large *production* of uric acid in the body, or simply to an abnormal *retention* of it there.

The deposition of uric acid in the bodies of the gouty may be simply dependent on a diminished faculty on the part of their fluids to hold the salts of uric acid in solution; and this inability to hold the uric acid salts in solution may depend on an abnormally acid state, or, what is the same thing, a diminished alkalinity of those fluids.

It was held, and is still held by many, that uric acid represents a low grade of oxidation of the nitrogenous waste necessarily produced in the metabolism of albuminous foods, and that when such foods are taken in great excess they cannot be completely oxidised into urea, which is very soluble and readily eliminated; consequently, an abnormally large proportion is converted into uric acid, representing a lower grade of oxidation; and the salts of this acid, being very insoluble, are less readily eliminated, and therefore tend to accumulate in the blood and to be deposited in the body.

This view, of course, traces gout to an excess of nitrogenous ingesta. But if we refer gout to a deficient alkalinity and diminished solvent power of the fluids, however brought about, we get a wider, and perhaps a truer, grasp of the causation of the disease; for while this view recognises the causative influence of an excess of albuminates in the food, it does not exclude other causes, which we must take into consideration in explaining the occurrence of this disease in many persons.

It has been noticed (Voit and Hoffmann) that strongly acid urines show a tendency to deposit sediments, and it has been pointed out that in the metabolism of albumen, the sulphur and phosphorus contained in it become converted into sulphuric and phosphoric acids, all of which may not be completely neutralised, and may be sufficiently in excess to augment the acidity of the urine; so that an excess of albuminous food may contribute to the deposition of insoluble salts of uric acid by diminishing the alkalinity of the fluids, which, indeed, it is known to do. In the same way, those dyspeptic conditions, which are so common in some gouty persons who are not large feeders, may tend to an increased formation of the organic acids, and so to a reduction in the alkalinity of the blood, and thus bring about *uricæmia* —*i.e.* a retention of uric acid in the blood.

Thus we already see that one of the most important dietetic indications in the treatment of the gouty is to maintain the normal alkalinity of the fluids, and to maintain or augment their solvent power. And precisely the same indication with regard to food applies to the tendency to the formation of uric acid gravel and calculi.

As we have already pointed out, it is a well-established fact that a highly nitrogenised animal dietary increases the acidity of the fluids of the body, and especially of the urine; and it is equally well known that a vegetable dietary increases their alkalinity.

One of our chief objects, therefore, in constructing a dietary for the gouty is to diminish, within suitable limits, the amount of animal food they consume, and to replace it with an equivalent quantity of appropriate vegetable substances.

The extent to which this can be carried with safety will depend upon the habits of life, the occupation, and the digestive peculiarities as they are met with in individual cases.

For the indolent and sedentary, animal food should be reduced to a minimum; to the energetic and active, a more liberal proportion may be allowed. But in all cases we must, above all things, avoid exciting dyspeptic states by an unwise urgency of dietetic rules ill-adapted to the digestive peculiarities which many of these patients present.

Great moderation in the consumption of animal food is, then, one of the first rules for the gouty.

It is also the experience of the majority of authorities that, in the food of the gouty, *fats* as well as albuminates should be reduced to the minimum; fatty, saccharine, and gelatinous foods, by interfering with the complete metabolism of the albuminates, tend to the production of uricæmia. Bauer points out that we ought not only to restrict the amount of fat in the food, but that as corpulent persons perspire freely, and therefore, as a rule, secrete a concentrated urine liable to yield deposits, we should also adopt other means to prevent the accumulation of fat.

G. Sée also insists especially on the prejudicial effects upon the gouty of a diet rich in nitrogenous food when *combined* with sugar, gelatin, and fats.

Ebstein, however, advocates the consumption of a moderate amount of fat, so as to diminish the quantity of carbo-hydrates needed, as he regards these as the most fattening of all foods. He also considers fat useful as quickly satisfying the appetite and diminishing the desire for food.

We see no reason for withholding a moderate amount of fatty foods from gouty persons who show signs of defective nutrition, provided they digest them without difficulty; but, on the other hand, we should restrict them as much as possible in the diet of the corpulent and well-nourished.

It is a grave error to impose on the gouty a too rigorous abstinence. Their diet must contain all that is needed for the due nutrition of the body and for maintaining its functional activity. It must, therefore, be proportioned, in some measure, to the work and activities of individual organisms. But it is a wise precaution at all times to draw the supplies of food, so far as is practicable, from the more readily-digested and more nutritious vegetables.

Green vegetables and fresh fruits are especially suitable, as they are known to render the urine more alkaline, while they do not favour the deposit of fat in the body; but an exclusively vegetable diet is by no means to be commended, save in quite exceptional instances.

The feeble digestion of many gouty persons is unequal to appropriating that comparatively *large mass* of vegetable food which is necessary to supply the wants of the system, and a certain proportion of more concentrated and easily-digested animal food is, therefore, necessary for them.

White are generally considered more appropriate than *brown* meats; and, bulk for bulk, this may be true. But there is no proof that small quantities of well-cooked and tender mutton or beef are more prejudicial to the gouty than larger quantities of chicken and rabbit; indeed, the latter, although a white meat, has often appeared to us more difficult of digestion than beef and mutton.

There is a general consent that smoked and dried or pickled pork, game, fish, and other meats should be proscribed, as they all present very condensed forms of nitrogenous food, and excite thirst, which is not always quenched with pure water! Rich and fat sauces should be altogether avoided, and all *entrées* and made dishes which are served with sauce. Strong meat-soups and extracts are also particularly undesirable; and when soups are taken, they should be vegetable soups, only slightly flavoured with animal extract. One teaspoonful of Valentin's Meat-juice added to half-a-pint of a purely vegetable soup imparts quite as much of this flavour as need be desired.

Cheese, as one of the most concentrated forms of nitrogenous food, and as often difficult of digestion, should be avoided.

As the yolk of egg contains a large amount of fat and lecithin, eggs should enter as little as possible into the dietary of the gouty.

Fish, oysters, and the crustacea (crabs and lobsters) must be partaken of sparingly, though the rich and firmer fish, such as salmon, mullet, mackerel, and perhaps lobster and crab, had better be altogether avoided.

An almost unlimited choice of fresh vegetable food may be permitted--potatoes and the ordinary green vegetables and salads. Sorrel, tomatoes, and asparagus have, however, been especially prohibited, on the ground that they contain oxalates, and oxalic acid is a congener of uric acid. But we have been recently assured that it is an error to proscribe *tomatoes*, as they contain but a very small amount of oxalic acid; whereas *spinach*, which has been so universally approved of, is, next to sorrel, the richest in this acid.* To asparagus, if eaten without melted butter, we see no practical objection.

Those dry vegetables which are both rich in albuminates as well as in carbo-hydrates, such as haricot and other beans, peas, lentils, should be partaken of only in small quantity. Mushrooms and truffles are prohibited.

Bread, which is also a highly-nitrogenous food, should be taken only in moderation, and is, perhaps, least harmful when well toasted. Bouchardat has proposed to substitute potatoes for it.

Most fresh, ripe fruits are wholesome, and most cooked fruits, as stewed or roasted apples, etc.; but the highly-saccharine fruits, whether fresh or dry, are not so suitable, and should be taken in very moderate quantities.

Next, as to the best beverages for the gouty; and first, as to milk. Some differences of opinion exist with regard to milk; and no doubt there are great individual peculiarities in respect of its digestibility. Some cannot digest it at all, some dislike it excessively, and others can digest it in any quantity and are fond of it. For the latter, we consider that it serves as an admirable form of food, especially if skimmed or diluted, presenting, as it does, all the principles necessary for the nutrition of the body in a form readily assimilated by those with whom it

* Dujardin-Beaumetz, "L'Hygiène Alimentaire," p. 169.

agrees, and containing a large quantity of water. It is an advantage to render it slightly alkaline, by adding to it a little alkaline water, such as Vals or Vichy water, when it often acts freely as a diuretic.* Indeed, we are in the habit of advising our gouty patients, and those who have shown any tendency to the deposition of uric-acid gravel, to drink, about ten minutes before their first meal, a breakfastcupful of hot milk and water, to which a small level salt-spoonful of bicarbonate of potash and the same quantity of table salt should be added. In this form, well diluted and rendered distinctly alkaline, we can see no objection to its use; but, as we shall see presently, Sir H. Thompson is much opposed to the free use of milk by those with a tendency to uric acid or oxalate of lime deposits.

Ebstein has maintained, and Germain Sée also, that of those who deposit uric acid gravel, there are some whose urines do not contain any excess of uric acid; but that this acid is deposited simply because these urines are not in a condition to hold it in solution: either they do not contain enough water, or they may contain an excess of acid phosphates, which combine with the soda needed to hold the uric acid in solution; it thus becomes free, insoluble, and deposited in the crystalline form. In such instances the value of an abundance of slightly alkaline watery beverages is very obvious. A draught of hot water half an hour before a meal or at bedtime, and the use of the alkaline table waters to mix with wine, or whatever other stimulant is taken, should be recommended. The habit of drinking, in some form or other, a considerable quantity of water is an important point in the dietary of the gouty; and whatever wine or spirit they take

* It has recently been stated by G. Sée and by Dujardin-Beaumetz that they have obtained highly diuretic effects from the administration of *Lactose* by itself.

should be largely diluted, either with pure water or with an alkaline effervescing table-water. The value of drinking considerable quantities of hot water has been largely insisted on by many physicians, and we have had occasion to form a favourable opinion of the practice if kept within certain limits.

Strong beers, porter, and stout should be avoided by all gouty persons. We have known a few instances in which stout has been well borne, but a large quantity of alkaline salts was at the same time taken habitually.

Cider, which contains malic acid in combination with potash, has been said by Meissner and Koch to favour the formation of uric acid, and on that account has been prohibited to the gouty. Germain Sée, however, considers cider, especially when sparkling, an excellent diuretic, which favours the expulsion of uric acid gravel; and his opinion is, as we shall see, shared by Sir H. Thompson, who considers it a useful beverage in calculous disorders.

Of wines, all strong, sweet, or spirituous wines should be carefully avoided, such as sweet or strong champagnes, ports, sherries, Madeira, Burgundy, and the stronger clarets. All wines which contain much sugar, alcohol, tannin, or free acid are unsuited to the gouty. Still Moselle, light hock, some of the best Hungarian wines, light, well-kept, fine-quality Bordeaux—all these are permissible in small quantity, diluted with an alkaline table-water, so as to neutralise any free acid they may contain. The more distinctly diuretic the effect of the wine, the better, as a rule, will it agree with the gouty.

With regard to alcoholic beverages in general, it may be said, unhesitatingly, that the gouty persons who can do without them entirely are wise to do so. If they cannot exist comfortably without some small or moderate amount of an alcoholic beverage, then they must exercise great care in its selection. There is all the difference in the world between the effects of a fine, mature, high-quality wine or spirit and the commoner kinds of the very same beverages. They should always be well diluted. Of spirits, the best are fine old Scotch whisky, dry Plymouth gin, and the finer kinds of French cognac, when they can be obtained.

Tea and coffee, when not strong, are both exceedingly useful beverages to the gouty, unless they are found to trouble the digestion, which they will do with some persons. In that case it is necessary to take them *without sugar*. It is the quantity of sugar so commonly taken with these beverages that helps to make them injurious.

The best China tea, and not Indian teas, should be employed for infusion, as the latter contains far too much tannin.

Germain Sée observes :—" Warm aromatic drinks like tea produce a kind of washing-out (*lavage*) of the uriniferous tubes, which are the receptacles of the uric acid ; in my long practice I have been furnished with many proofs of the utility of these beverages to the gouty." Dujardin-Beaumetz states, on the authority of Esbach, that black tea, infused for five minutes, will yield as much as 2 grammes per 1,000 of oxalic acid, and he, on that account, proscribes its use in gouty disorders. We hesitate to accept this statement without further investigation, and we should certainly not forbid gouty patients generally to drink tea. Persons with deposits of oxalates might do well to avoid it, as they are usually dyspeptics.

On the authority just quoted, cocoa is also said to be very rich in oxalic acid, containing from 3·5 to 4·5 grammes in 1,000. If this should prove to be correct it would have to be forbidden in cases of oxalate of lime deposits.

Phosphatic urinary deposits are usually secondary to some other morbid state, to the removal of which the dietetic or other treatment must be directed.

The formation of *biliary calculi* is also often found to occur in the gouty, and may doubtless depend on the same causes as uratic deposits, viz. on too great concentration and defective alkalinity of the fluids. The deposition of biliary concretions may depend either on an excess of cholesterin (the chief constituent of gall-stones) in the bile, or on a deficiency in solvent power of the fluid of the bile allowing the cholesterin to be deposited, although it may not be in excess.

The formation of an excess of cholesterin appears to be sometimes dependent on an excessive consumption of fats, or upon exaggerated activity of the nervous functions, cholesterin being looked upon by some as derived from the products of nervous waste.

Its deposition, when the bile is defective in alkalinity, has been demonstrated by Thénard, and this condition of the bile has been traced to a too exclusively animal dietary. Sedentary habits, of course, promote such deposits by favouring the stagnation of bile in the gall-bladder.

Whatever may be the cause, when biliary concretions are known to exist, a most carefully regulated dietary should be insisted upon.

Fatty substances should be entirely, or almost entirely, excluded from the food, as well as sugar.

The quantity of food taken should be strictly within the limits of what is necessary for the due maintenance of the nutrition of the body, and all excess must be strictly forbidden.

Farinaceous substances may be taken in moderation. Peas are regarded by some as unsuitable, as they are said to contain a fatty body analogous to cholesterin.

So far from carrots being appropriate in these cases, as used to be thought, they are to be avoided, as they contain sugar and "vegetable cholesterin."

Animal food should be taken in strict moderation, the fat being always avoided. Eggs also sparingly, not more than one daily. Green vegetables and fruits (not the sweeter kinds) are very useful, and so are potatoes; bread should be taken in moderation.

For beverage a little wine may be permitted, with some alkaline water, such as Apollinaris, Vals, or Vichy. A breakfastcupful of hot water, slowly drunk or sipped, half an hour before meals, is also useful.

Sir Henry Thompson, whose large experience in the treatment of calculous disorders gives to his testimony exceptional value, has stated it to be his belief that "in nineteen cases out of twenty an undue deposit of uric acid will disappear under a proper dietary," and its formation in calculous masses be prevented; and the same observation he applies to deposits of oxalate of lime. He does not, however, consider that much is gained in such cases by any great diminution of nitrogenous food; but he insists very strongly on the necessity of eliminating as completely as possible fatty and saccharine substances from the dietary. A certain limited quantity of fatty matters he allows, but forbids saccharine substances entirely. It is also best, he considers, that all alcoholic drinks should be avoided, or, in certain cases, taken only in very small quantities. If a little wine is thought necessary, he prefers, as we do, in such cases that still Moselle or a light Rhine wine should be drunk, to which we always recommend the addition of a little alkaline table-water, to neutralise the free acid all these wines contain. He approves also of a little very light beer or sound cider, neither sweet nor acid, and he rightly urges the importance of brewing in England some light infusion of malt and hops like the light *lager* beers of Germany.

Champagne, if sweet, he regards as especially harmful; but we have found a small quantity of dry and sound champagne, mixed with a little Apollinaris water, as well borne as any other wine in these cases.

Bordeaux wines, unless unmistakably pure and sound, as well as of light quality, are to be forbidden, as are all sweet wines, ports, sherries, etc., and all strong beers.

The important point is, that all the beverages should be free from saccharine matters.

As to the kind of food prescribed: it is, in the first place, necessary to ascertain the patient's habits of life, whether they are active or sedentary. Those who lead active lives must be allowed more hydrocarbons and more meat than the sedentary. In advanced age it is of great importance so to limit the dietary that we avoid overtaxing the eliminative organs.

The calculous patient is, in the greater number of cases, too stout, and he should be allowed only a very spare amount of fats. A reduction of weight is a good sign, and it is an undoubted advantage if, by dieting, a loss of four or five pounds of weight in the first month can be effected.

When not corpulent, a less rigid abstinence from fats may be permissible.

The following fat-containing foods must be eschewed, or taken only in very small quantities:—Milk, cream, butter, cheese, eggs (especially omelettes), pastry, fat pork, suet in puddings and pastes, and the fat of roast and boiled meats. Rice or sago puddings, being mixtures of milk, egg, and sugar, Sir Henry Thompson speaks of as "in the last degree objectionable for uric-acid-making, gouty patients," although he admits that they are excellent for children and healthy people. Farinaceous puddings may be permitted, if not made *sweet*, but with light broth instead of milk, a moderate amount of white of egg, and some condiment (a pinch of curry) instead of sugar.

All articles of food containing cane-sugar should be expunged from the dietary; by so doing we lighten the work of the liver, and lessen the manifold vicarious duties performed by the kidneys.

He commends the Carlsbad dietary, in which sugar and butter are absolutely forbidden, a method of reducing uric acid deposits more effectual than that of eliminating meat from the dietary. Nitrogenous food in moderation is permitted, but the hydro-carbons are greatly diminished.

The following is the dietary which Sir H. Thompson recommends in calculous affections :—

Fish in all its forms, except those containing much fatty matter (*i.e.* herrings, mackerel, eels, and the thin part of salmon).

Game in all forms. *Poultry*.

Lean meat in moderate quantity.

Preparations of gelatin.—Savoury jelly, or jelly agreeably flavoured but unsweetened.

Butter in moderation (this is the only direct form of fat admitted—fat in some form being necessary).

An *egg* or two, on account of their usefulness in all cooking operations. (The objection to eggs applies only to the yolk, or fatty part.)

Milk in strict moderation, and only with tea, coffee, or cocoa. It is very undesirable and noxious *in large quantity*, as it contains a large proportion of fat and sugar, and its casein is digested with difficulty. It is less objectionable when thoroughly skimmed.

Well made *whole meal bread*.

Oatmeal. Pearl barley.

Macaroni and other Italian pastes.

Some coarse meal is needed to act as an aperient and prevent constipation.

Whole meal bread is improved in flavour and texture by an admixture of fine (not coarse) Scotch oatmeal, in the proportion of about one-quarter to one-third of the wheat-meal employed.

Dry haricots and lentils are most nutritious vegetables, and should be taken made into *purées*. They are digested with ease, and contain much nutritious matter.

Rice, *sago*, *tapioca*, and *arrowroot*, are all useful if treated as *savoury* dishes, not as *sweets*.

Fresh green vegetables are especially good.

Fresh green peas and broad beans, *well masticated*.

Light salads are permissible to persons who digest them easily, but they must not be taken by those who digest them with difficulty.

Celery, sea-kale, asparagus, tomatoes, potatoes, and artichokes, are all permitted; so also are *apples*, roasted or baked, without added sugar.

The following are to be avoided:—Rhubarb, gooseberries, currants, strawberries, raspberries, grapes, plums, pears, and all *sweet* fruit, fresh or preserved.

Saccharin may be substituted for sugar.

The following diet, adopted with advantage by a medical man who suffered from gout and gravel, was published in the *Practitioner* :—

7.30 a.m.—Ten oz. of very hot water.

8 a.m.—*Breakfast*.—Equal parts of weak tea and milk, a small quantity of white sugar, a slice of fat bacon without a strip of lean, bread and fresh butter.

1 p.m.—Milk pudding, rice, sago, tapioca, macaroni, a blanc-mange, and small biscuits, with butter.

Ten oz. of hot water.

4 to 5 p.m.—Ten oz. of hot water.

6 p.m.—*Dinner*.—White fish or fowl (usually boiled), greens, bread (*no potatoes*).

Claret, 7 oz.

8 to 9 p.m.—Ten oz. hot water.

11 p.m.—Ten oz. hot water.

In this diet there is a very strict limitation of nitrogenous food, while the elimination of the products of nitrogenous waste is facilitated by the ingestion of considerable quantities of hot water.

If this gentleman "indulges either in meat or game, or drinks copiously of claret, or omits one or two glasses of hot water, he feels gouty and gravelly the next day."

Cantani's views as to the dietetic treatment of gout are somewhat different from those of his contemporaries, but they certainly contain an element of truth.

He considers it best, instead of severely restricting the consumption of animal albuminates, which are so necessary to the nutrition of the body and so comparatively easy of digestion, to rather aim at securing their complete combustion within the system by withdrawing from the dietary whatever substances are known to interfere with their oxidation or check their metabolism. He recommends a moderate amount of nitrogenous food—fish, eggs, broth; and the free use of green vegetables.

He forbids all starchy and saccharine foods—bread, rice, potatoes, sweets, and sweet fruits; he prohibits all alcoholic drinks, all pungent condiments, and coffee; all acids and acid foods, milk, and especially cheese, as he considers the injurious effects of lactic acid and the fatty acids in cheese can be directly established.

He advises the consumption of large quantities of fluid, and especially of pure aërated waters.

CHAPTER VI.

THE DIETETIC TREATMENT OF OBESITY.

VARIOUS dietetic methods have been advocated for the cure of obesity, but they have, nearly all of them, had the same end in view, viz. the reduction of the total amount of food taken. In a very large proportion, if not in all, of the cases of excessive corpulence a reduction in the *quantity* of food taken is the essential condition of its cure; and that reduction must be sufficient to remove all excess of fat-forming food (and there is scarcely any form of food, as we have seen in previous chapters, from which fat cannot be formed) from the dietary.

Let us take a hypothetical case. A person with a tendency to obesity, who appears to be a very moderate feeder, happens to take, in excess of his wants, half an ounce of sugar daily, which we will assume is converted into and is stored up in his body as fat. This is adequate to a yearly increase in weight of over eleven pounds, or in five years to four stones! Let us then bear this fact in mind in dealing with cases of obesity, that a patient weighing twelve stones may add four stones to his weight in five years, simply by the daily deposition within his body of half an ounce of fat derived from this small daily excess of fat-producing food.

The most common cause of obesity is the excess of food, although in some cases it may be difficult at first to discover in what particular there is excess; for we must also recognise a peculiar constitutional, and often inherited, aptitude for fattening—observed also in many animals—which leads to the development of obesity from an almost inappreciable excess of food or drink.

There is, also, another important preliminary consideration to be kept in view, and that is, that different obese persons may, and probably do, possess different faculties for the conversion of different kinds of food into fat, so that one person may derive his excess of fat from one class of food, and another from another class; and, therefore, that the remedial measures appropriate and successful in some cases, may not be those best calculated to lead to a successful result in others. Each case of obesity, therefore, must be made the subject of individual study and analysis, although certain general principles are, probably, applicable to the great majority.

The frequent occurrence of obesity about and after middle age points also to another very important consideration, viz. that the need of food naturally diminishes with advancing years, just as the capacities for digesting and assimilating and duly utilising food diminish also. Ignorance or insufficient recognition of this fact is the chief reason why it is so difficult to deal successfully with many of these cases. It is difficult to make a man of forty understand that he cannot properly utilise and adequately dispose of as much food as he used to when thirty, or a man of fifty as much as when he was forty; so that a diet which would not be, in any way, excessive at the former age, becomes distinctly excessive and provocative of undesirable corpulence at the latter. Even some physicians have overlooked this important point in estimating the *average* diet needed by corpulent persons at and beyond middle age. It is an error to apply the ordinary *average* ration, especially to persons of sedentary habits and occupation, at, approaching, or beyond middle age. With advancing age there should be a diminution in the average amount of food taken.

It cannot be too clearly understood that it is to the neglect of this consideration that so many instances of undue corpulency are attributable in advancing life. The capacity for muscular exertion is also lessened, and there is no longer either the disposition or the ability to engage in those active physical exercises, which in earlier years dispose of much of the surplus food supply, as has been already explained.

There is, however, a certain small or moderate proportion of cases of obesity which appear to arise independently of any excess of food, and to be determined by some morbid state of the system leading to defective oxidation and imperfect combustion of certain elements of the food within the body. To this class must be referred some of the "fat anæmics" alluded to by Dr. Weir Mitchell; the cases of obesity associated occasionally with the hysterical state, and other nervous disorders; as well as the gravest cases of all, viz. those cases in which fatty degeneration of the nitrogenous tissues accompanies the excessive deposition of fat.

These cases must, of course, be carefully differentiated from the ordinary common form of obesity, and their treatment must be determined by other considerations.

Dr. Weir Mitchell suggests that climate may have much to do with the tendency to obesity, and he says the first thing an American in England is struck with is "the number of inordinately fat middle-aged people, and especially of fat women." * But it is very doubtful if England has a greater proportion of very fat people than other European countries, and an American visitor to Carlsbad or Marienbad would probably discover that the fattest people undergoing a cure at these places would be of other than English nationality.

* "Fat and Blood." Fifth edition, p. 21.

Allusion has already been made to the association, in some rare cases, of anæmia with obesity. This is somewhat difficult of explanation, but we believe it will be found, as we have already suggested, that even in these cases some fault of diet often lies at the root of the condition. Weir Mitchell points out that the hysterical constitution when associated with indisposition to exertion, and prolonged rest, together with the morphia habit, "makes up a group of conditions highly favourable to increase of fat."

Many systems have been devised for the cure of obesity, and more or less success has been claimed for all of them. We shall pass briefly in review the chief of these, and point out what we consider to be their respective merits and defects.

One of the first to call attention to the importance, in these cases, of diminishing the amount of water taken, or of foods containing water, was Dancel, a French military doctor, who had been struck by the remarkable influence that water and watery foods had in causing great abdominal development in horses. His method of reducing obesity was to prescribe as *dry* a diet as possible. The food taken should contain very little water, and very little drink should be taken at any time. Soups and fluid foods were forbidden. Not more than from six to twelve ounces of fluid was allowed at each meal. Abstinence from fatty and farinaceous foods was also enforced, frequent purges were enjoined, and much exercise on foot.

This system, rigorously carried out, was in many instances attended with remarkably good results.

The Banting method, so widely adopted in England at one time, agreed to some extent with the preceding, in the strict limitation of the amount of fluid taken, and the exclusion of farinaceous foods, as well as sugar and fats. But in the Banting diet the quantity of food of every kind was strictly limited.

Breakfast at 9 a.m. consisted of 5 to 6 oz. of animal food—meat or boiled fish (except pork or veal); a little biscuit, or 1 oz. of dry toast; 6 to 7 oz. of solids in all. A large cup of tea or coffee (without milk or sugar) = 9 oz. of liquid.

Dinner at 2 p.m.—Fish or meat (avoiding salmon, eels, herrings, pork, and veal), 5 to 6 oz., any kind of poultry or game. Any vegetables, except potato, parsnips, beet-root, turnips, or carrot. Dry toast, 1 oz. Cooked fruit, unsweetened. Good claret, sherry, or Madeira, 10 oz. Total of solids, 10 to 12 oz.

Tea, 6 p.m.—Cooked fruit, 2 to 3 oz., a rusk or two ; 2 to 4 oz. of solids. 9 oz. of tea, without milk or sugar.

Supper, 9 p.m.—Meat or fish, as at dinner, 3 to 4 oz. Claret, or sherry and water, 7 oz.

This diet allowed only from 21 to 27 oz. of solids per diem, of which 13 to 16 oz. consisted of animal food, and only 2 oz. of bread; the rest consisted of fruit and fresh vegetables. There was the strictest possible exclusion of starches and sugar.

The total fluid was limited to 35 oz.—*i.e.* about a pint and three-quarters.

With this diet Mr. Banting reduced himself in a year from 14 st. 6 lb. to 11 st. 2 lb.

The *Ebstein* method, which has been largely applied in Germany, differs from the preceding in recognising the possible transformation of albuminates into fat; and Ebstein considers that this transformation is chiefly dependent on the simultaneous free use of carbo-hydrates, but that the consumption of fat has little or no influence in this direction. He recommends the use of fat because it produces a feeling of satiety or satisfaction, and so leads to the consumption of less food; and also, by diminishing thirst, lessens the desire for fluids. Dujardin-Beaumetz points out that Hippocrates anticipated Ebstein in this matter, and he quotes his advice to the obese that they should eat fat on account of its satisfying effects and its influence in lessening the consumption of food. Ebstein maintains that it is precisely owing to the presence of fat in food that the accumulation of fat in the body is prevented, and he consequently advises all kinds of fatty food—the fat of meat, butter, cream, and fatty sauces and soups; but he rigorously forbids the carbo-hydrates, such as sugar, potatoes, and all forms of starchy food, and he only allows $3\frac{1}{2}$ oz. of bread per diem. He permits asparagus, spinach, cabbage, peas and beans, and all kinds of meat in small quantity. The following is an example of the Ebstein *régime*:—

Breakfast (6 a.m. in summer, 7.30 a.m. in winter).—White bread, well toasted (rather less than 2 oz.), and well covered with butter. Tea, without milk or sugar, 8 or 9 oz.

Dinner, 2 p.m.—Soup made with beef-marrow. Fat meat, with fat sauce, 4 to 5 oz. A moderate quantity of the vegetables mentioned above. Two or three glasses of light white wine. *After the meal*, a large cup of tea, without milk or sugar.

Supper, at 7.30 p.m.—An egg, a little roast meat, with fat. About an ounce of bread, well covered with butter. A large cup of tea, without milk or sugar.

It will be observed that this is a very spare dietary, although it contains a considerable proportion of fat.

The large cup of tea three times a day is, no doubt, intended to enable the small amount of food to be borne without a feeling of exhaustion.

But the most popular system at present for reducing obesity is that advocated by Oertel, and adopted, with some modification, by Schweninger. It will be desirable, therefore, to describe it in detail.

Oertel claims for his system that it not only provides for the removal of fat, but also prevents its reaccumulation, and, at the same time, restores tone to the organs of circulation, which so often, in cases of excessive obesity, is lost. He distinguishes two degrees of obesity—one, the slighter form, in which the organs of circulation are unaffected, and vigorous bodily exercise is possible; and another—the graver form—in which the muscle of the heart is invaded and weakened, and other functional derangements connected therewith are developed.

Adopting Voit's statement that the human body decreases in fat if the daily food consists of the three great groups of food in the following proportions: Albuminous food, about $4\frac{1}{2}$ oz.; fatty food, about $1\frac{2}{5}$ oz.; and carbo-hydrates, about $5\frac{1}{3}$ oz., the following comparative table shows the relations of the Banting, Ebstein, and Oertel methods to the above theoretical estimate and to one another:—

	Albuminates.	Fats.	Carbo-hydrates.
Banting . .	6 oz.	$\frac{1}{3}$ oz.	$2\frac{3}{4}$ oz.
Ebstein . .	$3\frac{1}{2}$ oz.	3 oz.	$1\frac{3}{4}$ oz.
Oertel . . .	$5\frac{1}{2}$ to 6 oz.	1 to $1\frac{1}{4}$ oz.	$2\frac{1}{2}$ to $3\frac{1}{2}$ oz.

They all agree in reducing largely the carbohydrates, so that there is a general consent that these foods greatly contribute to the excessive deposit of fat.

Oertel's formula differs from the Banting formula simply in allowing considerably more fat and slightly more starchy food. It differs greatly from Ebstein's in allowing nearly twice as much albuminous food, less than half as much fat, and about twice as much carbo-hydrates. This amount of fat and carbo-hydrates is admissible in those cases where active exercise can be and is taken, as muscular exertion is attended with a considerable destruction of fat, and the relative excess of albuminous food in this formula leads to the displacement of the fat accumulated in the substance of the muscles, and to a new formation of muscular tissue in its place. At the same time, this diet protects the nitrogenous tissues from waste—a necessary condition of health which is lost sight of in Ebstein's method. Indeed, the central idea in this "cure" is to *strengthen the muscle of the heart*, and this is aimed at, not only by a carefully-considered dietary, but by the prescription of regular, active, bodily exercise and suitable gymnastics.

This method is somewhat modified in the management of those graver cases where the accumulation of fat about the heart has led to great embarrassment of that organ, and to consequent visceral congestion and even to dropsy. In such cases the fat and carbohydrates of the food are still further reduced, and the amount of fluid consumed is severely restricted, and perspiration is promoted by, if possible, long-continued bodily exercise, especially in climbing graduated ascents; if this is not possible, the fluids are reduced by inducing perspiration by means of vapour and other baths.

The beneficial effect of this treatment is soon felt; the dropsy and congestions decrease, the pulsations of the heart become stronger and more regular, and the patient feels himself getting stronger day by day—at least, such is the author's account of the results of this method.

The following, then, are the objects aimed at in this "cure":—

1. To improve the muscular tone of the heart;
2. To maintain the normal composition of the blood;
3. To regulate the quantity of fluid in the body; and
4. To prevent the deposit of fat.

And these objects are attained by the following means:—

1. The muscle of the heart is strengthened by enforced exercise—by walking or, better, by *climbing*

heights. The patient should walk slowly uphill until palpitation comes on, when he must stop until he can again breathe easily, but he must not sit down. He must walk several hours a day, and climb as much as possible. He should go upstairs now and then by way of exercise. Of course the capacity for taking exercise will be found to differ in different cases. Too much must not be required, but also not too little.

2. To preserve the normal composition of the blood, the food should be chiefly albuminous. It may consist of the lean of roast or boiled beef, veal, mutton, game, and eggs. Green vegetables, such as cabbage and spinach, may be taken; fat and carbohydrates only in very limited quantities; from 4 to 6 oz. of bread per diem.

3. To regulate the quantity of fluid in the body, the amount of fluid drunk daily must be limited. One cup (rather less than 6 oz.) of coffee, tea, or milk, morning and evening, and about 12 oz. of wine, with from 8 to 16 oz. of water, should comprise all the fluid consumed in twenty-four hours. In the hot season the amount of fluid may be slightly increased, if the case is not one of the graver kind. Beer is entirely forbidden.

The discharge of fluid from the body is promoted by such exercise as has been described; and if this is not possible, a course of baths with packing should be taken several times in the year. Each course should last four or five weeks, and the baths should be taken about twice a week.

4. To prevent the deposit of fat, the principles of diet already set forth must be carried into practice as follows:—

Morning.—One cup of coffee or tea, with a little milk, altogether about 6 oz. Bread, about 3 oz.

Noon.—3 to 4 oz. of soup, 7 to 8 oz. 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, 1 oz. of bread or farinaceous pudding (never more than 3 oz.), 3 to 6 oz. 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, 6 to 8 oz. of light wine may be taken.

Afternoon.—The same amount of coffee or tea as in the morning, with at most 6 oz. of water; 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: 6 to 8 oz. of wine with 4 or 5 oz. of water.

A larger quantity of liquid than that prescribed should never be taken at one meal. It is best to drink the quantity allowed in small portions at different times in the day.

In simple corpulency, without any disturbances of the circulatory organs, the quantity of fluid may be gradually increased; one or two glasses of wine may be permitted at the midday meal, and half a bottle of wine and half a pint of water in the evening.

Such is the so-called "Schweninger" or "Oertel cure."

What, however, especially characterises Schweninger's modification of this method is the *entire suppression of any beverage at meals.* Whatever fluid is taken must be drunk two hours after food.

Schleicher, of Antwerp, has, however, published a typical diet of Schweninger, which was adopted with great success, in which the exclusion of fluid at meals was not insisted on absolutely :—

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.

Germain Sée protests against the limitation of beverages in some of the foregoing systems. He maintains, on the contrary, that an abundance of water is most useful. "I have been able," he says, "to treat and to cure a great number of cases by a *régime* of albuminates and fats, together with a *great quantity of drink*, especially of warm aromatic drinks." * Hot tea is the beverage he especially favours. Water, he urges, aids digestion by its solvent power, stimulates organic changes in the tissues, and promotes the elimination of waste material. The strict limitation of water, he points out, must be very injurious in those gouty constitutions with a tendency to uric acid deposits, which so often show a disposition to corpulency. "The most useful beverages," he says, "are infusions of tea and coffee; and the preference should be given to tea, taken at breakfast in considerable quantity and at a high temperature. All obese persons who take this beverage habitually at or between their meals obtain better results than from pure water, even taken cold."

Alcoholic drinks he strictly forbids on account of their well-known tendency to favour fatty degeneration. A little wine and water is the most he permits.

He approves of Ebstein's system, with the modification here indicated, and reports excellent results from its application. He has, however, observed some difficulty in digesting the fats, and some dyspepsia provoked in certain instances.

Weir Mitchell † advocates "rest, milk dietetics, and massage in people who are merely cumbrously

* "Du Régime Alimentaire. Régime des Obèses."
† "Fat and Blood," pp. 104-106.

loaded with adipose tissues, and also in the very small class of anæmic women who are excessively fat." He maintains that on skimmed milk—*i.e.* milk without cream—fat people lose flesh, and that a large amount of weight may be got rid of rapidly and safely by the following means. "The person whose weight we decide to lessen is placed on skimmed milk alone, with the usual precautions; or at once we give skimmed milk with the usual food, and in a week put aside all other diet save milk, and all other fluids. When we find what quantity of milk will sustain the weight, we diminish the amount by degrees until the patient is losing a half pound of weight each day, or less or more, as seems to be well borne. Meanwhile, during the first week or two rest in bed is enjoined, and later, for a varying period, rest in bed or on a lounge is insisted upon, while at the same time massage is used once or twice a day, and later in the case Swedish movements. At the same time, the pulse and weight are observed with care, so that if there be too rapid loss, or any sign of feebleness, the diet may be increased. In many such cases I allow daily a moderate amount of beef, or chicken, or oyster soup, more as a relief to the unpleasantness of a milk diet than for any other reason. When the weight has been sufficiently lowered, we add to the diet, beef, mutton, oysters, etc., and finally arrange a full diet list to include but a moderate amount of hydro-carbons. Meanwhile, the milk remains as a large part of the food, and the active Swedish movements are still kept up as a habit, the patient being directed by degrees to add the usual forms of exercise. If we attempt to make so speedy a change in weight while the patient is afoot the loss is apt to be gravely felt; but with the precautions here advised it is interesting and pleasant to see how great a reduction may be made in a reasonable time without annoyance, and with no obvious result except a gain in health and comfort."

The great difficulty in applying this method lies in the enforced rest in bed for a week or two which it requires, and which few men engaged in any kind of occupation would be willing to adopt. It is more applicable to women without serious occupation.

In reviewing these various dietetic methods of treating obesity it will be seen, as we have already pointed out, that they all aim at reducing the average quantity of food taken. If we compare the normal average daily ration with that permitted in these methods, this fact becomes very evident :—

	Albuminates.	Fats.	Carbo-hydrates.
Normal average (grammes)*	130	84	404
Banting . .	170	10	80
Ebstein . .	100	85	50
Oertel . . .	155–179	25–40	70–110

The carbo-hydrates are especially attacked in all these methods, and very largely reduced. There would seem to be a far greater tendency to excess in this class of food than in the other classes. In two of these methods there is an excess of albuminates; this excess has been considered to favour the reduction of obesity by promoting the oxidation and combustion of the excess of deposited fat. This view of the effect of an excess of albuminates has been carried to an extreme in a method recently introduced from America, and sometimes spoken of as the "Salisbury" method. It is usual in this method to restrict the diet absolutely for a time to large quantities of rump-steak,

* Moleschott's.

cod-fish, and hot water. One of the strongest advocates* of this method mentions three pounds of rump-steak, and one pound of cod-fish, together with six and one-third pints of hot water, as the daily diet for the first fortnight. The next three weeks the hot-water is reduced to four pints, and other kinds of lean meat and fish are allowed, as well as a little green vegetable, and unsweetened rusks. During the following month the hot water is reduced to about a quart a day, and some crusts of stale bread, captain's biscuits, grilled meat, or poultry, or game of any kind, and hock or claret with seltzer water, are allowed. A slice of lemon may be used to flavour each tumbler of hot water. Five grains of bicarbonate of potash are also prescribed night and morning.

This last method, whatever may be its real merits, would be absolutely impossible of application in many cases, from utter inability to consume so large an amount of animal food. Inordinately large eaters might, however, find it successful.

Ebstein's method has the recommendation, no doubt, of diminishing the desire for food, and is applicable to the strong and vigorous, with large appetites. The deficiency in albuminates and excess of fats render it unsuited to feeble subjects with weak digestions.

Schweninger's system is fairly applicable to many cases, but the absolute exclusion of all drink during meals, although it no doubt has the effect of diminishing considerably the desire to eat in excess, disagrees with many persons of feeble digestion, and should not be incautiously prescribed.

In Banting's system there is too rigorous an exclusion of fats, which are essential to healthy nutrition.

Certain cases undoubtedly do well with a strict limitation of beverages; others, on the contrary,

* W. Towers-Smith.

as pointed out by G. Sée, are better for the free use of hot, diluent drinks, and these are, especially, the gouty cases with a tendency to defective elimination. It is in such cases that a teacupful of hot water taken half an hour before each meal and at bed-time answers well, and enables them to do with much less fluid at meal-times than is usually taken.

The two principal objects of all these methods is, *first*, to make the corpulent person consume the excess of fat deposited in his body by restricting the food-supply, or augmenting its combustion by increased physical exercise or other means; and, *second*, to establish a dietary which shall prevent its re-accumulation.

None of the methods described is appropriate to the treatment of all cases of obesity indiscriminately, while any one of them may prove successful in suitable instances.

In conclusion, the following is the method which we recommend to be generally adopted: a very careful examination should be made of each case in order to ascertain the presence or absence of any organic disease, especially of any cardiac degeneration, and if we are satisfied that the obesity is not secondary to any other morbid state, or associated with any general degeneration of organs, we may proceed with confidence to prescribe an appropriate *régime*.

The albuminates in the form of animal food should be strictly limited. Farinaceous and all starchy foods should be reduced to a minimum. Sugar should be entirely prohibited. A moderate amount of fats, for the reasons given by Ebstein, should be allowed.

Only a small quantity of fluid should be permitted at meals; but enough should be allowed to aid in the solution and digestion of the food.

Hot water, or warm aromatic beverages, may be taken freely between meals, or at the end of the digestive process, especially in gouty cases, on account of their eliminative action.

No beer, porter, or sweet wines of any kind to be taken; no spirit, except in very small quantity. It should be generally recognised that the use of alcohol is one of the most common provocatives of obesity.

A little hock, still Moselle, or light claret with some alkaline table-water is all that should be allowed. The beneficial effects of such a diet will be aided by abundant exercise on foot, and by the free use of saline purgatives, so that we may insure a complete daily unloading of the intestinal canal.

It is only necessary to mention a few other details. Of animal foods, all kinds of lean meat may be taken, poultry, game, fish (eels, salmon, mackerel are best avoided), eggs.

Meat should not be taken more than once a day, and not more than 6 oz. of cooked meat at a time.

Two lightly-boiled or poached eggs may be taken at one other meal, or a little grilled fish.

Bread should be toasted in thin slices and completely, not browned on the surface merely.

Hard captain's biscuits may also be taken.

Soups should be avoided, except a few tablespoonfuls of clear soup.

Milk should be avoided, unless skimmed and taken as the chief article of diet. All milk and farinaceous puddings and pastry of all kinds are forbidden.

Fresh vegetables and fruits are permitted.

It is important to bear in mind that the actual quantity of food permitted must have a due relation to the physical development of the individual, and that what would be adequate in one case might be altogether inadequate in the case of another person of larger physique.

CHAPTER VII.

DIET IN ANÆMIA, CHLOROSIS, NEURASTHENIA, AND ALLIED DISTURBANCES OF NUTRITION.

THE due and adequate nutrition of all the organs and tissues of the body, and their maintenance in a stable state of normal functional activity are essentially dependent upon the integrity of the circulating fluid, the blood, which brings to each of them the elements necessary for the support of their structure and the development of their functional energies. Any defect in, or deviation from, the normal composition of the blood will, therefore, tend to disturbance and deterioration in the condition and functions of all the organs of the body; and it is obvious, and needs no demonstration, that the reception, digestion, and assimilation of a sufficient quantity of suitable food are requisite to maintain the needful healthy quality and quantity of the blood, and to restore them when lost.

It is clear, then, that the morbid states of the blood known as anæmia and chlorosis cannot be successfully remedied without due attention to diet.

Those troublesome states of disturbed health and nutrition, commonly described as cases of neurasthenia or nervous exhaustion, are generally associated with an anæmic condition, and their dietetic treatment may be conveniently considered in this chapter.

In some of the latter morbid affections it seems not unlikely that the defective nutrition observed in them may be, in part, due to original disturbances in the functional activity of the cellular elements brought about, directly or indirectly, by nervous influences, and that the altered condition of the circulating fluid which ensues may be referred, primarily, to some disorder of the nervous system; hence, no doubt, the necessity of directing remedial measures to the restoration of a healthy tone in the nervous system in those cases, and the success which has attended the applications of such methods in combination with appropriate dietetic expedients.

Amongst the various causes of anæmia or hydræmia —by which is meant an alteration in the composition of the blood, so that it becomes poorer in red corpuscles and more watery—a defective or unsuitable supply of food must be regarded as one of the most frequent.

It has been proved that with a diet composed of exclusively non-nitrogenous food the percentage of hæmoglobin in the blood undergoes a notable diminution, while it is augmented by a diet rich in albuminates.

It is certain that much of the chlorosis, anæmia, and associated nervous disturbances observed amongst young girls at the age of puberty are referable to improper or insufficient feeding at school, together with the imposition of educational tasks to which they are unequal. Defective nutrition from insufficient food, combined with educational strain, we are disposed to regard as responsible for the breakdown in health observed in many young persons of feeble or sensitive organisation at this time of life.

It is too commonly forgotten by those who are charged with the care and education of youth that growth and development, which are often exceedingly rapid in the female at the period we refer to, can only take place by the agency, and at the expense of, the nutrient fluids and their active elements, especially the red corpuscles, and that these require a frequent and abundant supply of nutritious food for their constant regeneration; while the processes of digestion and assimilation to be carried on with wholesome and needful activity require a certain repose of the nervous system, which is inconsistent with severe mental tasks.

The more acute forms of anæmia may be caused by hæmorrhages, or be the result of severe illnesses, and in the latter case considerable emaciation generally accompanies it.

With suitable food recovery is very rapid in most of these cases, and a moderate loss of blood is soon made up; the fluid part is, however, more quickly restored than the corpuscles.

In some chlorotic females it has been said that the heart and blood-vessels are abnormally small, so that they suffer from a congenital weakness in the blood-forming and blood-propelling apparatus; in such instances, not only must great care be observed in the regulation of the diet, but all the organs of the body should be safeguarded from undue strain or any over-exertion.

In all cases of anæmia not only must we see that the supply of food is adequate and its quality suitable, but we must also watch over its digestion and assimilation. The functional disturbances which are associated with poor and watery blood are especially marked in the digestive organs, the secretions of which become defective both in quantity and quality, and dyspeptic troubles are, therefore, common accompaniments of the anæmic state. Disturbances of the nervous system from an imperfect blood-supply are likewise frequent, such as languor, depression of spirits, giddiness, headache, neuralgia, etc.; while the whole muscular system is enfeebled from defective nutrition, so that muscular fatigue and aching of the muscles are often induced by comparatively slight exertion; and in no muscle is this more evident, or distressing, than in the heart muscle, which shows its distress by palpitation on the slightest exertion, by a tendency to fainting, and not infrequently by becoming *sensitive* to pain—as can be readily proved by pressing with the finger in the intercostal space over the apex of the heart, when, in many cases of chronic anæmia, a distinct sense of pain and tenderness in the cardiac muscle can be excited. Œdema of the feet and ankles is also a symptom often present in anæmic states, due to the disturbances in the functions of the circulatory organs. Germain Sée appears to us singularly at fault in denying the possibility of œdema occurring as a consequence of simple anæmia, and concluding, as he does, that when œdema of the feet is observed in cases of chlorosis, it is due to a coexisting valvular cardiac lesion, and especially to mitral stenosis.*

It has been noticed that in anæmic persons, the conditions of normal metabolism are somewhat modified, and especially that there is increased metabolism of the albuminates, so that the excretion of urea is increased, and we have ourselves noted the high specific gravity of the urine (1028 to 1035) in some of these cases, from the presence of a great excess of urea.

The metabolism of fat appears, however, to be diminished, and it may often be observed in anæmic persons, that while their muscles are feeble and wasted, they wear a generally plump aspect, from the presence of a considerable amount of adipose tissue. This has been referred to defective oxygenation from the decrease in red-blood corpuscles, the carriers of oxygen, and consequent imperfect combustion of the hydro-carbons and carbo-hydrates.

From these preliminary considerations we are able to deduce the following indications for the dietetic treatment of cases of anæmia and chlorosis :—

* Germain Sée, "Régime Alimentaire. Des Chlorotiques et Anémiques," p. 416.

1. The food should contain the elements needed for the restoration of the deficient blood corpuscles, and the general normal integrity of the circulating fluid.
2. It should be directed to restoring tone to the enfeebled muscles, and especially to the cardiac muscle.
3. It should be supporting and soothing to the exhausted and irritable nervous system.
4. It should be of a kind, and in a mode of preparation, which renders it easily and quickly appropriated by the organs of digestion and assimilation—processes especially languid and feeble.

At the outset of the treatment, *rest* of the exhausted organism should be particularly enforced. The tendency to urge the young who are feeble and anæmic to take abundant exercise, and to make them follow the same mode of life as their healthy associates, cannot be too strongly condemned. It interferes with the success of all our remedial measures. To insist, as is so often done, that a chlorotic young girl shall rise at the same hour in the morning as the rest of the family, partake of the same meals at the same hours, engage in the same pursuits, and conduct herself as if she were strong and well, is most unreasonable and harmful.

Instead of such a routine, she should be given her breakfast in bed; she should not be allowed to rise much before mid-day; she should be encouraged to rest as much as possible, in the recumbent position, in an airy apartment, or be swung in a hammock during fine weather in the open air. As soon as some improvement in the blood condition is observable, and some return of healthy functional activity is apparent, a moderate amount of gentle exercise may be permitted, and this should be gradually increased with each increasing gain in health and strength.

The food given at first should be in small or moderate quantity, so as not to overtax the feeble digestive powers, and in a form that can be readily digested.

Milk, skimmed if necessary, is most useful when it is easily digested; but it must not be persevered with when it is digested with difficulty, and is on that account distasteful to the patient. A good substitute for milk is a mixture of equal parts of cream and hot water (2 oz. of each), to which a little bicarbonate of soda and a teaspoonful of brandy or sal volatile may be added. This is a good food to begin the day with. All forms of animal food, prepared in a manner easy of digestion, are useful and appropriate. Raw or slightly-cooked meat, pounded or scraped, and mixed with agreeably-flavoured consommé or meat broth, or made into sandwiches, or mixed with chocolate or Burgundy and water, or given in any wholesome form approved of by the patient, is of great value as a blood restorer.

G. Sée states that he has often cured cases of chlorosis without iron, or after iron has failed, by the administration of 400 grammes (about 14 oz.) of raw meat daily, together with hydrotherapy; and he considers those two means as indispensable in the treatment of dyspeptic chlorotics who cannot take iron, and the former also in those cardiac cases which cannot tolerate either iron or hydrotherapy.*

The digestive power for nitrogenous or other foods must be carefully watched, and, if necessary, aided by the addition of some appropriate digestive ferment. A teaspoonful of Liquor Pepticus or three or four grains of pepsin may be given with each meat meal.

* "L'Hygiène Alimentaire," p. 420

Peptonised milk—a breakfastcupful twice or three times a day—will be useful when unprepared milk disagrees.

To obviate the tendency to constipation, well-made whole meal bread may be given, watching again carefully for any signs of indigestion which it is apt occasionally to provoke. For the same purpose, oatmeal porridge may be taken at breakfast, and some fruit *compôte.*

Green, fresh vegetables, especially in the form of *purées*, are also to be recommended for the same purpose. Macaroni, vermicelli, polenta, and the various Italian pastes, cooked with meat-juice or gravy, are excellent.

Animal albuminates should predominate in the diet at first, given in quantity proportionate to the digestive capacities. Some easily-digested fat—particularly in cases where there has been loss of flesh—should soon be added; indeed, progress in blood-making will often fail to take place until some digestible fat be added to the dietary. A dessertspoonful of cod-liver oil once a day will frequently suffice, and should be ordered when it is not objected to. When this is objected to, some other form of fat should be introduced into the daily dietary.

Butter is one of the best; so is cream. They may be agreeably mixed with some farinaceous food in the form of light puddings, and served with fruit-sauce or jelly. Broiled fat bacon at breakfast is, with many persons, an easily-digested form of fat.

Eggs in any form, especially the yolks, are a very suitable food, as they present a concentrated and generally easily-digested form of nutriment rich in iron. The yolks of one or two eggs, beaten up with a little boiling water, with or without milk, to which a little sugar, nutmeg, or other spice, and a table-spoonful of brandy may be added, are an excellent and nutritious restorative in those cases of anæmia with cardiac feebleness and loss of appetite.

Bauer* is decidedly in favour of a liberal proportion of nitrogenous food in the dietary of anæmic patients. "It is probable," he says, "that the reproduction of the most essential components of the blood, especially of the red corpuscles, would be greatly favoured if relatively more albumen were contained in the food of such patients than is proper under physiological conditions."

It is very necessary, in these cases, that great attention should be given to the manner of preparing and serving the food prescribed, so as to make it as palatable and attractive as possible, for in a great number of these patients we have to contend with entire loss of appetite and indisposition to take food; and our chief resources, at first, will be found in pleasantly-flavoured fluid or semi-fluid foods, which can be swallowed without previous mastication. Condiments in moderate amount are very useful to render the food agreeable; and a certain amount of wine—of which, perhaps, a good sound Burgundy is the best—should be given, and is useful as a stimulant to the circulatory and a sedative to the nervous systems. We have found porter or stout useful and well borne in some instances, and, if taken at bed-time with a little bread and butter or a biscuit, it will frequently have the effect of inducing sleep in cases complicated with insomnia.

It has been recommended, on the authority of Moleschott, that chlorotics should partake freely of salt with their food, on the ground that it favours, directly and indirectly, the restoration of the blood corpuscles as well as the blood plasma.

Bauer's caution against the excessive use of

* "Dietary of the Sick: Diet in Anæmia and Hydræmia," p. 275.

vinegar, as causing "a high degree of anæmia and emaciation, since the acid lessens the alkalinity of the blood and the number of the blood corpuscles," has already been quoted.

For the appropriate dietetic and other management of those cases of *neurasthenia* or nervous exhaustion, in which the general nutrition is so gravely affected that quite phenomenal states of emaciation and muscular feebleness are observed in connection therewith, we are mainly indebted to Dr. Weir Mitchell. These cases cannot, however, be restored to health by appropriate food alone, but other curative agencies have to be simultaneously and systematically employed. These are complete isolation, rest in bed, and the regular application of massage and electricity. To use Weir Mitchell's own words, the method consists of "a combination of entire rest and of excessive feeding, made possible by passive exercise obtained through the steady use of massage and electricity."* He insists on the intimate association between the gain and loss of fat and the gain and loss of blood corpuscles. "The loss of fat . . . nearly always goes along with conditions which impoverish the blood; and, on the other hand, the gain of fat, up to a certain point, seems to go hand in hand with a rise in all other essentials of health, and notably with an improvement in the colour and amount of the red corpuscles. . . . . To gain in fat is nearly always to gain in blood." It may also be well to let Dr. Weir Mitchell himself describe the cases to which he considers his method especially applicable. They are "people who are kept meagre, and often also anæmic, by constant dyspepsia in its varied forms, or by those defects in assimilative processes which, while more obscure, are

* "Fat and Blood. An Essay on the Treatment of certain forms of Neurasthenia and Hysteria." Fifth edition (1888).

as fertile parents of similar mischief; . . . . that large group of women especially, said to have nervous exhaustion, or who are defined as having spinal irritation, . . . cases in which, besides the wasting and anæmia, emotional manifestations predominate, and who are then called hysterical, whether or not they exhibit ovarian or uterine disorders; . . . women who have lost flesh and grown colourless, but have no hysterical tendencies, . . . hopelessly below the standard of health, and subject to a host of aches and pains, without notable organic disease."

The large amounts of food given in this method, while the patient takes no exercise, are absorbed and utilised through the influence of massage "kneading the muscles, and by moving them with currents able to effect this end." To insure the most absolute rest in cases of great weakness, the patient is fed by a nurse; and when well enough to sit up in bed, the meats are cut up, so as to make it easier for the patient to feed herself.

The treatment is begun by putting the patient on milk diet—three or four ounces every two hours, increased in a few days to two quarts, given in divided doses every three hours. This, says Dr. Weir Mitchell, "nearly always dismisses, as by magic, all the dyspeptic conditions." The bowels are regulated by giving a cup of coffee, without sugar, on waking, or a grain of watery extract of aloes at bedtime; or, in more obstinate cases, a quarter of a grain of watery extract of aloes and two grains of dried ox-gall thrice a day.

After four to seven days a light breakfast is permitted; a day or two later, a mutton chop as a mid-day dinner; and again, in a day or two, bread and butter thrice a day. After ten days, usually, the patient is allowed three full meals daily, as well as three or four pints of milk, given at or after meals, in place of water, and two to four ounces of fluid Malt Extract before each meal.

"No troublesome symptoms usually result from this full feeding, and the patient may be made to eat more largely by being fed by her attendant. I like to give butter largely, and have little trouble in getting this most wholesome of fats taken in large amounts. A cup of cocoa or of coffee with milk on waking in the morning is a good preparation for the fatigue of the toilet. At the close of the 1st week I like to add 1 lb. of beef, in the form of raw soup. This is made by chopping-up 1 lb. of raw beef, and placing it in a bottle with one pint of water and five drops of strong hydrochloric acid. This mixture stands in ice all night, and in the morning the bottle is set in a pan of water at 110° Fahr., and kept two hours at about this temperature. It is then thrown on to a stout cloth, and strained until the mass which remains is nearly dry. The filtrate is given in three portions daily. If the raw taste prove very objectionable, the beef to be used is quickly roasted on one side, and then the process is completed in the manner above described. The soup thus made is for the most part raw, but has also the flavour of cooked meat.

"In difficult cases I sometimes add, at the third week, ½ oz. of cod-liver oil, half an hour after each meal. If it lessen appetite, or cause nausea, I employ it thrice a day as a rectal injection, and in cases where the large doses of iron used cause intense constipation, I find the use of cod-liver oil enemata doubly valuable, by acting as a nutriment, and by disposing the bowels to act daily. When given thus, I like to use it in an emulsion made with the juice drained off, after crushing the fresh pancreas of the beef in warm water. Enough of water to cover ½ lb. of chopped pancreas is allowed to stand for an hour in a warm kitchen, and then squeezed through a towel. An ounce is mixed with half that amount of oil and injected slowly thrice a day." (*Weir Mitchell.*)

As to stimulants, when there is no question of breaking off the alcoholic habit, a small amount of stimulant has been found to assist in the rapid increase of fat; such as an ounce of whisky daily in milk, or a glass of dry champagne, or Burgundy, or other red wine. It increases the capacity to take food at meals. Alcohol, however, is not essential.

With the administration of *solid* food, iron is given in large doses; and when the patient is able to sit up, "rather full doses of sulphate of strychnia thrice a day, with iron and arsenic."

As to the consumption of this "vast amount of food," Dr. Weir Mitchell observes:—"I have watched again and again, with growing surprise, some listless, feeble, white-blooded creature learning by degrees to consume these large rations, and gathering under their use flesh, colour, and wholesomeness of mind and body."

When the patient is taking the full diet, it is necessary to watch the urine. When urates begin to be deposited, it must be regarded as a sign of over-feeding, and some reduction in the quantity of food must be made. Attacks of dyspepsia (which are apt to occur) or diarrhœa are met by reducing the diet one-half, or returning to a milk diet for a day or two.

Two or three detailed examples of the diet employed in the treatment of these cases will be the best conclusion to this chapter.

Case 1.—(Weir Mitchell.)

Mrs. C., kept in bed, fed by an attendant, rose only to relieve bladder and rectum.

1st day.—One quart of milk, in divided doses, every 2 hours.
2nd day.—Cup of coffee on waking. Two quarts of milk, in divided portions, every 2 hours. Aloetic pill at night.
3rd to 6th days.—Same diet.
7th, 8th, and 9th days.—Same diet, with a pint of *raw soup*, in three portions.
10th day.—7 a.m., coffee. 7.30 a.m., ½ pint milk. 10 a.m., ditto. 12 noon, 2, 4, 6, 8, and 10 p.m., ditto. Soup at 11 a.m., 5 and 9 p.m.
14th day.—Egg and bread and butter added.
16th day.—Dinner added, and iron.
19th day.—The entire diet was as follows:—7 a.m., coffee. 8 a.m., iron and malt extract; breakfast, consisting of a chop, bread and butter, a tumbler and half of milk. 11 a.m., soup. 2 p.m., iron and malt; dinner of anything

she liked, with 6 oz. of Burgundy or dry champagne, and at the end one or two tumblers of milk. 4 p.m., soup. 7 p.m., malt, iron, bread and butter, usually some fruit, and commonly 2 glasses of milk. 9 p.m., soup. 10 p.m., aloetic pill.

(At 12 noon, *massage* for an hour. At 4.30 p.m., electricity applied for an hour.)

At 6th week soup and wine were dropped, iron lessened one half, massage and electricity only on alternate days. $\frac{1}{30}$th of a grain of sulphate of strychnia thrice a day at meals (continued for several months).

At 9th week, milk reduced to a quart. All mechanical treatment ceased.

Result.—Gain in flesh about face in 2nd week. Weight rose in two months from 96 to 136 lb.; gain in colour equally marked. At 30th day patient had normal catamenial flow, after 5 years of failure to menstruate. At 9th week, drove out. Cure complete and permanent.

CASE 2.—(DR. PLAYFAIR.)

A. B., age 32. Rest in bed, isolation.

1st day.—22 oz. of milk, in divided doses.

2nd day.—50 oz. of milk, in divided doses.

3rd day.—50 oz. of milk, in divided doses. (Massage, $\frac{1}{2}$ an hour.)

4th day.—50 oz. of milk, in divided doses; egg and bread and butter; dialysed iron, 40 minims, in 2 doses. (Massage, $1\frac{1}{2}$ hour.)

6th day.—50 oz. of milk, in divided doses; mutton chop. (Massage, 1 hour 50 minutes.)

8th day.—50 oz. of milk in divided doses; mutton chop; porridge, and a gill of cream; maltine twice daily.

(Massage, 3 hours; electricity, $\frac{1}{2}$ an hour; continued to end of treatment.)

15th day.—Three full meals daily of fish, meat, vegetables, cream, and fruit; 2 quarts of milk, and 2 glasses of Burgundy.

22nd day.—Amount of food lessened.

Result.—On 22nd day sat in a chair for an hour, after a month walked down stairs and went out for a drive. "Enormous increase in size." Cure complete and permanent.

Case 3.—(Dr. Playfair.)

Dietary on 10th day.

6 a.m.—Raw meat soup, 10 oz.
7 a.m.—Cup of black coffee.
8 a.m.—Plate of oatmeal porridge, gill of cream, a boiled egg, 3 slices of bread and butter, and cocoa.
11 a.m.—Milk, 10 oz.
2 p.m.—Rump-steak, $\frac{1}{2}$ lb. potatoes, cauliflower, a savoury omelette, milk, 10 oz.
4 p.m.—Milk, 10 oz., 3 slices of bread and butter.
6 p.m.—Cup of gravy soup.
8 p.m.—A fried sole, roast mutton (3 large slices), French beans, potatoes, stewed fruit and cream; milk, 10 oz.
11 p.m.—Raw meat soup, 10 oz.

Same scale of diet continued through whole treatment. Consumed with relish and appetite. No dyspeptic symptoms.

Result.—Gain in weight in six weeks from 4 st. 7 lb. to 7 st. 8 lb. = 3 st. 1 lb.

Case 4.—(Dr. John Keating.)

P.D., a *male*, age 53 (loss of nervous muscular force, defective memory, insomnia, convulsive muscular twitchings, frequent cough, emaciation, slight night sweats, impaired resonance right apex).

Treatment.—Allowed to be out of bed once a day for four hours, one of which was spent in business.

Food.—6 a.m.—A tumbler of strong, hot beef-tea, made from Australian extract.
8 a.m.—Half-tumbler of iron-water, and breakfast of fruit, steak, potatoes, coffee, and a goblet of milk.
8.30 a.m.—A goblet of milk, with a dessertspoonful of Loeflund's Malt Extract, 6 grains of citrate of iron and quinine.
10 a.m.—Electricity.
12 noon.—Goblet of milk and malt.
2 p.m.—Dinner (preceded by half-tumbler 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, 4 oz., preceded by massage with cocoa oil for an hour.

Two quarts of milk were taken daily, in addition to all other food.

Result.—A gain of over 15 lb. in weight, cough gone, became and remained strong and well.

This method, as adopted by Leyden, is thus described by Germain Sée :—

At 7 a.m.—Half a litre of milk, slowly sipped in ½ an hour, a small cup of coffee with cream, 80 grammes (nearly 3 oz.) of cold meat, a plate of fried potatoes.
10 a.m.—A litre of milk, with 3 biscuits.
12 noon.—The same.
1 p.m.—Broth, 200 grammes (about 7 oz.) of fowl, *purée* of potatoes, green vegetables, 120 grammes (about 4 oz.) of *compôte* and pastry.
3.30, 5.30, 8, and 9.30 p.m.—Half a litre of milk, making a daily consumption of 3½ litres of milk.
In the after part of the day, two meals each of 80 grammes (3 oz.) of roast meat, with bread and 3 biscuits.

The class of *fat* anæmic people—mostly women—are alluded to by Dr. Weir Mitchell as of the "utmost clinical interest." They are rare, as he remarks, and must be dependent on conditions not common to all anæmics. The cases that we have seen have been apparently traceable to long-continued faults of diet, especially to the avoidance of nitrogenous food and the consumption of a vastly-increased proportion of carbo-hydrates.

One of the most remarkable cases of this kind we ever observed was in a patient who had a perfect mania for pastrycooks' sweets. She spent large sums of money habitually at the pastrycooks'; and when any impediment was put in her way, she would succeed, by all sorts of ingenious contrivances, in getting her usual supply of sweets. This enormous consumption of carbo-hydrates in combination with fat (as in pastry) was, of course, associated with entire indifference to animal food.

"Obesity with thin blood" is certainly, as Dr. Weir Mitchell maintains, a "most unmanageable condition." The most useful treatment he believes to be a combination of an exclusively milk diet—well-skimmed milk—with rest and massage.

"In old cases of this kind, the best plan is to put the patient at rest, to use massage, restrict the diet to skimmed milk, or to milk and broth free from fat, and with them, when the weight has been sufficiently lowered, to give iron freely, and, by degrees, a good general diet, under which the globules rise in number, so that even with a new gain in flesh there comes an equal gain in strength and comfort."

He gives as an example the case of a lady, aged forty-five, who weighed 190 lb., her height being 5 ft. 4½ in.; she was also anæmic, feeble, and breathless.

"She was kept in bed five weeks. Massage was used at first once daily, and after a fortnight twice a day, while milk was given, and in a week made the exclusive diet. Her average of loss for 30 days was a pound a day, and the diet was varied by the addition of broth after the third week, so as to keep the reduction within safe limits. . . . After two weeks I gave her the lactate of iron every three hours in full doses. In the 4th week additions were made to her diet-list, and Swedish movements were added to massage, which was applied but once a day; and during the 5th week she began to sit up and move about. Her weight at the 7th week had fallen to 145 lbs., and her appearance had decidedly improved. . . . Now, after two years she is a well and vigorous woman."

In all these cases the milk should be well skimmed, and slowly taken in small mouthfuls at a time. It may, when necessary, be flavoured with a little tea or coffee, or caramel or salt. Its digestion is often aided by scalding with one-fourth the quantity of boiling water; and a few grains of bicarbonate of soda or a little alkaline water (Vichy, Vals, Apollinaris) may be added.

CHAPTER VIII.

FOOD IN SCROFULA, CONSUMPTION, AND CHRONIC FEBRILE CONDITIONS—FORCED FEEDING (SURALIMENTATION).

THE close pathological relationship, if not identity, between scrofula and consumption makes it appropriate to discuss their dietetic management together.

Consumption is also the type of chronic febrile disorders, and the progressive emaciation, which is its characteristic feature, and from which it derives its name, is chiefly dependent on the presence in the great majority, or, at some time or other, in *all* cases, of more or less fever. It is the progressive destruction or consumption of the tissues caused by this chronic fever that we are called upon to antagonise or compensate for by appropriate food. And the dietetic measures which are expedient and useful to check the wasting of consumptives are applicable also to other cases in which a chronic pyrexial state is present.

When a child shows the well-known signs of a *scrofulous* constitution, or when he is known to inherit a tendency thereto, it becomes a matter of great importance that he should be well and carefully fed. It is not, however, necessary to repeat here what has already been said in the section on Food in Infancy and Childhood: the principles of wholesome feeding during this period and the means of carrying them out have been there fully dwelt on. There can be no doubt that an insufficient or inappropriate diet in the early years of life predisposes to the development of scrofula, not only in those who have a hereditary tendency thereto, but in others also. A poor, coarse, innutritious vegetable dietary, involving much digestive effort for its assimilation and often causing irritation of the organs of digestion, and yielding little nourishment in proportion to its bulk, is, no doubt, provocative of many of the manifestations of scrofula observed amongst the children of the poorer classes; while, on the other hand, a sound and rational diet in infancy and early life acts as a most efficient prophylactic against the development of this disease.

We should be careful in all such cases to avoid the administration of food calculated to set up irritation of the child's digestive organs; or, if such already exists, we should at once supply a bland, unirritating diet calculated to remove it.

In poor families it is often the custom to allow quite young children to partake of the same coarse food as the grown-up members of the family. This is a most pernicious custom, and often proves highly injurious even to the most robust children. How much more so must it, therefore, be to the delicate and scrofulous!

Such children should have an abundant supply of good milk as the basis of their diet, also sound wholemeal bread and plenty of butter. Easily-absorbable *fats* are especially valuable to the scrofulous. Cod-liver oil is one of the best; but many other forms of fat are extremely useful, such as butter, cream, bacon fat, dripping. Bread lightly toasted and soaked in fluid bacon fat or dripping is generally liked by children, and is most wholesome. Suet-puddings, served with treacle, sugar, or jam, are also generally popular with children, and may be made the means of introducing a considerable amount of fat in the food, which would be rejected if presented in its natural form. Mutton suet, chopped fine and boiled in milk and sweetened, is another useful expedient of the same kind.

It is always necessary to pay much attention to the digestion, and to at once modify the diet if it is found to be attended with signs of dyspepsia.

In scrofulous children of the fat and flabby type it is not so important to administer fatty foods. It is better in such cases to give a diet rich in albuminates, but small in bulk.

The common error is to keep such children too exclusively on farinaceous food, and to give them a very insufficient supply of animal food. In children with very delicate digestions it is often difficult to get them to take fats or oils of any kind. In such cases inunction with oil—cod-liver oil or olive oil—after washing the surface with hot water and soap, is a good plan. All these cases require also an abundance of respiratory food, an abundance of active oxygen, which they should be allowed to obtain by a life in the open air—in the country or by the sea.

In cases of a disease like *pulmonary consumption*, attended with a chronic febrile condition, and consequent continuous loss of weight, unless this progressive wasting is counterbalanced by the supply and annexation of an adequate amount of food, the patient must, in course of time, succumb to the disease. But not only is it necessary in such cases to arrest the loss of weight, we must also strive to so improve the nutrition that the body may *gain* in weight; for it is well known that if we are able to establish an improved state of nutrition, the disease itself becomes favourably influenced thereby. Our success in this effort will depend much on the amount and type of the febrile state which accompanies the malady. When there are distinct intermissions or remissions in the febrile movement, and when this is quite moderate, we may succeed in procuring the assimilation of a considerable quantity of food, provided great care and discretion be employed in its selection and preparation. But when the fever is considerable and persistent, and the digestive functions (as is usually the case under such circumstances) are greatly impaired and appetite is entirely absent, it may be difficult or even impossible to obtain the appropriation of a sufficient quantity of food to exercise any adequate check on the wasting process. In such cases we are compelled to have recourse wholly to fluid and easily-absorbable foods in much the same manner as in the dietetic management of acute febrile diseases.

It is a generally-accepted rule that in the diet of the consumptive, fats and carbo-hydrates—*i.e.* the especially fattening forms of food—should be at any rate adequately, if not superabundantly, represented. A proper proportion also of albuminates must be included in their dietary.

One of the greatest difficulties we encounter in providing a suitable and adequate diet for consumptives is the frequency with which they complain of digestive troubles, want of appetite, and occasionally of positive disgust for food. Under such circumstances it is most important to provide well-cooked, appetising, and attractively-served food, varied as much as possible, and, so far as is consistent with wholesomeness, agreeable to the tastes of the patient. In the distinctly febrile forms it will be advisable to give small quantities of nutritious food at short intervals.

Some suggestive observations as to food in Dr. H. Weber's lectures on the "Hygienic Treatment of Phthisis" may be here quoted. He directs attention to "the possibility that there may be important relations between the life of the tubercle bacillus and the quality of the food that we take, especially the saline materials which enter into the composition of the blood, the cells, and tissues. . . . . Microbes require mineral food in the same way as plants and animals do, and if we knew exactly which mineral substances the tubercle bacillus requires, and could without harm to ourselves deprive our blood, and cells, and tissues of the salts, by abstaining from food containing them, we should deprive the bacillus of the means of existence." * The difficulties attending such an investigation are, of course, very great. A hint in the right direction may possibly be gained from the fact "that the food of carnivorous animals contains a larger quantity of soda and smaller of potash than that of herbivorous animals, and carnivorous animals are on the whole less subject to tuberculosis than herbivorous animals. If it could be proved that the potash salts are more conducive to the growth of tubercle bacillus than soda salts, articles of food containing excessive proportions of potash ought to be taken only sparingly" (page 48). G. Sée also suggests that the use of cod-liver oil may produce a condition of the tissues hostile to the propagation of the tubercle bacillus; this may be due, he thinks, to the oil appropriating some of the oxygen required for the active multiplication of the micro-organism. "The oil then acts as a protective agent to *our* organism, it acts as a destructive agent to the micro-organisms; our waste is lessened, which is useful; the nutrition of the bacillus is interfered with, which is still more useful." †

Phthisical patients, whose digestive functions are unimpaired, may be allowed to partake of the various nourishing forms of food that enter into the ordinary dietary of the healthy, in addition to which two or three glasses of milk should be taken at convenient intervals between meals, and one of these glasses of milk should be taken the last thing at night, or

* "Croonian Lectures," p. 47.

† "Régime des Phthisiques. Du Régime Alimentaire," p. 400.

even preferably during the night if the patient is awake.

Milk is a most valuable food for the consumptive, and we have already mentioned the several expedients which may be adopted for promoting its digestibility when it is not well borne.

By adding to each glass of milk two tablespoonfuls of hot water, in which about six grains of bicarbonate of soda and five grains of common salt are dissolved, we can often remove the difficulty in the digestion of milk, particularly when the milk is very rich. When we find evidence that the patient really cannot digest the casein of milk—*i.e.* when we find hard curds of milk rejected by vomiting, or giving rise to intestinal troubles and forming the chief part of bulky white motions—then we should make use of whey as a beverage. Its mode of preparation has already been described. A little cream may be added to it if desired.

Cream may also be made more digestible and more acceptable to many patients by mixing it with an equal quantity of hot water, and adding to each teacupful of the mixture a teaspoonful of the aromatic spirits of ammonia; some prefer a teaspoonful of brandy. In other cases we may use *peptonised* milk, and I have found patients able to digest Savory and Moore's peptonised milk when they have rejected milk in every other form.

Some physicians consider it important that the milk should be drunk almost immediately after it has been drawn from the cow, and that it is more digestible and nutritious when perfectly fresh than after it has been boiled.

Jaccoud * makes a great point of phthisical patients who dwell in the country drinking the milk *in* the cow's stables, not only that they may thus get

* "Curabilité et Traitement de la Phthisie Pulmonaire."

the milk perfectly fresh, but that they may breathe the atmosphere of the stables for a short period two or three times a day. He says he is very sure that this atmosphere has the effect of allaying bronchial and laryngeal irritations, and of relieving cough.

He also considers that the addition of some form of alcohol (brandy, rum, or kirsch) presents the double advantage of being useful in itself and promoting the digestibility of the milk.

Germain Sée considers the peculiar value of milk in phthisis to depend upon the fat it contains, and he argues that when enough milk is taken to provide the requisite amount of the other elements necessary for the nutrition of the body, the fatty constituents are in large excess, and this he regards as its great recommendation. For an exclusively milk diet, he estimates the necessary quantity at three litres daily (105 ounces), rather more than five imperial pints.

In many summer health-resorts * in Switzerland and Germany provision is made for following a "milk or whey cure," and in most of these sheep's, goat's, and ass's milk, as well as cow's, milk can be procured. There is no reason, however, for believing that goat's milk is more digestible than cow's milk; but, in the case of diarrhœa, it is thought to be preferable on account of the lime salts it contains. Ass's milk, however, like mare's milk, can often be taken when cow's milk has proved indigestible.

Some of the older physicians, who highly prized ass's milk in the treatment of phthisis, took great pains in seeing to the feeding of the animals that yielded the milk—pains which we may well believe were not wholly wasted; † more recently Latour added

* See my work on "Climate and Health-Resorts." (New Edition.)

† *Vide* Fonssagrives, "Thérapeutique de la Phthisie Pulmonaire," p. 235.

large quantities of common salt to the food of goats in order to obtain milk largely charged with what he considered a valuable remedy in the treatment of phthisis.

It is, perhaps, well to remember that the consumption of large quantities of milk, to the exclusion of other food, occasionally leads to troublesome constipation, and that this may often be remedied by mixing a little seltzer-water with the milk.

Koumiss, or fermented mare's milk, has acquired a great reputation in Russia in the treatment of pulmonary tuberculosis, and the Russians resort in considerable numbers to those stations on the borders of the Caspian Sea, amongst the Kirghis and Tartar tribes, where the koumiss cure is carried on. How much of the good results obtained at these stations is to be attributed to the pure aseptic air breathed in these extensive plains and how much to the koumiss it is not possible to estimate; but there can be no doubt that many phthisical patients derive much benefit from following this course.* The Russian koumiss is prepared from animals kept at liberty, and not worked. Mare's milk, owing to the large amount of lactose it contains, readily undergoes fermentation, the result of which is the production of a sour, highly gaseous fluid containing alcohol, carbonic acid, and lactic acid.

In Europe it is now largely prepared from cow's milk. The cows should be fed in open pastures, and special means are adopted to diminish the relative amount of casein and increase the relative amount of sugar contained in cow's milk. It must be regarded as a food intermediate in character between milk and alcohol—more stimulating than the former, more tonic than the latter. Unfortunately, many persons

* The establishments kept by Dr. Postnikoff and Dr. Annaeff at Ssamara can be recommended to those who may wish to try the Koumiss cure in the Russian steppes.

cannot overcome their dislike to it as a beverage. When it is well borne, it is found to be easy of digestion, often relieving dyspepsia and vomiting, and producing increase of weight. It is appropriate to febrile cases, as it quenches thirst, and can often be retained in the stomach when all other food is rejected; indeed, its especial value is in those cases of inveterate dyspepsia and gastric irritability in which all attempts at giving other kinds of food have failed. *Galazyme* and *këfir*, employed for the same purpose as koumiss, have been already described.

The utility of fatty substances in phthisis is undoubted, and in those cases in which we encounter an insuperable difficulty in procuring the acceptance or the digestion of cod-liver oil, we may encourage our patients to consume as much fresh *butter* and good *cream* as they can digest.

Excellent results have been obtained, even in some advanced cases, from the administration of cream. We have already mentioned a suitable mode of giving it. Some order a little rum or brandy to be mixed with it. The addition of sugar or salt is said to aid its digestion; or it may be mixed with a little tea or coffee, when these beverages do not disagree.

Cocoa and *chocolate* are useful forms of food, and contain a notable quantity of fat. Savory and Moore's peptonised cocoa and milk is very useful. Cocoa, as a beverage, is more digestible when made with water than when made with milk.

Pancreatic Emulsion will be found of service in many cases where there is difficulty in tolerating other forms of fatty food.

Of the various forms of animal food, well-cooked beef, mutton, chicken, and game; clear turtle soup; oysters; many kinds of fish—soles, whiting, turbot, cod, herrings, flounders, smelts, brill—are all suitable to vary the diet of the phthisical.

The use of *raw* meat has been highly extolled, especially by some French physicians, and Professor Fuster, of Montpellier, has claimed the most brilliant results from its administration in cases of phthisis. These results have not, however, been confirmed by other observers, although it is generally admitted that in many cases of troublesome dyspepsia and loss of appetite, especially when associated with diarrhœa, raw meat has rendered real service.

Various expedients have been adopted to overcome the repugnance which most patients at first manifest for this form of food.

In all cases it should first be reduced to as fine a state of subdivision as possible by scraping or cutting and pounding, or, better still, by the use of the little machines now made for this purpose.* Raw meat may also be reduced to a fine dry powder by first drying and then grinding it.

Pounded raw meat can, moreover, be made up into small round pellets, and covered with powdered sugar or gum or any other innocent covering, and swallowed with a little wine and water or brandy and water; or it can be mixed with a little hot clear soup. And it goes especially well mixed with light tapioca soup; this can be flavoured with any agreeable flavouring and drunk readily, and the mouth cleansed by drinking a few mouthfuls of weak brandy and water or claret and water after it.

The sending of phthisical patients to slaughter-houses to drink the *raw blood* of animals as they are

* Débove recommends that it should be "scraped with a knife, so as to detach all the muscular fibres and separate them from the fibrous tissues;" and he points out that what renders it so valuable as a food is its extreme subdivision, which multiplies the surfaces of contact and allows each fibre to be completely bathed by the digestive juices; also, as it has not been hardened by cooking, it allows these juices to penetrate it more readily.—"La Tuberculose Parasitaire," p. 77.

killed is more sensational and whimsical than rational and efficacious.

In some parts of Germany the roes of salted herrings, and in France several species of snails, are thought to be especially useful as food for the phthisical.

The different kinds of farinaceous foods are all useful and appropriate articles of diet. Wholemeal or well-made brown bread is, on account of the phosphates contained in it, better suited to young consumptives, if they digest it well, than white bread. Lentil-flour is also valuable, as it contains notable proportions of phosphates and iron. Oatmeal is rich in fatty matters, and the flour of maize is still richer—a fact which renders them both very suitable additions to the diet of the tuberculous.

Malt Extract is now largely employed as an addition to farinaceous food, the digestion and assimilation of which the *diastase* contained in it doubtless facilitates.

It is possible also to procure malt bread and malt biscuits.

With regard to the use of *alcoholic beverages*, much difference of opinion exists.

Some advocate the consumption of large quantities of alcohol in phthisis. Flint* quotes cases which appear to have been benefited by the consumption of as much as a pint of whisky daily! We shall find, practically, that the use and need of alcohol vary greatly in different individuals.

In some it diminishes appetite and retards digestion; in others it promotes both; and we shall encounter very few cases of phthisis which are not benefited, at some period of their course, by the discreet administration of alcoholic stimulants.

Germain Sée deduces from experimental data the

* In his work on "Phthisis."

following conclusions as to the use of alcohol in tuberculosis :—

(*a*) If there is fever it moderates it.

(*b*) If there is no fever it supports the strength.

(*c*) In all cases it diminishes bodily waste and emaciation.

It is noteworthy, also, that physicians, like Brehmer of Göbersdorf and Dettweiler of Falkenstein, who have quite exceptional experience of the daily needs of phthisical patients, use alcohol largely.

Every additional year's experience convinces us that most of the reputed harm accruing from the use of alcoholic stimulants in phthisis is due to the want of care and discrimination in the choice of the beverage used.

It is exceedingly necessary that the beverage, whether wine, spirits, or beer, should be pure and of the best quality.

When the patient is able to drink fermented *malt* liquors, he may be allowed one or two pints daily of good sound bitter beer, or porter, or stout ; of wines, a half a pint to a pint of *really* good Bordeaux or Burgundy, or of some of the better descriptions of Hungarian, and Italian, or Greek wines. Port and sherry we have found objectionable in most cases, disturbing digestion, and often causing headaches ; a proportionate quantity of whisky or brandy is preferable to either of these wines. Avoid with the greatest care, cheap, bad, acid clarets, the extended consumption of which does infinite mischief ; most Australian wines also are heavy and difficult of digestion.

In febrile cases, small quantities of alcohol given frequently have an excellent effect in supporting the strength ; and especially during the night is it important to give two or three tablespoonfuls of brandy or whisky, alone, or with a little fluid food, such as milk, or beef-tea, or a whipped egg.

What is termed by the French physicians "*alimentation forcée*"—*i.e.* forced feeding—is an expedient suggested by Dr. Débove of Paris for introducing food in large quantities into the stomachs of phthisical patients who have lost all appetite, or even acquired a positive repugnance for food.

Débove also maintains that his method of artificial alimentation, with or without a previous washing out of the stomach ("*lavage de l'estomac*"), with iced water, is a most efficacious measure for arresting the vomiting of phthisical patients.

Débove discovered, by accident, that in cases in which all food introduced into the stomach in the ordinary way was rejected by vomiting, food introduced by the œsophageal tube was, strange to say, retained; and on this observation he founded his method of artificial "*suralimentation.*" He finds he is able to introduce by this means into the stomach an "excess" of food which is retained and digested; and he truly observes, that a person with phthisis requires considerably more food than a person in health on account of the considerably greater bodily waste taking place. He has also observed that the digestive power of the patient has no relation with appetite. "A patient who has no appetite, or who has a marked 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." *

As the results of *suralimentation*, or excess of food, he has observed disappearance of night sweats, diminution and disappearance of cough and expectoration, increase of strength, rapid gain in weight, and at the same time a considerable amelioration in the physical signs.

By the use of powdered raw meat, Débove, and

* "Leçons Cliniques et Thérapeutiques sur la Tuberculose Parasitaire," p. 82.

Dujardin-Beaumetz in Paris, and Peiper in Griefswald, have been able to apply the principle of *suralimentation* without the necessity of using the œsophageal tube.

Dujardin-Beaumetz gives the following instructions for making this powder :—Take the lean of beef, cut it up into small pieces, dry it in a water-bath ; when thoroughly dried reduce it to powder in a coffee-mill, or by means of a machine constructed by Galante (No. 2, Rue de l'Ecole de Médecine, Paris). This powder can be mixed with lentil flour, and taken in the form of soup, or, better still, it may be mixed with chocolate, or with grog—"*grog de la poudre de viande.*" To make the latter, you place in a bowl two tablespoonfuls of meat powder, to this you add three dessertspoonfuls of "syrup of punch" (essence of rum punch), and enough milk to make a perfectly fluid mixture. By these means you can give from 1,500 to 6,000 grains of meat powder daily ;* the latter quantity would be equivalent to 24,000 grains, or three and a half pounds of raw meat. Or it may be given, as recommended by Débove, simply mixed with milk ; first adding just enough milk to make a smooth paste, and then mixing in the remainder so as to make a uniform fluid mixture that can be readily drunk. It is necessary in using these powders to see that they are genuine, and not over dried.

Débove attempts to explain the beneficial effect of "suralimentation" in the following manner :—"The tubercle bacillus develops in a certain soil, a soil which becomes less favourable to its culture when it is modified by *suralimentation* [excess of food] ; this, indeed, augments combustion, as is shown by the amounts of urea excreted in the twenty-four hours—amounts which reach 900, 1,200 grains, and even more. We may also say that by this method we

† Dujardin-Beaumetz, "L'Hygiène Alimentaire." Paris, 1887.

give our patients the power to resist their disease; as when the vine is attacked by the phylloxera, one of the best remedies is to manure well the land; by so doing, we do not destroy the parasite, but we give the plant the force necessary to struggle against it."

Since the adoption of powdered raw meat for *sur-alimentation*, the introduction of food into the stomach by means of the œsophageal tube is reserved for those cases in which, owing to irritability of the gastric mucous membrane, food taken in the ordinary way cannot be retained in the stomach.

While we should do all in our power to encourage our phthisical patients to take an abundance of nourishing food (and for this purpose we should make their diet as varied and attractive as possible), we must be careful not to admit into their dietary forms of food which, although attractive to the patient, tend to exhaust his digestive forces without rendering him an equivalent amount of support and nourishment. We should, therefore, exclude pastry, uncooked fruits, salads, pickles, and all forms of indigestible food. H. Weber objects to potatoes on account of the amount of potash they contain. "Experience shows that the exclusive or even preponderating use of potatoes favours scrofula."

It would be undesirable to fix too rigidly the daily dietary of the phthisical, but the following scheme may serve as a general guide—a sort of plan of route from which wide excursions may be made under the guidance of a discreet physician:—

On waking in the morning, a tumblerful of milk should be taken mixed with a little hot water, to which it is often useful to add a few grains of common salt and bicarbonate of soda, especially when a certain amount of accumulated mucus has to be got rid of by expectoration. There is no objection to taking a little tea, coffee, or cocoa at this hour, with milk or cream, if preferred. Sometimes the stimulus of a tablespoonful of brandy, rum, or whisky is needed at this hour. This first meal is often best taken in bed. About an hour afterwards a substantial breakfast should be taken, consisting either of broiled bacon and lightly-boiled eggs, or some fresh fish, or some cold meat or game or poultry, and with this meal milk, or cocoa or coffee or tea, or some good sound light wine and water may be taken, according to taste.

Supposing this meal to be taken about nine or ten o'clock, a glass of milk or a cup of beef-tea should be taken about noon.

Half-past one or two o'clock is a good hour for the chief meal of the day. This should consist of some fish when it can be procured fresh and good, together with some meat, chicken or game, and fresh vegetables; and some light milk-pudding with a little marmalade or other cooked fruit. With this meal half a pint of good Hungarian wine, light claret, or Burgundy, or an equivalent quantity of brandy or whisky and water, may be taken.

At five in the afternoon another glass of milk should be taken, or a cup of thin chocolate, or tea with plenty of milk or cream; or the yolk of an egg beaten up with a little brandy and water may be substituted, if preferred. It is rarely desirable to order any solid food at this hour if it is intended that the patient should make another substantial meal at seven. At this hour a meal similar in all respects to that taken at 1.30 or 2 o'clock should conclude the substantial feeding of the day.

About half an hour before bedtime (which should not be later than 10 or 10.30 p.m.) another glass of milk, prepared in the same manner as that in the morning, together with one or two tablespoonfuls of brandy or whisky; or a cup of arrowroot, or beef-tea, or tapioca soup, according to taste, may be taken. And, finally, some provision of light nourishment mixed with a little stimulant should be arranged in order to be taken during the night when woke by coughing or after perspiration, or when merely restless.

A glass of Vichy water, taken warm, half an hour before meals, as recommended by G. Sée, may be found useful in some cases and to promote the secretion of gastric juice.

In distinctly febrile cases a much more fluid dietary will have to be followed, and the food will require to be taken at shorter intervals.

CHAPTER IX.

CERTAIN SPECIAL DIETETIC CURES.

THE "DRY" CURE—MILK AND WHEY CURES—THE KOUMISS CURE—THE GRAPE CURE.

In Germany, the land of systematic and occasionally fantastic "cures," a certain John Schroth has promulgated a "*dry*" cure, and established an institution in which it can be practised, and it has received the notice of physicians as eminent as Bartels and Jürgensen — an attention its intrinsic value scarcely merited. It has been applied, amongst other cases, to the cure of gastric dilatation, to the removal of chronic peritoneal effusions and rheumatic effusions into joints, and to cases of inveterate syphilis.

It consists in gradually depriving the patient of fluid to an extent which is said to be absolutely intolerable in many instances, causing intense suffering from thirst, and exciting in most cases a considerable amount of fever, the temperature rising as high as 104° F. The body is at the same time submitted to warm, moist packing. Fatal cases of scurvy have been induced by this treatment, and the results obtained have been by no means brilliant ; it is therefore not necessary to occupy space by describing it in detail.

There are undoubtedly many morbid affections in which a judicious limitation of fluids is calculated to be advantageous, and in which a diet as dry as can be conveniently tolerated is advisable.

This is the case in circulatory disturbances with a tendency to venous engorgement and to exudation into the serous cavities ; in cases of chronic inflammatory effusion which is slow to disappear ; in gastric dilatation; in cases of flatulent dyspepsia induced by too free use of tea, coffee, and other beverages; and in certain cases of excessive corpulence. In considering the dietetic treatment appropriate to the last condition, we have pointed out how and to what extent the limitation of fluids may be applied. It must, however, be borne in mind that in gouty cases, with a tendency to uratic deposits, a deprivation of water is calculated to do harm.

In some of the preceding chapters we have had occasion to dwell at some length on the application of a milk diet to the treatment of certain morbid states, and it will be unnecessary to repeat here what has been fully considered elsewhere. But the so-called "Milk" cure has been systematically applied to the relief of many other ailments, and the method adopted we shall now briefly describe.

Karell, of St. Petersburg, has been one of the chief advocates of an exclusively milk diet in certain diseases, and Weir Mitchell has to some extent adopted his views and extended their application.

In connection with this subject Weir Mitchell observes: "The study of the therapeutic influence and full results of exclusive diets is yet to be made; nor can I but believe that accurate dietetics will come to be a far more useful part of our means of managing certain cases than as yet seems possible." *

The following are the diseases in the treatment of which an exclusively milk diet has been found of value:—Dropsies of all kinds, cardiac, renal, and hepatic; obstinate intestinal neuralgias; incorrigible dyspepsias with grave disturbances of nutrition; hepatic disorders, such as hyperæmia, simple hypertrophy, and fatty liver; asthma, when the consequence of pulmonary catarrh and emphysema; hysterical

* "Fat and Blood," Fifth edition, 1888.

and hypochondriacal states associated with serious disturbances of nutrition; and especially in disorders of nutrition dependent on latent catarrhs of the stomach and intestine.

Karell considers the methodical application of the milk cure produces its curative effects by acting as a *regulator of nutrition;* and he maintains that it is highly beneficial not only in the cases already enumerated, but also in rheumatic and gouty affections, in organic diseases of the heart and advanced renal degeneration, and especially in degeneration of the arteries.*

Both Karell and Weir Mitchell direct that the milk used should be *well skimmed*—as creamless as possible; and it should be obtained fresh twice daily from country-fed cows. They also agree that at first the doses should be small. Weir Mitchell prescribes 4 oz. every two hours, and as the dose is increased the interval between the doses is lengthened to three hours: he also allows a glass during the night to which a little lime-water is added to keep it sweet.

Karell commences with 3 oz. to 6 oz. three or four times a day. He insists on the doses being rigorously fixed and scrupulously adhered to, and that no other food be taken. The doses should be taken at equal intervals, and drunk slowly in small mouthfuls, so that the saliva may mix with it. Taken in this way it will be readily digested, whereas drunk *ad libitum* it would cause indigestion. In winter the milk should be warmed by standing the glass in hot water; in summer it should be of the temperature of the apartment. It should not be boiled except in rare cases of diarrhœa.

If the milk is well digested, as indicated by small solid motions, the dose is slowly increased. The first week is the difficult one to get over; during the

* "Archives Générales de Médecine." 1866.

second week two bottles a day may be taken, at fixed intervals—viz. 8 a.m., 12 noon, 4 p.m., and 8 p.m. These hours may be changed, but the intervals must be maintained.

When there is great objection on the part of the patient to its use, with nausea or disgust, Weir Mitchell allows it to be flavoured with a little tea, coffee, caramel, or salt. He also advises, in certain cases, that the general diet should be displaced slowly until the exclusive milk diet can be tolerated. When it provokes acidity some alkali may be added, such as lime-water or Vichy water; or it may be scalded with a quarter boiling water and a little carbonate of soda, and salt added; or a little barley- or rice-water may be mixed with the milk to prevent firm clotting, as described in the section on "Food in Infancy."

Karell asserts that, although he commences with such small doses, the patients never complain of either hunger or thirst; and he adds that, if patients who are seriously ill attempt to take, instead of the four cups of skimmed milk, four large glasses of milk direct from the cow, they will certainly not be able to digest it, and the treatment will be discredited. In obstinate sickness and diarrhœa he has obtained the best results from these small doses, and he cites one such case in which he gave only four tablespoonfuls of skimmed milk three times a day. No doubt, in a case of this kind, the almost absolute rest of the digestive organs which such treatment affords, is an important agent in the cure.

Constipation he considers a natural consequence and a good sign—a sign that the milk is absorbed. It may be remedied by a simple enema of water, or by a small dose of castor oil or rhubarb; and if obstinate a little coffee should be mixed with the morning milk, or some stewed prunes or a baked apple may be eaten at 4 p.m.

Flatulence is, as a rule, completely relieved by this diet; if, however, any flatulence or diarrhœa should be complained of, it is owing either to imperfect skimming of the milk or to its being taken in too large a quantity. Thirst may be relieved by simple water or seltzer-water.

If during the second or third week there should be a great desire for solid food, a little stale bread with salt, or a small portion of a salted herring is permitted; and once a day a little soup made with milk and thickened with groats. After five or six weeks some modification is admissible; milk, however, should still be taken three times a day, and some other suitable food at dinner. Weir Mitchell allows Nestlé's or some other similar food to be substituted as the case progresses. To objectors Karell says: "Milk is a food easy of digestion for everybody, provided it is given with precaution in strictly measured doses and is of good quality." He states that he has obtained excellent results in desperate cases where other remedies had proved useless, and especially in chronic gastric and intestinal disorders.

Weir Mitchell points out the importance of combining rest with this treatment at the commencement, as the patients lose weight at first and feel weak on account of the small amount taken; after long use, however, they increase in weight. For the first week or two it also causes sleepiness. The tongue becomes covered with a white, thick fur, and the patients complain of an unpleasant sweetish taste in the mouth on waking. The stools are of a yellowish colour, and have a peculiar odour. There is usually a large flow of urine* which may exceed in quantity the fluid ingested, and so lead to the removal of dropsical effusions. Weir Mitchell has also observed that

* It has recently been stated by G. See and Dujardin-Beaumetz that *lactose* given alone acts as a powerful diuretic.

uric acid disappears almost entirely from the urine, which assumes "a singular greenish tint," and when hot nitric acid is poured upon it, it no longer gives the usual mahogany tint at the plane of contact; and it would seem that, during a diet of milk, "the ordinary pigments of the urine disappear, or are singularly modified." The substances which give rise to the ordinary fæcal odours also disappear.

"The changes here pointed out are remarkable indications of the vast alterations in assimilation, and in the destruction of tissues which seems to take place under the influence of this peculiar diet." *

In many of the German and Swiss Spas, and especially in those with alkaline and salt springs, where chronic catarrh of the respiratory organs is treated, such as Ems, Ischl, Reichenhall, etc., the so-called "Whey cure" is applied. This consists in drinking warm whey either alone, or mixed with the mineral water, in definite quantities, at set times. Many physicians regard this practice as, in all respects, similar to the use of skimmed milk, and in no respect preferable except in persons who find the casein of milk indigestible. About 20 oz. daily are taken.

It relieves irritable laryngeal coughs, and exercises a favourable influence over chronic laryngeal and bronchial catarrhs. It has been found useful in certain forms of dyspepsia, and in chronic phthisis. It acts also as a diuretic, especially in combination with the saline mineral waters, and recent observations have shown that *lactose* possesses distinctly diuretic properties.

The "whey cure" is not an exclusive diet cure, but it is usual to strictly limit the quantity of animal food taken, and to augment the amount of fruit and vegetables; it adds, however, to the diet a certain

* "Fat and Blood," p. 103, 5th edition.

amount of milk-salts and milk-sugar. There are various methods of preparing whey, and these have been described in former chapters. At the health-resorts mentioned, whey is prepared from the milk of the sheep and the goat, as well as from cow's milk.

Koumiss, the fermented milk of the Steppe mares, which is used as a food and as an intoxicating beverage by all the nomadic tribes of the South-Eastern Steppe country of Russia, has been already referred to in previous chapters.

It is as a *systematic cure* in various maladies that we now refer to it again. It is in the Steppes themselves that the best Koumiss and the best results of the koumiss treatment are obtained, although at Moscow and St. Petersburg institutions exist for the application of this cure, where koumiss prepared from Steppe mares is employed. A specially selected breed of mares yield the milk made use of. The summer climate of the Steppes seems to be especially favourable to the treatment of pulmonary complaints, but the winters are extremely severe. The nomads appear to possess the art of making koumiss in the greatest perfection; but its composition is by no means stable. It is comparatively rich in sugar, and poor in casein and fat.

Large quantities of koumiss can be easily digested, and it has been observed to exert a diaphoretic or a diuretic action, according as the external temperature is high or low. Its use is constantly attended by a gain in weight.

Many cases of phthisis are reported to have been cured by this treatment when followed in the Steppes of Orenberg or Ssamara, where doubtless the dry climate has also a curative influence.

The best koumiss is made from the milk of light-coloured unbroken mares, pasturing in the Steppes, near mountain ranges, where they can get running water and salt-beds. They should be able to bathe frequently, and they must not have either hay or oats.

There are two kinds prepared, one light and slightly fermented, the other strong and highly fermented.

The patients are made to rise early and take a glass of koumiss every half-hour, except during the two hours preceding dinner and supper. Meat and fats form the chief part of the ordinary food; sweets, fruit, and salads are avoided, as well as ices, coffee, and spirits.

Lime-water is used to arrest the diarrhœa koumiss often causes. At first a few glasses only are taken daily so as to accustom the patient gradually to the cure.

Most invalids digest it well; it relieves constipation and acts as a diuretic. They gain in weight and show signs of increased blood-formation. Tent-life and much exercise in the open air are no doubt important adjuncts to the cure.

We have already mentioned, in a former chapter, Annaeff's and Postnikoff's establishments at Ssamara, as the best places for following this cure.

Good koumiss is a milky-looking, frothy liquid, with an agreeable slightly acid taste. It contains about 1 per cent. of alcohol and lactic acid. Its ready digestibility has been referred to the alcohol in it stimulating the digestive secretions, and the carbonic acid allaying gastric irritability.

The proportion of alcohol in koumiss is too small to produce any symptoms of intoxication; but a tendency to sleep and to mental and bodily languor has been noticed to follow its use. Excitement of the sexual organs has also been noted by several observers to follow the use of koumiss.

The treatment in the Steppes lasts two or three months, and is often renewed the following summer.

Annaeff's establishment stands in a park on a hill on the banks of the Volga, three versts distant from Ssamara. It is provided with a library, theatre, and other comforts. The koumiss is prepared by a Tartar family in the sight of the patients, and with due regard to cleanliness. In its manufacture the milk-sugar is converted into alcohol, carbonic acid, and lactic acid. The casein is in a state of fine subdivision most easy of digestion. Dr. Stange, of St. Petersburg, who studied the koumiss cure in Annaeff's establishment, gives the following

Table of the Relative Composition of the Several Strengths of Koumiss.

	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	—	—
Albumen . .	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

An analysis of koumiss, made in Moscow after two days' fermentation, gave alcohol, 1·65 per cent.; fat, 2·05; milk-sugar, 2·20; lactic acid, 1·15; finely divided casein, 1·12; salts, 0·28; carbonic acid, 0·70. Dr. Stange came to the conclusion that "favourable results can only be obtained from the koumiss cure in the Steppes, since, besides the employment of a genuine koumiss, a hot and dry climate is absolutely necessary;" that it is especially beneficial in catarrhal conditions of the respiratory and gastric mucous membrane; that it is often successful in the first stage of phthisis, in the second stage it simply improves the general condition, in the third stage it is badly borne; that it is especially curative in cases of defective nutrition generally — cases of anæmia, chlorosis, malarial cachexia, scrofula, etc.

Artificial koumiss is prepared in England by the Aylesbury and other dairy companies.

The koumiss cure has been well and briefly defined as "essentially nothing more than a high nutrition of the sick."*

The *grape cure* is another dietetic cure of which a brief account must here be given.

The nutritive value of grapes is not great; they, however, contain much sugar as well as potash salts. They are an agreeable form of food, and afford one of the few means at our disposal between nutritive substances on the one hand and medicinal substances on the other. Much of the benefit referred to this cure may doubtless be attributable to the climatic advantages presented by those agreeable localities, such as Meran and Montreux, where it is usually followed.

Professor Lebert speaks of the grape cure as essentially a dietetic cure, notwithstanding its refreshing and aperient effects; and he is quite opposed to the consumption of very large quantities, as has been advised by some authorities, and considers that only moderate quantities should be prescribed. The effect of the cure is aided by a good supporting diet. Pulmonary patients should not take more than an average of 2 lb. daily, beginning with about a pound; and other patients should not exceed 4 lb. In cases of gastric catarrh 3 lb. a day may be eaten, the diet at the same time being carefully regulated. Constipation, with hepatic congestion and "abdominal

* Bauer, "Dietary of the Sick," p. 357.

plethora," may be benefited by 3 lb. to 4 lb. daily; and in these cases the dose may, exceptionally, be increased to 5 or 6 pounds. The laxative influence of 4 lb. to 6 lb. of grapes eaten daily has been found beneficial in hæmorrhoidal affections and in cardiac diseases with a tendency to visceral congestion and venous engorgement, in hyperæmia of the liver and in chronic constipation.

The tendency to renal and hepatic concretions is often advantageously modified by this cure. Professor Lebert remarks, as the result of his own observations at Montreux, that the grape cure is very valuable "to those who are neither ill nor well, who are fatigued by a too exciting and somewhat intemperate life; or, weakened by severe illnesses, are convalescing slowly; or who, leading habitually a too sedentary and too laborious existence, find in our country, besides the grapes, which regulate the digestive functions, all those hygienic conditions which they most need. In this way the passage of debility and fatigue into real diseases may often be prevented." It is best to begin with half a pound of grapes in the morning fasting (or an hour or two after a light breakfast if they disagree when taken fasting) and another half a pound at 5 p.m. After two or three days a third half a pound should be taken between 11 and 12 noon. Little by little the dose is increased to about a pound each time. In cases of chest disease Lebert rarely exceeded the smaller quantity. In other cases which bear the cure well larger quantities may be prescribed. In some cases of dyspepsia a bunch or two at dessert may be substituted for the midday dose.

The aperient effect may not be manifest at first, but it usually shows itself after a few days.

Figs and pears are also permitted with the cure at Meran in order to diminish the repugnance to one kind of fruit alone.

Some irritation of the gums is apt to be excited during the cure; this may be relieved by rinsing the mouth with cold water, to which a little bicarbonate of soda is added. It has also been recommended that the patient should, while eating the grapes, take from time to time a small piece of fine white bread to remove the acid adhering to the teeth.

Towards the end of the cure, which lasts from four to six weeks, the quantity of grapes should be gradually diminished.

The mean composition of grapes, according to König, is water, 78·17 per cent.; sugar, 14·36; free acid, 0·79; nitrogenous substances, 0·59; non-nitrogenous extractives, 1·96; stones and woody fibre, 3·60; total ash, 0·53. The ash consists chiefly of potash salts, together with salts of lime and magnesia.

We have already indicated certain cases in which the grape cure may prove beneficial. It is also prescribed with success in those cases of "abdominal plethora" associated with a deposition of much superfluous fat; much of this fat may be removed if the laxative influence of the grapes is aided by a spare diet in which the fats and carbo-hydrates are strictly limited. It cannot be credited with any real curative influence in phthisis, but it appears to be useful in cases of chronic bronchial catarrh and emphysema; and it may no doubt relieve the bronchial catarrh which accompanies most cases of phthisis.

It has been found beneficial in cases of gastric and intestinal catarrh in anæmic persons, in vesical catarrh, in gouty concretions, and in cases of malarial cachexia.

CHAPTER X.

ON ARTIFICIAL DIGESTIVE AGENTS AND ON ARTIFICIAL ALIMENTATION.

One of the most remarkable developments of modern therapeutics, and one which has rendered great service in the treatment of many troublesome maladies in which the functions of the various organs of digestion and assimilation have been directly or indirectly impaired, has been the artificial preparation, out of the body, of the several digestive ferments, or active agents of the digestive secretions, by means of which it has been possible either to administer pre-digested food, *i.e.* food ready for immediate absorption into the circulating fluids, or to aid digestion by supplying with the food the deficient digestive ferments.

The utility of these expedients in the dietetic management of many morbid states has been alluded to in some of the preceding chapters.

The amylolytic ferment of the saliva can be replaced by the *diastase* of malt, which possesses the property of converting starches into dextrin and maltose, and this property of malt is largely utilised, either in the administration of the various "Malt Extracts," or by the addition of the meal of malt to other farinaceous foods.

The *pepsin* of the gastric juice, obtained from the gastric glands themselves of certain animals, was the earliest employed of all the digestive ferments, and it is now largely given to increase the activity of gastric digestion when impaired, and to promote the solution and peptonisation of the albuminates *in the stomach.*

But the most extensively used of all these ferments is that extracted from the pancreas, for this has a far wider-reaching digestive action than either of the others, as it not only digests nitrogenous foods and converts albuminates into peptones, but it has the power of converting starch into dextrin and sugar, and it further possesses the property of emulsifying fats; so that nearly all the pre-digested or partially pre-digested foods—*i.e.* all the *peptonised* foods—now in use are peptonised by the addition of the pancreatic ferments.

We propose to examine briefly the properties and uses of each of these three artificial digestive agents.

An objection, it seems to us, of a somewhat singular character has been made to the employment of pre-digested foods, viz. that they usurp the gastric and duodenal functions, and that their use is demoralising (!) to the healthy stomach. No one dreams of objecting to crutches on the ground that they are demoralising to those who are not lame, because no one imagines they will ever be ordered for persons with sound limbs. So with these artificial digestive agents, they are intended and devised for the *sick* and not for the *sound*, for the *abnormal* stomach, not the *normal* one, to supply what is defective, not to add to what is already abundant, and it is a perfectly gratuitous objection to assert that they are demoralising in certain healthy conditions, in which it was never intended they should be used! No valid objection, that we are aware of, has been made to their use in those disorders of the digestive functions for which they are especially appropriate.

And first with regard to the use of *Malt extracts* and Malted food in general. It must be borne in mind that these are simply pre-digested starches, together with other nutritive substances, and it must not be concluded that they can supplement or reinforce the pancreatic digestion of starch *in the small intestine,* for the amylolytic ferments are wholly inactive in the presence of free acid, and the salivary (diastasic) ferment is under ordinary conditions destroyed in the stomach. The diastase of malt, like the salivary ferment, exerts its amylolytic action most energetically in a neutral fluid; the addition of an alkaline carbonate retards it, while a very slight amount of acid (such as the hydrochloric and of the gastric juice) puts a stop to it. In the feeding of very young infants who cannot digest milk, and who, as we have seen, naturally lack the salivary and pancreatic secretions, when malted foods are used it is for the purpose of supplying pre-digested starch, which they are unable to digest from the lack of these ferments. It is possible that we might in *older* subjects convey the diastasic ferment safely through the stomach into the small intestine, if we desired to, by previously neutralising the acid of the stomach by giving a little carbonate of lime or magnesia; but we should then be interfering with the action of one digestive ferment in order to reinforce that of another.

The diastasic power of malt extracts has been found inferior to that of ground malt itself, and these, as we have said, must be regarded rather as preparations of soluble foods than as digestive agents. They contain, besides the diastase of the malt and predigested starch (dextrin and maltose), some of the albuminates and salts of the barley. Like ground malt, when added to farinaceous foods and kept at a temperature below 150° F., they promote the transformation of the starches into dextrin and sugar; but it is an error, as we have just pointed out, to suppose that they continue this amylolytic action when taken into the stomach.

Many varieties of "malted foods" are now in common use, but "Liebig's Infants' Food" may be taken as the prototype of all these. It contains ground malt, wheat flour, potassium bicarbonate, and milk, and it is directed to be made in the following manner :—

Mix well ½ an ounce of ground malt, with ½ an ounce of wheat flour, and 7¼ grains of potassium bicarbonate ; add 1 ounce of water, and 5 ounces of fresh cow's milk. Warm over a slow fire, and keep stirring until it gets thick. Remove from fire, stir for five minutes, replace it on the fire, and again remove it as soon as it gets thick. As the starch gets converted into dextrin and sugar by the diastase of the malt it will become a thin and sweet liquid. Then finally boil it well. Strain through muslin.

This food is highly nutritious ; besides the constituents of the milk, it contains pre-digested starch (dextrin and maltose) and the albuminates (gluten and albumen) of the wheat flour and of the malted barley.

Foods composed (as some malted foods are) of malted flour and desiccated milk, when mixed with water, are defective as the sole food for children, as they do not contain the adequate proportions of fats, proteids, and salts ; but these can be readily increased by the addition of a little cream, or rich milk, or some raw meat juice. In preparing the various malted foods it is usual to bake the wheat flour, so as to render the starch granules more soluble.

Mellin's, Nestlé's, Savory and Moore's, Allen and Hanbury's infant foods are examples of these malted preparations. The two latter are not completely pre-digested, so that something is left to exercise the child's digestive organs ; and Savory and Moore use "whole wheat meal," and their food, therefore, contains more of the nutrient constituents of the grain.

Pepsin, the proteolytic ferment of the gastric juice, acts only when in combination with an acid, and preferably hydrochloric acid. In contact with a dilute solution of sodium carbonate, at the temperature of the body, it is quickly destroyed, and it is also quickly destroyed by the alkaline secretions of the small intestine, aided by the action of the pancreatic ferment, trypsin.

Pepsin is rarely used for the preparation of artificial peptones or pre-digested foods, but it is largely given to promote the activity of stomach digestion in the stomach itself.

For this purpose many excellent preparations exist, but some are very uncertain, and many probably quite inert.

Professor Chittenden, of Yale University, found the following remarkable differences in the proteolytic power of different pepsins :—*

	Relative proteolytic action.
1. Parke Davis and Co.'s Pepsinum Purum in lamellis	100
2. Fairchild's Pepsin in Scales	52
3. Scheffer's Dry Pepsin Concentrated	48
4. Jensen's Crystal Pepsin	35
5. Boudault's Pepsin	14
6. Royal Chemical Company's Pure Pepsin	9

In England there are especially reliable pepsin preparations in Benger's liquor pepticus and Bullock's acid glycerine of pepsin; and Burroughs and Welcome supply Fairchild's "pepsin in scales" in the form of convenient tabloids.

Thirdly, we come to the *pancreatic extracts* and *peptonised* foods, in the preparation of which pancreatic extracts play the principal parts.

We have already, in a former chapter (page 153), estimated the value of peptones in nutrition, and considered to what extent they can replace albuminates.

We must again point out that the value of those preparations depends on their being *pre-digested* foods, and it would be an error to suppose that in administering them we are introducing an active digestive

* *Philadelphia Medical News*, Feb. 16, 1889.

ferment into the small intestine; for the proteolytic action of trypsin is arrested in an acid medium like the gastric juice, and the gastric pepsin aids in the destruction of the ferment. "Hence, it is obvious that pancreatic extracts or ferments given by the mouth can be of no value whatever, since the proteolytic ferment, at least, will undoubtedly be destroyed in the stomach before reaching its normal sphere of action."*

If, however, as seems possible, the pancreatic extracts could be administered in capsules composed of a substance insoluble in dilute acid, but soluble in alkaline fluids, and be so conveyed through the stomach harmless to the duodenum, the difficulty would be overcome. (*Keratin* appears to be a substance of this kind.)

Trypsin acts best in an alkaline medium, and pancreatic extracts are usually mixed with an alkali; but it is also active in a neutral medium.

Peptonised foods, strictly speaking, are artificially-digested albuminates, and might be made with pepsin and hydrochloric acid, as well as with pancreatic extract; but the latter is generally used, and when applied to foods containing carbo-hydrates, or fats, as well as albuminates, its amylolytic and emulsifying properties also come into operation, and we obtain a very completely pre-digested food.

Pancreatin and the pancreatic peptones decompose very readily, and for this reason it is important in using them to be careful that no poisonous ferments are thereby introduced into the organism.

Meat peptones are, no doubt, highly nutritious, but they are often of an unpleasant taste and odour: the smell of pure muscle peptone is stated by Zuntz to be very objectionable, and the more agreeably

* Prof. Chittenden on "Digestive Ferments." *Philadelphia Medical News*, Feb. 16, 1889.

flavoured preparations are said by Dujardin-Beaumetz to contain much comparatively useless gelatin-peptone.

The unpleasant odour and taste detract undoubtedly from the administration of meat-peptones by the mouth, but it does not interfere with their employment in rectal alimentation, for which they are, as we shall presently see, very valuable.

Benger's peptonised beef-jelly (partially digested and solidified beef-tea), and chicken jelly are, however, pleasantly flavoured foods, and agreeable to patients generally. Savory and Moore's beef peptone is also said to be of not unpleasant flavour.

There are many meat peptones in the market, the best known being Koch's, Kemmerich's, Catillon's, and Carnick's.

There are also many *pancreatised* foods, containing other pre-digested substances besides peptones; these are very useful in states of depressed nutrition with loss of digestive power. "Benger's Food" is one of the best of these; it is prepared with cooked wheat-meal and pancreatic extract; mixed with warm milk or milk and water, it acts on starches like malt diastase, and renders the casein more digestible. In the same manner pancreatised oat flour and lentil flour are prepared by Bengér.

"Carnick's Soluble Infants' Food" is made with partially peptonised milk, by means of pancreatin, together with wheat flour and some added lactose.

Concentrated peptonised milk and milk and cocoa are prepared by Savory and Moore, and are agreeable and valuable preparations.

Loeflund's peptonised kindermilch is also a good food.

But many peptonised foods can be conveniently made for the sick-room, as required, by means of pancreatic extracts now readily obtainable.

The best of these are Benger's liquor pancreaticus, Benger's peptonising powders, and Fairchild's *zymine*, a very convenient and active pancreatic extract, introduced by Messrs. Burroughs and Wellcome, and supplied in air-tight glass tubes, each containing the exact quantity of pancreatic extract (5 grains), and sodium bicarbonate (15 grains) required to peptonise one pint of milk. These pancreatin powders are very hygroscopic, and it is important that they should be kept in air-tight glass tubes such as these.

Milk can be readily peptonised by these pancreatic extracts, the casein is converted into soluble peptones, and it thus becomes a most valuable food for delicate infants and others who cannot digest the coagulated casein of cow's milk. If, however, the milk be *completely* peptonised, it acquires a bitter taste which renders it unpleasant, and children will object to take it; but if, as we shall describe, the process of peptonisation be arrested at the proper time, and the milk be only partially peptonised (which, for other reasons, is an advantage), no disagreeable bitter taste is developed.

The method of peptonising milk by means of Fairchild's peptonising powders is very simple.

Into a clean quart bottle pour a pint of milk, add a quarter of a pint of water, and a tube of Fairchild's powder; shake them together. Put the bottle into water as hot as the hand can bear (about 150° F.), and let it stand for half an hour; then boil for two or three minutes. It is then ready for use. It should be kept in ice, or freshly made for each feeding. Boiling is for the purpose of permanently arresting the action of the ferment; cold will arrest it temporarily, and if kept covered with ice it is not necessary to boil it.

If the milk be allowed to stand longer than half an hour, peptonisation will proceed too far, and undesirable bitter products will be generated.

We can regulate the peptonisation to any degree required, and we should be guided by the readiness with which the food is assimilated by the patient. For young bottle-fed infants, a very slight degree of peptonisation is often all that is required.

A teaspoonful or two of Benger's liquor pancreaticus and 15 grains of bicarbonate of soda will answer equally well. The more completely we desire the food to be peptonised, the more, proportionately, of the digestive agent should be employed, and the longer should the process be allowed to continue.

Peptonised milk gruel is also an excellent and valuable pre-digested food, highly commended by Sir W. Roberts. It can be made 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 hours, and then boiled for a few minutes and strained.

In this mixture not only is the casein of the milk peptonised, but the starch of the meal is converted into sugar, and its albuminates peptonised.

The bitterness of the pre-digested milk is scarcely perceptible in this gruel.

Lean meat can also be readily peptonised by means of Fairchild's pancreatic extract, or Benger's liquor pancreaticus.

If 4 oz. of finely-minced lean meat be added to half a pint of water, and then gradually brought to a boil, then half a pint of cold water be added so as to reduce the temperature to about 140° F., and then thirty grains of Fairchild's zymine and twenty grains of sodium bicarbonate be added, and the mixture kept warm for about three hours, the meat will be peptonised.

Peptonised beef-tea can be made in the following manner :—Take half a pound of finely-minced lean beef, add to it a pint of cold water, and cook over a gentle fire till it boils. Decant the beef-tea into a jar or bottle, rub the meat into a paste, add it to the beef-tea, and mix in another pint of water to reduce the temperature to about 140° F. Add a table-spoonful of liquor pancreaticus, or sixty grains of Fairchild's pancreatic extract, and twenty grains of sodium bicarbonate. Stand in a warm place for three hours, shaking occasionally ; then boil quickly for two or three minutes and strain.

This is a weak beef-tea, but it can be made of any strength required.

Following this method various foods can be pre-digested or peptonised according to the wants and tastes of the invalids.

Bauer praises very highly Leube's meat solution, as it contains, besides peptones, some unaltered albumen. It is made by exposing meat and dilute hydrochloric acid to a high temperature in air-tight vessels.*

In *rectal alimentation*, the unpleasant flavour of meat peptones is no bar to their employment, and they have been found very useful in this method of artificial feeding.

But it is necessary to inquire here to what extent the nutrition of the body can be maintained by the administration of food solely in the form of rectal enemata?

It has been ascertained experimentally that soluble

* 1,000 grammes of lean meat minced fine are placed in a porcelain vessel with 1,000 centigrammes of water, and 20 centigrammes of pure hydrochloric acid. This is placed in a closed Papin's digester and boiled for 10 to 15 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 16 to 20 hours ; after this it is neutralised with pure sodium carbonate, and evaporated to a syrupy consistence. —Bauer, "Dietary of the Sick," p. 88.

albumen, such as is contained in expressed meat juice, is absorbed in the rectum to nearly the same extent as complete peptones; also that starch is converted into sugar and absorbed in considerable quantity; egg albumen, when mixed with a small quantity of common salt, is also absorbed; but the mixture is too irritating to be suitable for enemata. Fat in emulsion also appears to be absorbed in the rectum. Solutions of peptones appear to be absorbed readily, but they must not be too concentrated or they prove irritating to the mucous membrane of the rectum, and they are then not retained. Expressed meat juice and peptones seem then the most suitable foods for rectal alimentation. According to Bauer's observations, *under no circumstances* can more than *a fourth part* of the amount of nourishment necessary for subsistence be absorbed in the rectum from nutrient enemata, as its capacity is limited, and the absorption cf nutrient matters therein exceedingly slow.

Leube has pointed out the importance, if nutrient enemata are to be used for any length of time, of only employing substances that cannot cause the least irritation of the mucous membrane of the rectum, and that can be prepared without any great difficulty; and he has suggested enemata of meat and pancreas made in the following manner:—Mince fine 150 to 300 grammes of meat, and mix with 50 to 100 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 25 to 50 grammes of fat may be mixed intimately with the mass by the help of a warmed pestle. A syringe with a wide nozzle must be used. Such enemata cause no irritation of the mucous membrane of the rectum, and can be retained from 12 to 36 hours. Evidence was also obtained by Leube that a considerable portion of the albumen and fat of such enemata was absorbed.

Owing to the difficulty of keeping pancreatic extracts sweet, Wood * has advised the preparation of a glycerine extract made by rubbing down bullocks' pancreas with glycerine, and adding some of this to finely-divided meat for each injection; but the known aperient action of glycerine when injected into the rectum would surely lead to the speedy rejection of such enemata.

Peptonised milk-gruel or peptonised beef-tea, mixed with some soluble carbo-hydrate, such as maltine, or a mixture of one of the malted foods and peptonised milk, are useful preparations for rectal alimentation. Small quantities of wine or brandy may be added to such enemata when stimulation is indicated.

It is advisable to wash out the rectum with pure water an hour before administering a nutrient enema. Only a small quantity should be injected at a time, from 1 oz. to 3 oz.; a larger quantity is liable to be rejected. The tube should be well oiled to avoid setting up soreness or irritation at the anus, and it is well to use a long one so as to inject the fluid as high up as possible in order that it may come in contact with a more extensive absorbing surface. The addition of opium to the injection may insure retention, but it may also retard absorption.

Peptonised *suppositories* are also prepared containing peptonised concentrated milk, or meat, together with digested oil. These are said to have sustained life for weeks without exciting any rectal irritation.

* "Therapeutics."

We have seen that it is impossible to maintain life for any length of time simply by rectal alimentation. If we have to trust to this alone, we can only avert death from starvation for a brief time, probably for two or three weeks. Not only is the amount of nutriment that can be absorbed by the rectum insufficient for the maintenance of life, but diarrhœa is extremely liable to set in after a time, so that the rectal injections are no longer retained.

As a temporary expedient rectal alimentation is exceedingly useful in all those cases in which there exists a mechanical impediment to the reception of food in the natural way; if this is not permanent it may afford time for its removal, but if it is permanent it can only prolong life for a few weeks.

Rectal feeding is also a useful resource in certain states of the digestive organs in which they are intolerant of the presence of food, and in which it is desirable they should for a time be kept at rest. In cases of obstinate vomiting, of gastric ulcer, of acute gastritis, of diphtheritic paralysis, of spasmodic or other stricture of the œsophagus, as well as in the exhaustion of fevers, in delirium, and in other conditions which it is not necessary here to enumerate.

Attempts have been made to administer food by subcutaneous injection of oils, milk, eggs, and other substances, but not with any markedly good results; indeed, the very small amount of nourishment which could under any circumstances be thus administered renders the attempt of little practical utility.

APPENDIX I.

HOSPITAL DIETARIES.

No precise scientific data are available for estimating the *quantity* of food appropriate and sufficient for the various classes of invalids; and when it is considered how different are the conditions, as affecting the nutritive needs and digestive capacities presented by different individuals suffering not only from different, but even from the same maladies, it would seem almost impossible that such precise and accurate data should ever be obtainable. Under these circumstances our only reliable guide is that furnished by the prolonged and observant experience of those who have had the direction and care of institutions adapted for the reception of the sick. It will, therefore, be of some practical value to collect together and compare a certain number of those di-taries which the experience of such institutions has shown to be suitable and sufficient.

In most of these dietaries wide scope is usually given for the introduction of "extras," which is an acknowledgment of the necessity for permitting great latitude in estimating the quantity of food requisite for individual cases.

In the estimate made by Bauer, from the tables accessible to him, of the relative quantities of albumen, fat, and carbohydrates (in grammes) contained in the dietaries of some of the principal English hospitals, the variations, especially in the quantity of fats, appear to be considerable.

It is probable, however, that these calculations were made from tables that, in some instances, are no longer in use.

	Albumen.	Fat.	Carbo-hydrates.	Total.
Middlesex Hospital . .	85	28	297	410
St. Bartholomew's Hospital	83	50	291	424
Consumption ,,	83	32	254	369
St. George's ,,	109	65	308	473
Westminster ,,	125	43	388	556
German ,,	97	68	309	474
Margate Sea Bathing Infirmary	123	55	438	616

In those Hospitals in which the diets are classified mainly into "Full," "Middle," and "Milk" diets, it may be instructive to compare these together. Meat is "cooked" in all cases, unless the contrary is stated.

Full Diets.

Guy's.	*King's College.*	*London.*
Bread, 14 oz. Butter, 1 oz. Meat, 6 oz. Potatoes, ½ lb. Alternate days. Mutton broth, ½ pint, or baked rice pudding, ½ lb. Porter (males), 1 pint; (females), ½ pint. (Or milk, instead of porter). Tea and sugar.	Bread, 12 oz. Meat, 6 oz.; females, 4 oz. Potatoes, ½ lb. Gruel, 1 pint. Porter (males), 1 pint; (females), ½ pint. Milk, ½ pint.	Bread, 12 oz. Meat, 6 oz. Potatoes, ½ lb. Porter, 1 pint; or milk, 1 pint.

Bartholomew's.	*St. Thomas's.*	*University College.*
Bread, 14 oz. Butter, 1 oz. Meat, 8 oz. Potatoes, ½ lb. Beer (men), 2 pints; (women), 1 pint. Tea, 2 pints.	Bread, 12 oz. Butter, ¾ oz. Meat, 4 oz. Potatoes, ½ lb. (or fresh vegetables). Porter, if ordered. Milk, ½ pint. Tea, 1½ pint; with milk and sugar.	Bread, 12 oz. Meat, 6 oz. Potatoes, ½ lb. Broth, or pea soup, ¾ pint (on alternate days). Rice pudding, made with milk, 4 oz. Beer, 1 pint, when ordered. Milk, 1 pint.

Westminster.	*Great Northern.*	*Edinburgh Infirmary.*	*Women's.*
Bread, 14 oz. Butter, ¾ oz. Meat, 5 oz. Potatoes, ½ lb. Milk gruel, 1 pint. Milk, ½ pint. Tea, ⅓ oz. Sugar, 1 oz.	Bread, 12 oz. Butter, ½ oz. Meat, males, 6 oz.; females, 4 oz. Potatoes, 8 oz. Broth, 2 pints. Milk, ½ pint. Tea or coffee, 1½ pints.	Bread, 14 oz., or Potatoes, 2 lb., in place of 11 oz. of bread. Meat, 6 oz. Broth: Meat, 2 oz. Barley, 1 oz. Vegets., ¾ oz. Porridge: (Oatmeal, 4½ oz.), 1½ pint. Butter-milk, 20 oz. Milk (new), 10 oz.	Bread, 10 oz. Butter, ¾ oz. Meat, 5 oz. Potatoes, ¼ lb. (Other vegetables on 3 days). Beef tea, 1 pint. (Obtained from 1 lb. rump steak). Milk, 1 pint.

It is certainly somewhat remarkable to find such wide variations as are apparent in the above tables of "Full Diets" in some of our principal hospitals, especially as those are the diets usually allotted to convalescents or to surgical cases, and they are diets with which it is not usual to order "extras."

The quantity of *cooked meat* varies from 4 oz. at St. Thomas's to 8 oz. at St. Bartholomew's! In four *no* butter is provided, and in the other the quantity allowed varies from ½ oz. to 1 oz. In such essential articles of diet as these more uniformity might surely be expected.

MIDDLE DIETS.

Guy's.	*King's College.*	*London.*	*Bartholomew's.*
Bread, 12 oz. Butter, 1 oz. Meat, 4 oz. Potatoes, ½ lb.	Bread, 12 oz. Meat, men, 4 oz.; women, 3 oz. Potatoes, ½ lb.	Bread, 12 oz. Meat, 4 oz. Potatoes, ½ lb.	Bread, 12 oz. Butter, ¾ oz. Meat, 4 oz. Potatoes, ½ lb.
On alternate days: Mutton broth, ½ pint, or milky rice pudding, ½ lb.	Gruel, 1 pint.		
Porter, ½ pint; or milk. Tea and sugar.	Porter, ½ pint. Milk, ½ pint.	Porter, ½ pint; or milk, ½ pint.	Beer, 1 pint. Tea, 2 pints.

University College.	*Westminster.*	*Great Northern.*	*St. Thomas's.*
Bread, 12 oz. Meat, 4 oz.; or fish, 8 oz. Potatoes, ½ lb. Soup (with barley), 1½ oz.; or beef tea, 1 pint; or rice pudding, with milk. Milk, 1 pint. Beer (if ordered), ½ pint.	Bread, 10 oz. Butter, ¾ oz. Meat, 3 oz. Potatoes, ½ lb. Milk gruel, 1 pint Tea, ⅓ oz. Sugar, 1 oz. Milk, ½ pint.	Bread, 12 oz. Butter, ½ oz. Meat, 4 oz. Potatoes, 8 oz. Broth, 1½ pint. Milk, ¼ pint. Tea or coffee, 1½ pint.	Bread, 12 oz. Butter, ¾ oz. Meat, men, 4 oz.; women, 3 oz. Potatoes, ¼ lb.; or fresh vegetables. Rice or bread pudding, 8 oz.

Milk Diets.

Bartholomew's.	*King's College.*	*St. Thomas's.*
Bread, 12 oz. Butter, $\frac{3}{4}$ oz. Milk, $1\frac{1}{2}$ pint; or milk with arrowroot, rice, or sago, 1 pint. Tea, 2 pints. Gruel.	Bread, 8 oz. Milk, $\frac{3}{4}$ pint. Rice milk, $\frac{1}{2}$ pint; or rice, or bread pudding, $\frac{1}{2}$ lb.	Bread, 12 oz. Butter, $\frac{3}{4}$ oz. Milk, $1\frac{1}{2}$ pint. Rice, or bread pudding, $\frac{1}{2}$ lb. Tea, $1\frac{1}{2}$ pint, with milk and sugar.

University.	*Great Northern.*	*Guy's.*
Bread, 12 oz. Milk, 2 pints. Beef-tea, 1 pint. Arrowroot, 2 oz. } Made into jelly. Sugar, 1 oz. }	Bread, 12 oz. Milk, 3 pints. Rice pudding, $\frac{1}{2}$ lb., if ordered. Barley water, *ad. lib.*	Bread, 12 oz. Butter, 1 oz. Milk, 2 pints; or milk, 1 pint, with rice, sago, or arrowroot. Beef tea, $\frac{1}{2}$ pint, if ordered. Gruel and barley water, *ad. lib.*

Glasgow Infirmary.	*Women's.*
Bread. 8 oz. Milk, 3 pints. Rice, $2\frac{1}{2}$ oz.	Bread, *ad. lib.* Butter, $\frac{3}{4}$ oz. Milk, 2 pints. Beef tea, 1 pint. Light pudding, $\frac{1}{2}$ pint.

In these diets we may also notice considerable discrepancies as to quantity. The bread varies from 8 to 12 oz.; the total amount of milk from $1\frac{1}{4}$ pint to 3 pints. Two allow a large quantity of tea, six allow no tea. Four allow butter, and four allow no butter.

Some other hospitals classify their diets differently; we will compare the so-called "Ordinary Diets" of these Institutions:—

St. Mary's.	*St. George's.*	*Middlesex.*
Bread, 12 oz. Butter, 1 oz. Meat, 4 oz. Potatoes, ½ lb.; or other vegetables. Milk, ½ pint. Milk or beef tea, 1 pint. Tea, coffee, or cocoa, 2 pints, with sugar.	Bread, 12 oz. Butter, 1 oz. Meat, 3 oz. Potatoes, ½ lb. Milk, ½ pint. Porter, ½ pint. Gruel, 1 pint. Tea, 2 oz. weekly. Sugar, ½ lb. weekly.	Bread, 10 oz. Meat (uncooked, and with bone!), 6 oz. Potatoes, ½ lb. Milk, ½ pint. Beef tea, strong, ½ pint.

Brompton.	*Royal Chest.*
Bread, 13 oz. Butter, 1 oz. Meat, 4 oz. Egg, or bacon. Potatoes, 5½ oz.; and other vegetables. Milk, gruel, or soup, ½ pint. Pudding, 8 oz. Tea, coffee, or cocoa, 1 pint. Treacle.	Bread, 12 oz. Meat, 4 to 6 oz. Potatoes, ½ lb. Milk, ¾ pint. Milk or cocoa, ½ pint. Light pudding (with milk and eggs), 6 oz.

It is certainly regrettable that more uniformity in the estimation of the quantities of food necessary for invalids is not observable in these tables.

In some hospitals the diets are not specially named, but simply numbered; as in the following:—

Charing Cross Hospital.

No. 1 Diet.—Milk, 4 pints; beef-tea, 1 pint.
,, 2 ,, —Bread, 9 oz.; butter, 1 oz.; broth or beef-tea, 1 pint; milk, 2 pints; milk pudding.
,, 3 ,, —Bread, 12 oz.; butter, 1 oz.; meat, 4 oz.; potatoes, $\frac{1}{2}$ lb.; milk, 1 pint; milk pudding.
,, 4 ,, —Bread, 12 oz.; butter, 1 oz.; meat, 6 oz.: potatoes, $\frac{1}{2}$ lb.; milk, 1 pint; milk pudding.

Royal Free Hospital.

No. 1 Diet.—Bread, 8 oz.; beef-tea, $\frac{1}{2}$ pint; gruel, 1 pint; coffee, $\frac{3}{4}$ pint; milk, $\frac{1}{4}$ pint.

No. 2 Diet.—Bread, 12 oz.; soup, 1 pint (with boiled rice, 3 oz.); gruel, 1 pint; coffee, $1\frac{1}{2}$ pint; milk, $\frac{1}{4}$ pint.

„ 3 „ —Bread, 12 oz.; meat (uncooked), 8 oz. (males); 6 oz. (females); potatoes, $\frac{1}{2}$ lb.; gruel, 1 pint; coffee, $1\frac{1}{2}$ pint; milk, $\frac{1}{4}$ pint.

The following hospitals provide a "*Fish*" diet.

Middlesex.—Bread, 10 oz.; milk, 1 pint; fish, 8 oz. (whiting, cod, plaice, or brill); potatoes, $\frac{1}{2}$ lb.

St. George's.—Bread, 12 oz.; butter, 1 oz.; milk, $\frac{1}{2}$ pint; gruel, 1 pint; fish, plain boiled, 4 oz. (whiting, plaice, flounders, or haddock).

Women's.—Bread, 10 oz.; butter, $\frac{3}{4}$ oz.; milk, $1\frac{1}{2}$ pint; beef-tea, 1 pint; fish, 6 oz.; potatoes, $\frac{1}{4}$ lb.

London Fever.—Bread, 10 oz.; fish (sole, haddock, cod, or brill, uncooked), 8 oz.; potatoes, 8 oz.; cocoa, 1 oz.; sugar, $\frac{1}{2}$ oz.; milk, $\frac{1}{6}$ pint.

We give as examples the full diet tables of the following three hospitals :—

London Hospital.

Admission Diet.—(For all patients on admission, unless otherwise ordered).—Bread, 12 oz.; milk, 2 pints; beef-tea, 1 pint.

For Children.—Bread, 8 oz.; milk, 1 pint; beef-tea, $\frac{1}{2}$ pint.

Full Diet.—Bread, 12 oz.; potatoes, 8 oz.; meat, 6 oz.; porter or milk, 1 pint.

Middle Diet.—Bread, 12 oz.; potatoes, 8 oz.; meat, 4 oz.; porter or milk, $\frac{1}{2}$ pint.

Fever Diet.—Milk, 2 pints; beef-tea, 1 pint.

Children's Diet.—Bread, 8 oz.; potatoes, 6 oz.; meat, 2 oz.; milk, 1 pint.

Hydro-carbon Diet.—Bread, 12 oz.; fat bacon, 4 oz.; milk, 1 pint; pudding (arrowroot, 1 oz.; yolks of 2 eggs; milk, 1 pint).

Diabetic Diet.—Gluten bread, 6 oz.; meat, 6 oz.; watercress; gluten bread pudding (soak 1 oz. gluten bread in $\frac{1}{2}$ pint milk for an hour, beat up with an egg, and 1 oz. gluten flour, then put mixture into a mould, and bake).

Special Diet.—Mutton chop, or beef steak (8 oz. uncooked): or fish (10 oz. uncooked), with, in each case, bread, 12 oz.; potatoes, 8 oz.; and milk or porter, 1 pint; as ordered.

Ordinary beef-tea is made with 8 oz. meat to the pint.

Children's Hospital.

Milk Diet.—Bread, 6 oz. (with butter); milk, 2 pints; rice, or other milk pudding.

Broth Diet.—Bread, $7\frac{1}{2}$ oz. (with butter or dripping); milk, $1\frac{1}{4}$ pint; mutton broth, made with vegetables, $\frac{1}{2}$ pint.

Beef-tea Diet.—Bread, 5 oz. (with butter); milk, $1\frac{1}{2}$ pint; beef-tea, 13 oz.

Fish Diet.—Bread, 8 oz. (with butter, dripping, or treacle); milk, 1 pint (or milk, $\frac{1}{2}$ pint, and cocoa, $\frac{1}{2}$ pint); sole, boiled, $2\frac{1}{2}$ oz.; potatoes, mashed, 3 oz.

Meat Diet.—Bread, $6\frac{1}{2}$ oz. (with butter, dripping, or treacle); milk, 1 pint (or milk, $\frac{1}{2}$ pint, and cocoa, $\frac{1}{2}$ pint); meat, $2\frac{1}{2}$ oz.; potatoes, mashed, 4 oz.

London Fever Hospital.

Low Diet.—Bread, 6 oz.; milk, $\frac{1}{2}$ pint; gruel, 1 pint; sugar, $\frac{1}{4}$ oz.

Beef-tea Diet.—Bread, 4 oz.; milk, 1 pint; beef-tea, 1 pint.

Middle Diet.—*Males*, bread, 10 oz.; milk, 1 pint; broth, 1 pint; rice, or bread (for pudding), 2 oz.; egg (for pudding), 1; sugar (for pudding), $\frac{1}{2}$ oz. *Females*, 2 oz. less bread.

Fish Diet.—*Males*, bread, 12 oz.; fish (sole, haddock, cod, or brill), uncooked, 8 oz.; potatoes, 8 oz.; cocoa, 1 oz.; sugar, $\frac{1}{2}$ oz.; milk, $\frac{1}{8}$ pint. *Females*, 2 oz. less bread.

Full Diet.—*Males*, bread, 16 oz.; meat, 12 oz. (*uncooked*, and without bone); potatoes, 12 oz.; cocoa, 1 oz.; sugar, $\frac{1}{2}$ oz.; milk, $\frac{1}{4}$ pint; beer, 1 pint. *Females*, 4 oz. less bread, 2 oz. less meat; beer, $\frac{1}{2}$ pint.

The following extras may be prescribed:—

Beef-tea, strong beef-tea, and eggs, as ordered.

Arrowroot, $\frac{1}{2}$ oz.; custard pudding—1 egg, $\frac{1}{2}$ pint milk; $\frac{1}{2}$ oz. sugar; tea, $\frac{1}{4}$ oz. per day; sugar, 1 oz. per day; butter, 1 oz. per day.

Extras which are largely ordered by the physicians and surgeons in London hospitals are thus very fully enumerated in the diet tables of the *Middlesex Hospital.*

Chops (mutton, or pork), $\frac{1}{2}$ lb. when trimmed; *steak*, rump, $\frac{1}{2}$ lb.; *chicken*, a quarter; *sausages*, $\frac{1}{2}$ lb.; *rabbit*, a quarter; *tripe*, $\frac{1}{2}$ lb.; *bacon*, 3 oz.; *strong beef-tea* (12 oz. beef to pint); *jelly beef-tea* (24 oz. to pint); *broth* (neck of mutton, with bone, $\frac{1}{4}$ lb. to pint), without meat; *chicken broth* ($\frac{1}{2}$ chicken to pint); *oysters*, *greens*, *suet pudding* (beef suet, 1 oz.; flour, 2 oz.); *custard pudding*, *arrowroot*, *sago*, *oatmeal gruel* (3 oz. to pint); *eggs*, *jellies*, *porter*, *ale*, *stout*, *wine*, *spirits*, *oranges*, *lemons*, *meat essences*.

The *hours* and *apportionment* of food are exemplified in the following extract from the diet tables of St. Mary's Hospital:—

Ordinary Diet.

Breakfast, 6 a.m.—Tea, coffee, or cocoa, with sugar, 1 pint; milk, $\frac{1}{4}$ pint; bread and butter.
Dinner, 12 noon.—Meat, 4 oz.; potatoes, or other vegetables, $\frac{1}{2}$ lb.; bread.
Tea, 4 p.m.—Tea, coffee, or cocoa, with sugar, 1 pint; milk, $\frac{1}{4}$ pint; bread and butter.
Supper 7 p.m.—Beef-tea, milk, or cocoa, 1 pint; bread and butter.

APPENDIX II.

INVALIDS' DIETARY.—SELECT RECIPES.

1. Almond Cakes for Diabetics (Seegen's), p. 431.

2. Alum Whey (*an astringent drink*).—To a pint of boiling milk add ¼ oz. of powdered alum previously mixed with three or four tablespoonfuls of hot water. Strain.

3. Arrowroot.—Mix two teaspoonfuls of arrowroot with three tablespoonfuls of cold water; add half a pint of boiling water, constantly stirring. Milk may be used instead of water. Flavour with sugar, nutmeg, lemon-peel, or other spice. Add port wine or brandy, if required. (Some advise boiling for three minutes in an enamelled saucepan.)

4. Artificial Human Milk (Frankland's), p. 302.

5. Barley Jelly (Eustace Smith), p. 306.

6. Barley Water.—On a tablespoonful of pearl barley (washed in cold water), the rind of a lemon peeled thin, and two or three lumps of sugar, pour a quart of boiling water. Let it stand for seven or eight hours, and strain. More or less of the juice of the lemon may be added, according to taste.

7. Barley Water (Bartholow).—Wash 2 oz. 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. Flavour with thinly-cut lemon-rind, and sugar to the taste; but do not strain unless at the patient's request.

8. Beef Essence, p. 382.

9. Beef Juice (Bartholow).—Broil quickly some pieces of round or sirloin, of a size to fit in the cavity of a lemon-squeezer. Both sides of the beef should be quickly scorched to prevent the escape of the juices, but the interior should not be fully cooked. As soon as ready, the pieces should be pressed in the lemon-squeezer, previously heated by being dipped in hot water. The juice, as it flows away, should be received into a hot wine-glass, and after being seasoned to the taste with salt and a little cayenne pepper, taken while hot.

10. 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° Fahr. Make up the water lost by 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.

11. 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 it 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° Fahr.

12. Beef-Tea (Germain Sée), p. 367.

13. Beef-Tea with Oatmeal.—Mix thoroughly one tablespoonful of groats with two of cold water, add to this a pint of boiling beef-tea. Boil for ten minutes, stirring all the time, and strain through a coarse sieve.

14. Biedert's Cream Mixture, p. 309.

15. Bouillon, American (American Broth).—Place in a tin vessel that can be hermetically closed, alternate layers of finely-minced meat and vegetables. Seal it up, and keep it heated in a water-bath (*bain-marie*) for six or seven hours, and then press out the broth.

16. Bouillon (Broth) *as used in the hospitals of Paris.*—

Raw meat, without bone	1 kilogramme	(about 2¼ lb.)
Fresh vegetables - -	400 grammes	(about 1 lb.)
Salt - - - - -	10 ,,	(about 150 grs.)

Should be boiled very slowly over a very gentle fire.

17. Bran Cakes (Camplin's), p. 430.

18. Brandy and Egg Mixture, p. 366.

19. Bread-Jelly (*for the preparation of an artificial food for infants*).—Take 4 oz. of crumb of bread two or three days old, soak in cold water for six or eight hours; then squeeze all the water out of it (lactic acid and other peccant matters are thus removed). Place the pulp in fresh water, and boil gently for an hour and a half, so as to break up the

granules of starch, and promote its conversion into dextrin and glucose.

Rub this semi-fluid gruel through a fine hair-sieve; when cold, it forms a smooth jelly.

It will not keep long, and must be prepared twice daily.

For children who can digest no milk, this jelly may be simply mixed with enough warm water (one tablespoonful to 8 oz. of water) so as to have the consistence of thin cream, and a little refined sugar added.

To make it, however, a suitable food for more than mere temporary purposes, it would need the addition of some albuminate and some fat. Its percentage composition, mixed in the proportions stated, is proteids 0·74, fat 0·13, carbo-hydrate 4·15.

If the addition of milk can be tolerated, then a mixture of 3 oz. of bread-jelly to 4 oz. of milk (or peptonised milk) and 4 oz. of water will make a fairly good food; or the necessary amount of proteid and fat may be obtained by the addition of raw-meat juice and cream (the raw-meat juice being prepared by expression from a mixture of four parts meat and one part water).

Dr. Cheadle* recommends as a highly nutritious food for children a mixture of four parts of the above bread-jelly mixture (with water only), three parts of raw-meat juice, half a pint of cream, and one-fifth part of sugar. The raw-meat juice must be quite fresh, and made twice a day.

20. Broth, Cold (Parkes), p. 176.

21. Caudle.—Beat up an egg to a froth; add a glass of sherry and half a pint of gruel. Flavour with lemon-peel, nutmeg, and sugar.

22. Celery stewed, for Rheumatism, p. 96.

23. Chicken Broth (Bartholow).—Skin and chop up small 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.

24. Chicken, Veal, or Mutton Broth may be made like beef-tea (No. 11), 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

* "Artificial Feeding of Infants."

increased by the addition of pearl barley, rice, vermicelli, or semolina.

25. EGG-NOG (Bartholow) (*a nutritive drink in acute disease*).—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 a fresh 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.

26. Enema of Meat and Pancreas (Leube's), p. 548.

27. Entire Wheat-meal Cakes (Sir Henry Thompson), p. 190.

28. Fruit Soups, p. 371.

28*a*. *Grog de la Poudre de Viande* (Dujardin-Beaumetz), p. 522.

29. Haricot Beans, Directions for Cooking (Sir H. Thompson), p. 349.

30. IMPERIAL DRINK (*a cooling, diuretic beverage*).—Pour a pint of boiling water on a large teaspoonful of cream of tartar, a little sugar, and a few pieces of lemon-peel. Strain when cold.

31. Inulin Biscuits for Diabetics (Kulz's), p. 425.

32. LAIT DE POULE.—Make an emulsion by beating up the yolks of two eggs with hot water, sweeten with sugar, and flavour with a little orange-flower water.

33. LEMONADE (Pavy).—Pare the rind from a lemon thinly, and cut the lemon into slices. Put the peel and sliced lemon into a jug, with an ounce of white sugar, and pour over them a pint of boiling water. Cover the jug closely, and when cold strain.

34. LEMONADE.—Rub two or three lumps of sugar on the rind of a lemon, express the juice, and add three-quarters of a pint of cold or iced water, or a bottle of soda-water.

35. LEMONADE, EFFERVESCING.—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 small teaspoonful of bicarbonate of soda or potash.

36. LEMON-PEEL TEA (Pavy).—Pare the rind thinly from a lemon which has been previously rubbed with half an ounce of lump sugar. Put the peelings and the sugar into

a jug, and pour over them a quart of boiling water. When cold, decant the liquid, and add a tablespoonful of lemon-juice.

37. Liebig's Infant's Food, pp. 299, 540.

38. Lime-water, p. 303.

39. LINSEED TEA.—To a pint of water add two tablespoonfuls of linseed, half a lemon, $\frac{1}{4}$ oz. of bruised liquorice root (or a piece of liquorice the size of a filbert), and sugar-candy to taste. Boil for an hour and a half, and strain.

40. Macaroni à l'Italienne (Sir Henry Thompson), p. 194.

41. MALT (GROUND) AND RICE PUDDING.—Stir an ounce of ground malt into a pint of boiling milk; strain through a sieve, and add the milk to 2 oz. of well-soaked rice. Mix well, and stand for ten minutes in a warm place; then bake for an hour.

42. Meat Biscuits (Parkes), p. 208.

43. Meat Solution (Leube's), p. 547.

44. MEAT TEA (Bartholow).—Put one pound each of beef, mutton, and veal, cut into small pieces, into three pints of cold water. It should simmer for three or four hours, but not boil. When finished, the tea should be carefully strained, and seasoned with salt, and cayenne pepper if preferred.

45. MILK AND SUET (Pavy).—Boil an ounce of finely-chopped suet with a quarter of a pint of water for ten minutes, and press through linen. Then add a dram of bruised cinnamon, an ounce of sugar, and three-quarters of a pint of milk. Boil again for ten minutes, and strain. A wine-glassful or two at a time. Nutritive and fattening.

46. MUTTON BROTH (Bartholow).—Boil one pound of lean loin of mutton, exclusive of bone, with three pints of water, till tender, throwing in a little salt and onion according to taste. Pour out the broth into a basin, and when it is cold skim off the fat. It can be warmed up as wanted.

47. OATMEAL GRUEL.—Mix thoroughly one tablespoonful of groats with two of cold water; add to this a pint of boiling water, stirring constantly. Boil and stir for ten minutes. Sweeten with sugar.

43. OATMEAL PORRIDGE.—To a pint of boiling water add half a teaspoonful of salt, and sprinkle slowly in three to four ounces of oatmeal till of sufficient thickness, keeping

it stirred with a porridge-stick. Boil gently for fifteen to twenty minutes; add a little more boiling water, and boil for five minutes more. It may be served with milk, cream, butter, sugar, etc.

49. Oatmeal Porridge with Milk.—Into an enamel-lined saucepan put a quart of milk. When on the point of boiling, stir in slowly ½ lb. of coarse oatmeal, and continue stirring as it thickens. Let it boil for about twenty minutes. It can be made thicker or thinner as desired, and served with cream, salt, sugar, or other addition.

50. Oatmeal Soup (Bartholow).—Put 2 oz. of oatmeal in a basin; pour over it a pint of cold water, stir it, and let it stand a minute; then pour over it, quickly stirring all the time, a pint of good broth; pour through a fine strainer into a saucepan, taking care that none of the coarse part of the meal goes into the soup. Boil the soup for ten minutes, season, and serve.

51. Orgeat (Pavy). (*A demulcent and nutritive drink.*)—Blanch 2 oz. of sweet almonds and four bitter almond seeds. Pound them into a paste with a little orange-flower water, rub this with a pint of milk diluted with a pint of water until it forms an emulsion. Strain and sweeten with sugar.

52. Peptonised Beef-Tea, p. 547.

53. Peptonised Enema (Ewald).—Boil a pinch of flour in half a cupful of a 20 per cent. solution of glucose. Mix in three whipped eggs, a glass of red wine, and a teaspoonful of peptone.

54. Peptonised Milk, p. 545.

55. Peptonised Milk-Gruel, p. 546.

56. Port Wine Jelly.—Put one ounce of isinglass into a quarter of a pint of water, and set on the fire till the isinglass is dissolved. Then add 1 oz. of sugar and a pint of port. Strain through muslin into a mould, and let it set.

57. Powdered Meat (Dujardin-Beaumetz).—Take cold boiled meat, mince it fine, dry it in a water-bath (*bain-marie*), and reduce to powder in a coffee-mill.

58. Powdered Meat Punch (Dujardin-Beaumetz).—Place in a bowl two tablespoonfuls of powdered meat, three tablespoonfuls of syrup of punch, and sufficient milk to make a very fluid mixture.

59. Raw Meat (Ringer).—Cut into small squares 2 oz. of rump-steak free from fat, without entirely separating the meat; pound in a mortar for five or ten minutes; add three or four tablespoonfuls of water, and pound again for a short time; then remove all sinew or fibre of the meat, leaving only the creamy substance; add salt to taste.

Before using, place the cup or jar containing the pounded meat in hot water until just warm.

May be made into sandwiches with thin bread-and-butter. Useful in chronic diarrhœa.

60. Raw Meat with Milk and Sugar (Ringer).—Scrape with a knife half a pound of rump-steak until all the pulp is removed from it; sweeten with sugar, breaking the lumps of sugar with the meat in a basin with a small wooden spoon. Add slowly as much milk as will make it the thickness of arrowroot; flavour with brandy. Strain through a gravy strainer if there is any fibre of the meat in it, as the mixture should be perfectly smooth.

61. Raw Meat with Fruit Jelly (Adrian).—Mix 2 oz. of pulp of fillet of beef (made by scraping with a knife) and 15 grs. of common salt with 1 lb. of fruit jelly of any kind.

62. Raw Meat in Emulsion (Yvon).—Take 2 oz. of pulp of raw meat, ½ oz. of blanched sweet almonds, about half one bitter almond, and ½ oz. of white sugar. Pound them together in a marble mortar, and add enough water to make an emulsion.

63. Raw Meat Juice (Cheadle).—Add to finely-minced rump-steak cold water, in the proportion of one part of water to four of meat. Stir well together, and allow to stand for half an hour. Forcibly express the juice through muslin by twisting it.

This contains, per cent.:—Albuminate 5·1, nitrogenous extractive 3·1, salts 0·7.

Dr. Cheadle calls this "the most easily digested and restorative of all animal foods; the most valuable of all nitrogenous preparations for children."

It mixes well with milk, and it is highly antiscorbutic. It does not keep well, and must be made fresh.

64. Raw Meat and Tapioca Soup (Dujardin-Beaumetz).—Take 1 oz. of raw-meat pulp, made by scraping meat (preferably mutton) into a fine pulp with a knife, mix it with half a pint of tapioca soup (No. 76).

65. Raw Soup (Weir Mitchell's), p. 503.

66. Red or Black Currant Drink with Arrowroot.—Boil two tablespoonfuls of red or black currant jam in a quart of water; let it simmer for half an hour, strain, and replace on fire to keep boiling. Mix a teaspoonful of arrowroot in cold water, and pour the boiling fluid on it, and keep stirring until uniformly mixed. May be cooled by standing on ice.

67. Rice Milk.—Soak 1 oz. of rice for twelve hours, wash it quite clean, and drain it. Add the soaked rice to a pint of boiling milk, with half a teaspoonful of salt and of sugar. Stir well, and cook slowly for an hour. Rub through a hair sieve. (Sago or tapioca may be substituted for rice.)

68. Rice Pudding.—Soak 2 oz. of rice in two waters, for six hours each; add it to a pint of milk, and boil and stir till it thickens. Remove from fire, and mix well in 2 oz. of butter, a little grated nutmeg (or lemon-peel), and sugar. Cool, and then bake in a suitable buttered dish.

69. Rice Soup.—Soak $\frac{1}{2}$ oz. of Patna rice for ten hours. Then stir it with boiling water for five minutes. Remove it into cold water, drain it, and stir it into a pint of boiling stock. Simmer in saucepan (not completely covered) for two hours. Season with salt, add the beaten-up yolks of two eggs, and serve hot.

70. Rice Water (Pavy). (*A useful drink in dysentery, diarrhœa, etc.*)—Wash well 1 oz. of Carolina 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. May be flavoured with lemon-peel, cloves, or other spice.

71. Sago (Bartholow).—Put $\frac{1}{2}$ oz. of sago into an enamelled saucepan, with three-quarters of a pint of cold water, and boil gently for an hour and a quarter. Skim when it comes to a boil, and stir frequently. Sweeten with a dessertspoonful of sifted loaf-sugar. A tablespoonful of wine, or a dessertspoonful of brandy may be added.

72. Soup (Prison Diets), p. 244.

73. Stirabout (Prison Diets), p. 246.

74. Succus Carnis (*Meat Juice*) Recenter Expressus (Pettenkofer and Voit).—Meat is cut up small, arranged in layers, separated from one another by coarse linen, and then placed in a powerful press. From each kilogramme of meat about 230 grammes of a blood-red acid juice are obtained. It contains about 6 per cent. of albuminates. It tastes like

raw meat; its flavour may be improved by the addition of salt, and beef-tea not hot enough to coagulate the albumen.

75. Tapioca Jelly (Bartholow).—Soak a cup of best tapioca with a pint of cold water; when soft put into a saucepan with some sugar, the rind and juice of one lemon, a little salt, one pint more water; stir until it boils; turn into a mould; set to cool; add one glass of wine if desired.

76. Tapioca Soup.—Boil a pint of meat broth or stock, and while kept constantly stirred sprinkle in ¾ oz. of previously-washed tapioca. Cover the saucepan, and let it simmer till the tapioca is quite soft. Skim and serve.

77. Treacle Posset. (*A diaphoretic drink for a cold.*)—To two or three tablespoonfuls of treacle add a pint of boiling milk. Boil up well, and strain.

78. Vermicelli Milk Soup.—Into a quart of boiling milk put a level saltspoonful of salt (or celery salt); add slowly (stirring constantly) 2 oz. of vermicelli; keep stirring for fifteen or twenty minutes, until quite soft. The yolks of two eggs should be added when the soup is ready to be removed from the fire. This soup may also be flavoured with cinnamon and sugar.

79. Whey (Lemon), p. 365.

80. Whey (Louis Starr's), p. 304.

81. Whey made with Cream of Tartar.—Mix a large teaspoonful of cream of tartar with two tablespoonfuls of hot water, and add this to a pint of boiling milk. Add a little sugar and lemon-peel. Let it stand till cold, and then strain.

82. Whey (Sweet).—To a pint of milk add about a square inch of rennet, and slowly warm to about 100° Fahr. Stand for thirty minutes in a warm place, and then strain through muslin.

INDEX.

NOTE.—*The French "gramme," used in the Text, is equal to* 15·432 *grains (roughly* 15 *grains), and* 28·3495 *grammes are equal to* 1 *oz. avoir. The "litre," as a fluid measure, is equal to* 35 *oz., or* 1¾ *imperial pint.*

Abdominal plethora, Grape cure in, 537
Absinthe, 129
Acute disease, Food in, 357
—— gastric catarrh, Food in, 379
—— nephritis, Milk diet in, 454
Adult life, Food in, 325
Adulteration of Wines, 136
Advanced life, Food in, 335
Aërated bread, 186
Age and condition, Food in relation to, 286
Albumen, 7
——, Circulating, 15
——, Organic, 15
——, Vegetable, 73
Albuminates, Class of, 7
——, Composition of the, 7
——, Effects of excess of, 22
——, Functions of the, 14, 17
Albuminuria, Diet in, 445
—— from eating eggs, 447, 450
—— from food, 446, 447
Albumose, 150
Alcohol a cause of gastric catarrh, 381, 384
—— in acute disease, 373
——, its effects on the organism, 121—125
——, its varying action on different individuals, 123
Alcoholic beverages, 120
—— —— in gout, 469
—— —— in phthisis, 519, 520
—— stimulants in neurasthenia, 503
—— strength of wines, 134
Alcohols, 128
Alimentary principles, 6
—— substances, 34
Alimentation, Rectal, 547
Alkaline phosphates of sodium and potassium, 28
—— table waters, Value of, 138
—— waters in diabetes, 421, 435
—— —— in gout, 468
Allen and Hanbury's Infant Food, 541
Almond cakes for diabetics, 431
Alum whey, 62, 559
Amylic alcohol (fusel oil), 127
Amylopsin, 158
Anæmia, Causes of, 494
——, Excessive excretion of urea in, 496
—— in young girls caused by insufficient food, 321
—— with obesity, 480
Animal and vegetable foods compared, 343
—— —— ——, Difference in composition of, 73
—— food, Composition of, 36
—— ——, Effects of, 342, 343
—— —— in anæmia, 499
—— —— in gout and uricæmia, 463, 464
—— foods, 35
—— ——, Digestibility of, 156
Anisette, 129
Annaeff's koumiss cure, 538
Annexation of food, 146
Anti-rheumatic effects of celery, 96
Antiscorbutic properties of fresh fruits, 101
Antiscorbutics, 199
Antiseptic action of bile, 160
—— agents for preserving food, 205
Aphrodisiac effect of fish diet, 47
Appert's process for preserving foods, 200
Apples, 101, 102
Arctic regions, Diet in, 334
Argol, 132
Armies, European, Meat ration of, 275
Aroma of wines, 131, 135
Arrack, 127
Arrowroot, 91, 559
Artichoke, Green, 96
——, Jerusalem, 91

Artificial digestive agents and artificial alimentation, 538
—— human milk, 302
—— peptones, 153
Aseptin, 205
—— amykos, 205
Ash of animal foods, Composition of, 72
Ashby and Wright on infant-feeding, 301
Asparagin, 74
Ass's milk, 294
—— ——, Composition of, 54
Assimilability of animal and vegetable foods, 165
Assimilation of food, 146
Austrian soldier's rations, 274
Average daily diets, 217
—— —— diet for very laborious work, 218
—— —— requirements of alimentary principles, 213
Avenin, 81

Bacillus acidi lactici, 52
Bacon, Properties of, 41
Bacteria, Putrefactive, in alimentary canal, 159
Baked meat, Objections to, 181
Baking powders, 184, 185, 191
Banana, 103
Banting's cure for obesity, 480
Barley and rice water in fevers, 371
——, Composition and properties of, 77, 81, 85
—— jelly, 306
Barsac, 137
Batatas edulis, 91
Bauer and Künstle on the diet of typhoid patients, 361
—— on alcohol, 122
—— on beef-tea in fevers, 368
—— on the functions of the carbohydrates, 23
Beans, 87
——, Mode of cooking, 195
Béclard, Jules, on vegetarianism, 345
Beef, Composition of, 36, 38, 141
—— essence for gastric catarrh, 332
—— peptone, 544
—— -tea, Bauer on, 368
—— ——, Dujardin-Beaumetz on, 368
—— ——, G. Sée on, 367
—— ——, Peptonised, 547
—— ——, Value of, in fevers, 367
Beer, 140
—— in febrile diseases, 374
——, its influence on digestion, 143
——, Properties of, 142
——, Varieties of, 141
Beers, Amount of alcohol in, 141
——, German, Analysis of, 141
Beetroot, 93
Benedictine, 129
Beneke's dietary for treatment of cancer, 352
Benger's food, 290, 544
—— liquor pepticus, 542
—— —— pancreaticus, 545
—— peptonising process, 545
Bernard, C., on glycosuria, 415
Beverages, 106
——, Alcoholic, 120
—— for the gouty, 467
—— in fevers, 372
—— in obesity, 487
Biedert's cream mixture, 309
Bilberries, 103
Bile, its functions, 161
——, its influence in the digestion of fats, 160, 161
Biliary concretions, Diet in, 471
Bilious attacks from over-feeding, 327
Biscuits, Advantages and disadvantages of, 192
Bleeding before slaughtering, 37
Blood as food, 41
—— fibrin, 7
Bodily income and expenditure according to Landois, 214, 215
—— income and output, 211
Boiling, Effects of, 174
——, its effect on water, 107
——, Modes of, 175
Bones, Nutritive value of, 41
Bordeaux wines, 136
Boric acid for preserving food, 205
Boroglyceride, 205
Bouchard's diet for gastric dilatation, 347
Bouchardat's dietary in diabetes, 440
Bouillon, 174, 560
Bouquet of wines, 132, 135
Brain, its food value, 41
—— -workers, Diet suitable for, 333
Braising, 179
Bran, 78
—— bread for diabetics, 430
—— in bread, Indigestibility of, 189
Brandy, 126
—— and egg mixture, 366

Bread, Aërated, 186
—— badly made a cause of dyspepsia, 187
——, digestibility of different kinds, 187, 188
—— for diabetics, 430
—— in dyspepsia, 401
——, Leavened, 184
—— made of dried fish, 45
—— making, 184
—— ——, Different methods of, 184
—— of Iceland moss for diabetics, 425
——, Preserved, 198
——, Whole-meal, 189
——, —— ——, in prisons, 243
Breakfast, Proper time for, 279
Bright's Disease, Chronic, 446
Brill, 45
Brine, Constituents in, 204
Bristowe on glycosuria, 420
Broccoli, 95
Broiling, 181
Bronchial catarrh, Whey cure in, 581
Broth made by cold infusion, 176
—— or bouillon, 175
Buckwheat, Composition of, 86
Burgundy wines, 135, 136
Burnett's, Colonel, diets for the soldier, 255, 268
Butter, Composition of, 52, 65
——, Preservation of, 66, 206
—— -milk in chronic gastric catarrh, 386
—— ——, its composition, 62
Butylic alcohol, 128

Cabbage tribe (*Cruciferæ*), 95
Cacao-butter, 118
Caffein, 108
Calcium and magnesium phosphates, 28
—— carbonate in the tissues, 27
—— phosphate in the tissues, 27
Calculation of diets, Tables for, 223, 224, 231, 232
Calculous disorders, Diet in, 459
Camplin's bran cakes, 430
Cancer, Beneke's dietary for, 351
—— caused by excess of animal food (?), 351
—— of stomach, Dietetic treatment of, 391
Cane-sugar, 75, 104
Cantani's diet for gout, 476
—— dietary in diabetes, 441
Carbo-hydrates, Class of, 9
—— ——, Functions of, 22
—— ——, their conversion into fat, 23, 25
—— ——, their conversion into glucose, etc., 23
Caricin or papain, 159
Carlowitz, 137
Carlsbad course in chronic gastric catarrh, 388
Carnick's soluble infants' food, 544
Carrot, 93
Casein, 7
——, Vegetable, 74
Cauliflower, 95
Causation of glycosuria, 416
Caviare, 46
—— for diabetics, 433
Celery, an anti-rheumatic, 96
Cellular tissues, their agency in nutrition, 19
Cellulose, 9, 75
——, Indigestibility of, 166
Cerealia, The, 76
Cerealin, 78, 290
Certain special dietetic cures, 526
Chablis, 134
Champagne, 134, 137
Chapman's entire-wheat flour, 290
Charqui, 197
Chartreuse, 129
Château d'Yquem, 132
Cheese, 66
——, Composition of, 68
——, Digestibility of, 69
——, Fermentative processes in, 67
——, Varieties of, 67
Cherries, 101
Chicory, 120
Children, young, Dietary of, 313
Chittenden, Prof., on digestive ferments, 542
Chocolate, 118
Chondrin, 8
Chronic febrile conditions, Diet in, 509
—— gastric catarrh, Dietetic treatment of, 384, 385
—— parenchymatous nephritis, Milk diet in, 455
Chyle, 163
Chyme, 150
Cider and perry, 139
—— in gout, 469
Circulating albumen, 15
Circumstances which retard gastric digestion, 157
Clarets or Bordeaux wines, 135, 136

Classification of food, 6—10
—— of wines, 136
Climate, influence on diet, 334
Clotted cream, 61
Coagulation of milk, 57
Cocoa or cacao, 117
—— and milk peptonised, 517
Cod, 45
Coffee and alcohol, their effects compared, 117
——, Composition of, 113, 114
——, its influence on digestion, Sir W. Roberts's observations on, 117
——, Properties and preparation of, 115, 116
——, Toxic effects of, 115
Cognac, 126, 128
Cold as a preservative of food, 201
Colostrum, 56, 288
Commercial peptones, 155
Committee, Parliamentary, on soldiers' dietary, Report of, 254
Common salt, its importance in food, 28, 144
—— ——, its influence on excretion of urea, 29
Complete foods (milk and eggs), 51
Composition of human body, 5
Concentration of food, 276
—— ——, how far possible, 276
Condensed milk, 60, 297, 298
Condiments, 144
—— and stimulants, their uses, 31
Constipation, chronic, Dietetic treatment of, 408
—— from milk diet, 453
Consumption, pulmonary, Food in, 511
Continental system of feeding, 281
Convalescence, Diet in, 375, 376
Cooking, Objects and effects of, 173
—— of fish, 182
—— of vegetable foods, 183
——, Preparation, and Preservation of food, 173
Cornflour or maizena, 84
Correctional diets, 249
Couscousou, 80
Cow's milk, circumstances influencing its composition, etc., 56
—— —— and human milk compared, 296
—— ——, Composition of, 51, 54
Crab, 47
Crawfish, 48
Cream, 61
——, Clotted, or Devonshire, 61
—— mixture, Biedert's, 309
—— in anæmia, 498
—— in phthisis, 514
—— of tartar, 132
Creamometer, 59
Crustacea and mollusca, 47
Cucumber, 97
Curaçoa, 129
Curd and whey, 61
Cures for obesity, 480
—— ——, Banting's, 480
—— ——, Dancel's, 480
—— ——, Dry, 480
—— ——, Ebstein's, 481
—— ——, Oertel's, 482
—— ——, Salisbury, 489
—— ——, Schweninger's, 482
Currants, 100, 103

Dates, 103
Dauglish's process of bread-making, 184, 185
Débove on raw meat in phthisis, 518
—— on suralimentation in phthisis, 521
Decorticated whole-wheat meal, 80
Defective feeding a cause of anæmia, chlorosis, etc., 494
Defects in prison diets, 250
Deficient diet, Effects of, 229
Déjeuner à la fourchette, 280
Denis-Dumont on cider, 139
Devonshire cream, 61
Dextrin, 9, 75
Diabetes, Alkaline waters in, 421, 435
——, Dietetic treatment of, 414, 423
Diabetic dietaries, 439
Diabetics, Classification of, 420
Diarrhœa, chronic, Raw meat in, 412
Diarrhœa, Dietetic treatment of, 410
Diastase, 140, 538
Diets, Average daily, 217
—— for the dyspeptic, 407
Diet, Average daily, Dujardin-Beaumetz's, 229
——, —— ——, for very laborious work, 218
——, —— ——, Moleschott's, 217

Diet, Average daily, Pettenkofer's and Voit's, 217
——, —— ——, Ranke's, 217
—— for brain-workers, 333
—— for India, 270
—— in acute disease, 357
—— in albuminuria, 445
—— in anæmia, chlorosis, neurasthenia, and allied disturbances of nutrition, 493
—— in biliary concretions, 471
—— in chronic febrile states, 509
—— in convalescence, 375
—— in gout and calculous disorders, 459
—— in phthisis, 523
——, Subsistence, of Playfair, 216
——, Tables for calculation of, 219—221, 225
—— under varying circumstances of muscular effort, 216
Dietaries, Hospital, 551
—— in neurasthenia, 505
——, Prison, 237
——, Seamen's, 237
——, Soldier's, 237
Dietary, A mixed, the best, 351
—— of young children, 313
Dietetic cures, 526
—— —— of obesity, 477
—— treatment of acute gastric catarrh, 379
—— —— of chronic constipation, 408
—— —— of chronic gastric catarrh 384
—— —— of diarrhœa, 410
—— —— of diseases of the digestive organs, 377
Dietetics of fever, 360
—— of infancy and childhood, 289
—— of neurasthenia, 501
Difference in composition of animal and vegetable foods, 73
Digestibility of different food-substances in the stomach, 156
—— —— kinds of bread, 187, 188
Digestion, assimilation, and utilisation of food, 146
Digestive ferments, 538
—— organs, diseases of, Food in, 377
Dilatation of stomach, Dietetic treatment of, 394
Diminution in food required with advancing years, 335
Dinner, Early or late, 281
Disease caused by over-feeding, 330
Diseases of digestive organs, Food in, 377
—— to be treated by the milk cure, 527
Dispora caucasica, 63
Diuretic effects of gelatin, 18
Donkin, Dr. Scott, on milk diet in diabetes, 427
Drugs, their effect on milk secretion, 293
Dry diet in gastric dilatation, 395, 396
—— cure, The, 526
—— wines, 136
Drying foods for preservation, 197, 398
Duck, 42
Dujardin-Beaumetz, his classification of dyspeptics and their diet, 406
—— ——, his diet for gastric dilatation, 397
—— ——, his dietary in diabetes, 440
—— ——, his table for calculating diets, 227
—— —— on alcohol in acute disease, 373
—— —— on diet in albuminuria, 457
—— —— on powdered meat in phthisis, 522
—— —— on the effects of alcohol, 121
—— —— on the functions of the carbo-hydrates, 24
—— —— on the utility of phosphates, 30
—— —— on wines, 133
Dukes, Dr. Clement, on food at school, 317
Düring's dietary in diabetes, 443
Durrha or sorghum, 86
Dyspepsia, its dietetic treatment, 398
Dyspeptic, Diets for the, 407
——, Rule for the, 402

Early breakfast, 279, 280
—— dinner, 281
Eau de vie, 126
Ebstein's cure for obesity, 481
—— dietary in diabetes, 442
Eczema caused by food at school, 323
Edible fungi, 99
Edwards' patent desiccated soup, 208
Eel, 44

Effects of coffee and alcohol compared, 117
—— of deficient diet, 229
—— of excessive diet, 230
—— of fasting on milk secretion, 293
Eggs, Composition of, 70
——, Dried, 199
—— in anæmia, 499
——, Methods of preserving, 199
——, Properties of, 51, 69, 71
—— useful in fever, 366
Emulsifying action of pancreatic juice, 159
Enemata of meat and pancreas, Leube's, 548
——, Nutrient, 548
——, ——, in ulcer and cancer of stomach, 391, 393
Energy developed from different food-stuffs, 234, 235
Entire wheat-meal cakes, 190
Equilibrium of metabolism, 11
—— —— disturbed in fever, 361
Erbswurst, 208
Ergotised or spurred rye, 83
Embden groats, 82
Escargot, 50
Ethylic alcohol, 128
Endive, 97
Examination of milk, 58
—— of the gastric juice in dyspepsia, 405
Excess of albuminates a cause of uricæmia, 463
—— ——, Effects of, 22
—— of alcohol, Effects of, 125
—— of animal food a cause of cancer (?), 351
Excessive diet, Effects of, 230
Exclusion of air for preserving foods, 199

Fairchild's extractum pancreatis, 310
—— pepsin in scales, 542
—— zymine, 545
Farinaceous foods in fever, 370
Fat, Absorption of, 163
—— anæmics, Treatment of, 507
——, an albumen-sparing food, 20, 22
—— formed from albuminates, 15
——, Influence of on muscular exercise, 22
Fats and carbo-hydrates, Relative value in diets, 232
——, Digestion of, 153, 159, 160
Fats in anæmia, 499
—— in scrofula, 510
—— in the diet of the gouty, 464
—— or hydro-carbons, Class of, 8
Ferments in gastric juice, 150
Fever, Dietetics of, 360
——, Importance of water in, 369, 372
——, Jellies in, 370
——, Need of albuminates in, 361
——, Purpose of nitrogenous food in, 370
——, Raw meat in, 370, 374
Fibrin, 7
——, Vegetable, 74
Figs, 103
Fining of wines, 132
Fish, circumstances which influence its food-value, 43
——, Cooking of, 182
—— diet favourable to brain-development, 47
——, Edible properties and composition of, 44
——, Modes of preserving, 204
Five o'clock tea, 281
Flesh of different animals, their food properties, 37
Flint, Dr., on whisky in phthisis, 519
Flounder, 45
Flour of wheat, 78
Fluid foods necessary in fever, 363
Food accessories, 9
—— of animal organisms, 4, 5
——, Assimilation of, 146
—— at school, 316
——, Classification of, 6, 10
——, Concentration of, 276
——, Cooking, Preparation, and Preservation of, 173
——, Definition of, 2
——, Digestion of, 146
—— for the expectant mother, 293
—— habits of different races, 347
—— in adult life, 325
—— in advanced age, 335
—— in diabetes, 414
—— in disease, 355
—— in health, 1
—— in infancy and childhood, 287
—— in relation to age and condition, 286
—— in scrofula, consumption, and chronic febrile conditions, forced feeding, 509
——, Non-organic, 10
—— of vegetable organisms, 4, 5

Food, Organic, 10
——, Origin of, 3
——, Purpose of, 1, 2
—— stuffs, 34
——, Utilisation of, 164
Foods predigested, 538, 542
—— suitable to advanced life, 339
Force-value of various foods, 233
Fortified wines, 132, 136
Fowl, 42
Frankland's artificial human milk, 302
—— table of potential energies of food-stuffs, 234
French soldier's rations, 271
Frozen meat, Loss in cooking, 201
Fruit soups in fevers, 371
Fruits, Dried, 199
——, ——, Properties of, 101
——, Fresh, their antiscorbutic properties, 101
——, ——, Composition of, 100
——, ——, Properties of, 102
Frying, 181
Functions of mineral substances in food, 27
—— of the albuminates, 14, 17
—— of the carbo-hydrates, 22
—— of the hydro-carbons, 19
—— of water, 27
Fusel oil (amylic alcohol), 128
Fuster, Prof., on raw meat in phthisis, 518

Galazyme, Composition of, 64
—— in phthisis, 517
Gall-stones, Diet in, 471
Game as food, 43
—— for invalids, 43
Gastric catarrh caused by excess of food, 380
—— —— caused by unsuitable food, 380
—— ——, Suitable foods for, 382, 383
—— digestion, 150
—— ——, Circumstances which retard, 157
—— juice, Composition of, 150
—— ——, Examination of in dyspepsia, 405
—— ——, Ferments in, 150
Gelatigenous substances, 17
Gelatin, 8
——, an albumen-sparing food, 18
——, a peptogenic food, 18
——, Diuretic effects of, 18
——, Value of, in fevers, 367
German soldier's rations, 273
Gherkins, 97
Gin, 127
Girls' schools, Defective feeding in, 323
Glacialin, 205
Gliadin, 74, 78
Globulin, 7, 163
Gluten, 74
—— casein, 78
—— fibrin, 78
—— or vegetable fibrin, 7
Glycerin, 22
Glycogen formed from albuminates, 17
Glycogenic function of liver, 163, 419
Glycosuria and uric acid, 421—427
——, Food in, 423
——, its causation, 416
Goat's milk, 294
—— ——, Composition of, 54, 55
Goose, 42
Gooseberries, 103
Gout, Alcoholic beverages in, 489
——, Alkaline waters in, 468
—— and rheumatism from overfeeding, 328, 336
——, Cantani's diet for, 476
——, Cider in, 469
——, Diet in, 459
——, Tea and coffee in, 470
——, Wines in, 469
Gouty, contracted kidney, Milk diet in, 455
—— diabetics, 422
Grain of wheat, Structure of, 79
Granulose, 147
Grape, 100, 103
—— cure, 535
—— ——, Prof. Lebert on, 535
—— -sugar, 75, 104
Grapes, Composition of, 537
Graves, 134
Green artichoke, 96
—— tea, 109
—— vegetables, Mode of cooking, 195
—— ——, their composition, 94, 98
Grilling, 181
Groats, Embden, 82
Grog de la poudre de viande, 522
Grouse, 43
Gruel, Oatmeal, 82
——, ——, or barley, in fever, 370
——, Peptonised milk, 546
Gubler, Professor, on vegetarianism, 346

Guinea-fowl, 42
Gum, 9

Habitual diets of persons of different occupations, 214
Haddock, 45
"Hanging" meat, Reason for, 37
Hare as food, 43
Haricot beans, their food-value, 349
Haricots blancs, 88
Hassall's Flour of Meat, 198
Heart as food, 42
"Heavy teas," Objection to, 283
Helix pomatia, 50
Hemi-albumose, 150
Herring, 44, 45
Hircin or hircic acid, 55
Hock, Sparkling, 135
Hoe-cakes, 84
Hollands, 127
Hominy, 83
Honey, 104
Hospital dietaries, 551
Hot tea in obesity, 487
—— water after meals, 285
—— —— as a drink for the gouty, 469, 475
—— —— before food in gastric disorders, 396
—— —— in dyspepsia, 404
—— —— in obesity, 490, 496
Huchard's diet for gastric dilatation, 397
Human and cow's milk compared, 296
—— body, its composition, 5
—— milk, Artificial, 302
—— ——, Composition of, 54, 288
—— ——, Variability in composition of, 295
Hungarian wines, 137
Hydro-carbons, their functions in nutrition, 19
—— ——, their relations to the temperature of the body, 20
Hydrochloric acid in gastric juice, 150

Iced water, 108
Iceland moss bread for diabetics, 425
—— ——, Bread made of, 100
Idiosyncrasies with regard to articles of diet, 334
Imperfect mastication a cause of gastric catarrh, 380
Importance of nitrogen, 4
Income and output, Bodily, 211
Indian corn, 83
—— dietary, 270
Indigestion, Causes and dietetic treatment of, 399
Individual reactions to alcohol, 123
Indol, 160
Infancy and childhood, Food in, 287
Infant, Rate of growth of, 300
Infant's stomach, Capacity of, 300
Infants' food, 299
Influence of diet on the milk secretion, 292
Injurious effects of tea, 112
Insalivation, 146
Insufficiency of convict prison diets for soldiers, 252
Intervals between meals, 279
Inulin, 75
—— biscuits for diabetes, 425
Invalids' dietary, Select recipes, Appendix II., 558
Iron, its distribution in the body, 28

Jaccoud, Prof., on milk in phthisis, 514
Jellies in fever, 370
Jenner, Sir W., on vegetable soups in fever, 369
Jerusalem artichoke, 91
Johannisberg, 134, 135

Karell on the milk cure, 527
Kefir for feeding infants, 313
Kidney, gouty, Milk diet in, 455
Kidneys as food, 42
Kirsch or kirsch-wasser, 127
König's Tables of Analysis, 40, 49, 54, 65, 98, 99, 114, 119, 130, 141
Koumiss, 56, 63, 532
——, Composition of, 534
—— cure, The, 532
—— in chronic diarrhœa, 413
—— in phthisis, 516
Kümmel, 129

Latour on goat's milk in phthisis, 515
Lactic acid, 52
—— —— ferment in gastric juice, 150
—— ——, its formation from carbo-hydrates, 36

Lactometer, 59
Lactose, Properties of, 52
—— a diuretic, 531
Lait de poule, 71
La Langouste, 48
Larose, 134
Laryngeal catarrh, Whey cure in, 531
Late dinner, 281
Lavage d'estomac in gastric dilatation, 395
Lawes' and Gilbert's experiments, 17
Leavened bread, 184
Lebert, Prof., on the grape cure, 535
Lecithin in yolk of egg, 71
L'Écrevisse, 48
Lees of wine, 132
Legumin, 7, 86
—— or vegetable casein, 74
Leguminosæ or pulses, 86
Lemon, lime, and shaddock as antiscorbutics, 102
Lentils, 88
Léoville, 134
Lettuce, 97
Leube's diets for the dyspeptic, 407
—— enemata of meat and pancreas, 548
—— meat solution, 547
—— soluble meat in gastric ulcer, 390
Lichenin, 74
Liebig's extract, 207
—— food, 290, 299
—— infants' food, 540
—— theories, 13, 19
Light puddings, 195
Liqueur or spirituous wines, 136
Liqueurs, 129
Lime-water, how to prepare, 303
Limitation of beverages in obesity, 487
Linseed in constipation, 410
Liver, its composition and food-value, 41
Lobster, Composition of, 47
Loeflund's peptonised kindermilch, 544
Longevity and spare diet, 337
Loss of weight in boiling, 177
—— —— in roasting, 178
—— —— in stewing, 179
Luncheon, 280
Lupulin, 143

McCall's process for preserving foods, 200

Macaroni, 81
—— à l'Italienne, 194
——, vermicelli, etc., 193
Mackerel, 45
Macon, 134
Madeira, 134
Maize, Composition and properties of, 77, 82, 83
Maizena or corn-flour, 84
Malaga, 135
Malic acid in fruits, 102
—— —— in wine, 131
Malt extract in gastric ulcer, 390
—— extracts, 539
—— —— in phthisis, 519
Malted foods, 540
Malting, 140
Maltose, 146
Mannite, 75
Maraschino, 129
Mare's milk, Composition of, 54, 56, 534
Marsala, 134
Marschberg, 135
Masson and Challot's preserved vegetables, 199
Mastication, 146
——, Imperfect, as a cause of dyspepsia, 400
Maté or Paraguay tea, 119
Meals, Hours of, 280
——, Intervals between, 279
Meat biscuits, 208
——, Hassall's flour of, 198
—— infusions and extracts in fevers, 366
——, lean, Peptonised, 546
—— peptones, 543, 544
—— ration of several European armies, 275
—— solution, Leube's, 547
Medicated milk, 57
Melitose, 75
Mellin's food, 290, 304, 306, 541
Melon, 103
Metabolism, 10
—— of albuminous substances of body increased in febrile diseases, 360
Milk a complete food, 6
—— as a food in febrile diseases, 364
—— as food for adults, Defects of, 53
——, ass's, Composition of, 54, 55
——, Coagulation of, 57
——, Composition of, 6, 51
——, Condensed, 60

Milk-curdling ferment in gastric juice, 150, 152
—— cure, The, 527
—— diet in Bright's Disease, 451
—— —— in cancer of stomach, 393
—— —— in chronic diarrhœa, 412
—— —— —— gastric catarrh and gastric ulcer, 389
—— —— in consumption, 114
—— —— in neurasthenia, 502
——, Dried, 199
——, Examination of, 58
——, goat's, Composition of, 54, 55
—— gruel, Peptonised, 546
——, human, Composition of, 54, 55, 288
—— in diabetes, 427, 428
—— in old age, 53
——, mare's, Composition of, 54
——, Medicated, 57
——, objections to its use in fever, 364
—— of wet-nurse, 57
——, Peptonised, 545
——, precautions in its use in fever, 365
——, Preservation of, 60, 200, 206
——, Salts of, 53
—— secretion as affected by drugs, 293
—— —— as affected by fasting, 293
——, sheep's, Composition of, 54
——, Skimmed, 60
——, Souring of, 52
——, variations in composition of, 55
Millet, Composition of, 85
Mineral foods and water, Class of, 9, 10
—— substances, Functions of, 27
—— waters, Class of, 9, 10
Mixed diet, Importance of, 31, 351
Mode of making tea, 111
Modern "vegetarians," 344
Molasses, 104
Moleschott's estimate of daily food requirements, 214
—— standard diet, 226
Mollusca, 47, 49
Money, Dr. Angel, on infant feeding, 305
Monotony of diet injurious, 164
Morelle, 99
Moselle wines, 131, 135
Mucedin, 78
Mulberry, 103
Muscle, Composition of, 35
Mushroom, 99
Mussel, Properties of, 49
Must, Composition of, 130
Mustard and cress, 97
Mutton broth, 563
——, Properties and composition of, 39, 40
Myosin, 35
Mytilotoxin, 50

Nectarines, 101
Nephritis, chronic parenchymatous, Milk diet in, 455
Nestlé's food, 290, 541
Neurasthenia, Diet, etc., in, 501
——, Massage, etc., in, 502
Neurasthenic Dietaries, 505
Nitrogen, Importance of, in nutrition, 4
Nitrogenous alimentary principles, 7, 10
—— foods promote oxidation, 343
—— substances, Functions of, 14
Non-nitrogenous foods, 10
Non-organic food, 10
Notter, Surgeon-Major, M.D., on soldiers' rations, 268, 275
Noyeau, 129
Nursing mother's diet, 289
Nutrient enemata, 391, 393, 548
Nutritive value and uses of the different classes of food, 13

Oatmeal, Composition and properties of, 81, 82
—— for the tuberculous, 519
—— gruel and porridge, 563
—— soup, 564
—— water, 310
Oats, Composition and properties of, 77, 81, 85
Obesity, causes of, 477
——, Cures for, 480
——, ——, Banting's, 486
——, ——, Dancel's, 480
——, ——, dry, 480
——, ——, Ebstein's, 482
——, ——, Oertel's, 482
——, ——, Salisbury's, 489
——, ——, Schweninger's, 482
——, Dietetic treatment of, 477
——, Hot tea in, 487
——, Limitation of beverages in, 487

Obesity, Methods of treating, 491
——, Skimmed milk in, 438
Oertel's cure for obesity, 482
Ofner, 137
Onions, 97
Oranges, 100, 102
Order and frequency of taking food, 278
—— of courses at dinner, 284
Ordinary articles of food and drink, 34
Orenberg, Koumiss cure at, 532
Organic albumen, 15
—— food, 10
Origin of food, 3
Over-feeding in adult life, 326
—— —— a cause of disease, 330
Oxford and Cambridge method of training, 332
Oysters, Properties of, 49

Pancreatic digestion, 160
—— emulsion in phthisis, 517
—— extract (Fairchild's), 310
—— extracts, 542
—— juice, 158
Pancreatin, 543
Pancreatised cod-liver oil enemata, 503
—— foods, 544
Papain, 159
Para-peptone, 150
Parkes on alcohol, 124
—— on coffee as a stimulant, 116
Parsnip, 93
Partridge, 42
Pastry, Indigestibility of, 193
Pâte d'Italie, 81, 193
Pavy on alcohol, 122
—— on glycosuria, 417
Peaches, 102
Pear, 100, 102
Pearl barley, 81
Pea sausage or Erbswurst, 208
Peas, 88
——, Digestibility of, 170
——, mode of cooking, 195
Pectin, or vegetable jelly, 9, 79, 102
Pemmican, 197
Pepsin, 150, 541
—— in anæmia, 498
——, Variability of, 542
"Peptogenic Milk Powder" of Fairchild, 308
Peptones, 150, 151, 153, 543
——, their toxic action, 154
Peptones, Value of, 154
Peptonised beef-tea, 547
—— cocoa and milk in phthisis, 517
—— foods, 542
—— lean meat, 546
—— milk in anæmia, 499
—— milk-gruel, 546
—— —— in phthisis, 514
—— suppositories, 549
Peptonising milk, 103, 308, 545
Perry, 139
Pettenkofer's and Voit's experiments on food requirements, 210
Pheasant, 42
Phosphates, Utility of, 30
Phthisis, Daily dietary in, 523
——, Food in, 511
——, Milk in, 514
——, Raw meat in, 518
——, *Suralimentation* in, 521
"Physiological albuminuria," 446
—— equilibrium, 11
Pigeon, 43
Pilchard, 45
Plaice, 65
Plantain, 103
Plastering of wines, 133, 136, 137
Plastic or tissue-forming foods, 14
Playfair's subsistence diet, 216
Plums, 102
Polenta, 84
Pollards or bran-flour, 79
Pork, Properties and composition of, 40
Porridge, Oatmeal, 82, 563
Port, 134
Porter, 141, 143
Potassium and sodium phosphates, 28
—— —— salts, their distribution in the body, 28
—— —— sulphates, 28
—— chloride in blood cells and in muscle, 28
Potato, Properties of, 89
Potatoes as an antiscorbutic in prison diet, 245
——, Mode of cooking, 195
——, Preservation of, 207
Potential energies of food-stuffs, 234
Poultry and game, 42
—— ——, Composition of, 43
Powdered meat, 198
Prawns, 48
Predigested foods, 538, 542
Preservation of foods, 196

Preservation of milk, 60
Preserved vegetables, 199
Prison diet, Defects in, 250
—— dietaries, 237—251
Prognosis in diabetes, 419
Proof spirit, 126
Pro-peptone, 150
Propylic alcohol, 128
Proteids, 7
Protein, 7
"Provincial system" of feeding, 282
Prunes to remedy constipation, 102
Ptomaines, 153
Ptyalin, 146
Pulmonary consumption, Diet in, 511 (See also Phthisis.)
Pulp of raw meat, or pounded raw meat, in fevers, 370, 376
Pulses, The, 86
——, Composition of, 87
Purpose of food, 1, 2
Putrefactive bacteria in alimentary canal, 159

Quail, 43
Quantity of food conditional on physical activity, 329

Rabbit, 43
Rabuteau on sodium chloride in food, 29
Radish, 94
Rain-water, 107
Raisin, 101
Range of various diets, 226
Raspberries, 103
Raw eggs in Bright's Disease, 450
—— meat in anæmia, 498
—— —— in chronic diarrhœa, 412
—— —— in fevers, 370, 374
—— —— in phthisis, 518
—— soup (of beef), 503
Ray, 46
Recipe for making soup in prisons, 244
—— for making stirabout in prisons, 246
—— for making whole-meal bread in prisons, 243
Recipes, Select, see Appendix II., 559
Rectal alimentation, 547
Rectum, Absorption in, 548
Red or astringent wines, 130, 136
Refrigerating chamber, 201
Regular meal-times, Necessity for, 278
Relative advantages of animal and vegetable foods, 341
—— suitability of different articles of diet, 231
—— value of foods of the same class, 32
Remissions in febrile disease favourable for administration of food, 362
Rennet, 52
Report of Parliamentary Committee on Soldiers' Dietary, 254
Respiratory or heat-forming foods, 14
Rest before and after food, 285
—— in anæmia, Importance of, 497
Retarders of gastric digestion, 158
—— of salivary digestion, 149
Revalenta, 88
Revalesciere, 88
Rice, Composition and properties of, 77, 85
——, Mode of cooking, 195
——, Properties of, 84
Rigor mortis, its cause, 36
Roasting, Effects of, 177
Roberts, Sir W., experiments with coffee, 117
—— on milk in diabetes, 428
—— on the influence of alcohol on digestion, 125, 128
—— —— of beer on digestion, 143
—— —— of wines on digestion, 137
Robin on diet in convalescence from typhoid, 376
Roe, Hard and soft, of fish, 46
Roots and tubers, 89
Rubner on digestibility of different foods, 166
Rudesheimer, 134, 135
Rules for feeding in fever, 362
—— for infant-feeding, 301
—— for the dyspeptic, 402
Rum, 127
Ruster, 134
Rye, Composition and properties of, 77, 85

Saccharin for diabetics, 434
—— substances, 9, 104
—— wines, 136
Sago, 92
St. Julien, 134
Salad vegetables, 97
Salads, 190

Salep, 93
Salicylic acid for preserving food, 205
Salisbury cure for obesity, 489
Saliva, Functions of, 147
Salmon, 44
Salsify, 94
Salt for chlorotics, 500
Salted meats, Objections to, 204
Salting foods, 2 3
Salts of milk, 53
—— of the vegetable acids, their importance, 29
Sauer-kraut, 95
Sauternes, 137
Savory and Moore's food, 290, 541
—— —— peptonised milk, 309, 514
—— —— —— cocoa and milk in phthisis, 517
Schedule of infant feeding, 304
Schweninger's cure for obesity, 482
School, Food at, 316
Scientific basis of dietaries and rations, 209
Scotch ale, 142
—— or pot-barley, 81
Scrofula, Diet in, 509
Scurvy, relation to vegetable salts, 29
Seakale, 95
Sée, G., on alcohol, 122
—— —— in phthisis, 519
—— on beef-tea, 367
—— on effects of coffee and alcohol, 117
—— on milk in phthisis, 515
—— on tea as a beverage, 404
—— on the functions of the carbohydrates, 24
Seegen's dietary in diabetes, 438
Select recipes, Appendix II., 560
Semmola's beverage for cases of albuminuria, 458
Semolina (Fr., *Sémoule*), 80
Sheep's milk, Composition of, 54, 55
Sherry, 134, 135
Shrimps, 48
Skimmed milk as a cure for obesity, 488
—— ——, Composition of, 60
—— —— in anæmia, 498
—— —— in diabetes, 427
Smoked bacon, Digestibility of, 204
Smoking foods, 203
Snail (escargot), 50
Snipe, 43
Soda, Bicarbonate of, to neutralise acidity of cooked fruits, 340
Sodium carbonate and bicarbonate in the blood, 28
—— chloride in chlorosis, 500
—— —— in food, 29
—— ——, its importance in the body, 27
Soldiers' dietary, 252
—— ——, Report of Parliamentary Committee on, 254
—— rations, Austrian, 274
—— ——, French, 271
—— ——, German, 273
—— ——, Russian, 275
—— ——, Surgeon-Major Notter on, 268, 275
Sole, 44
Solids in cow's milk, 53
Sorghum or durrha, 86
Sorrel, 96
Soup at commencement of dinner, its value, 284
—— in prisons, Recipe for making, 244
Soups, Fruit, in fevers, 371
Souring of milk, 52
Soya bread for diabetics, 432
Sparkling wines, Preparation of, 133
Spinach, 95
Spirits, Ardent, 126
Sprat, 45
Spring water, 107
Ssamara, Koumiss cure at, 532
Standard daily diets for a man in ordinary work, 217
Stange, Dr., on the koumiss cure, 534
Starch granules, Action of heat on in cooking, 183
Starchy substances, 9
Starr, Dr. Louis, on dietetics of infancy and childhood, 289
Steapsin, 159
Stein-Reisling, 135
Stewart, Prof. Grainger, on albuminuria, 446, 448
Stewing, 178
Stimulants, 9
—— and condiments, their uses, 31
Stirabout in prisons, Recipe for making, 246
Stockvis on albuminuria, 447
Stomach, cancer of, Food in, 391
——, dilatation of, Food in, 394
——, diseases of, Food in, 377
——, ulcer of, Food in, 389
Strawberry, 100, 101, 103

Subcutaneous injection of food, 550
Subsistence diet of Playfair, 216
Substitutes for mlik in infant feeding, 309
—— for mothers' milk, 291, 294
Succus entericus, Functions of, 162
Sugar formed from nitrogenous matters, 415, 418
—— in the blood, 415
—— in the urine, 414
Supper, 281
Suppositories peptonised, 541
Suralimentation in phthisis, 521
Sweetbread, 42
Sweet potato, 91
Sweet wort, 140
Swiss milk and whey cures, 515
Syntonin, 7
—— or acid-albumen, 150
System of feeding of the upper classes, 283
Systems for curing obesity, 489

Tables for calculation of diets, 219—221, 225
Tannic acid in tea, 109, 110
Tannin in wine, 131, 135
Tapioca, 92
Tartaric acid in fruits, 102
—— —— in wine, 131
Tasajos (dried meat), 197
Tea and coffee for the gouty, 470
—— —— in dyspepsia, 403, 404
—— —— in fevers, 371
——, Composition of, 109
——, Inhibitory effects on digestion, 113
——, its injurious effects, 112
——, its stimulating and restorative effects, 111
——, Mode of making, 111
—— or coffee after dinner, Objections to, 285
Temperature, Influence of on diet, 334
Tendency to excessive consumption of animal food, 348
Thein, 108
Theobroma cacao, 118
Theobromin, 108, 118
Thompson, Sir H., on braising, 179
—— on diet in calculous disorders, 473
—— on excessive use of animal food, 351
—— on frying, 181
Thompson, Sir H., on macaroni, 194
—— on the haricot bean and its food-value, 349
—— on the use of entire-wheat meal, 190
——, recipe for making whole-meal cakes, 190
Time required for digestion, 402
Tissue-forming foods, 14
Toasting, 191
Tokay, 132, 134
Tomato, 97
Tongue, its food-value, 41
Torrified bread for diabetics, 431
Tous les mois, 92
Toxic action of peptones, 154
—— effects of alcohol, 125
—— —— of coffee, 115, 116
Training at Oxford and Cambridge, 332
——, Food in, 330
Treacle, 104
Trimethylamin, 44
Tripe as food, 42
True diabetes, 420
Truffle, 99
Trypsin, 159, 543
Tryptone, 159
Tscherwinsky on the conversion of carbo-hydrates into fat, 25
Tubercle bacillus, Influence of food on, 513
Turbot, 45
Turnip, 93

Ulcer of stomach, Dietetic treatment of, 389
Unfermented cakes, 192
Urea, Elimination of, 14
——, Excessive excretion of, in anæmia, 496
——, Excretion of, in diabetes, 426
——, Increased excretion of, in fever, 358
Uric acid gravel, Diet in, 464
—— —— and glycosuria, 421—427
Uricæmia, Diet in, 463
—— caused by excess of albuminates, 463
Urine, The, in milk cures, 530
Utilisation of foods, 164

Value of peptones, 154
Variations in composition of milk, 55
—— of diet for age, 229

Veal, Properties and composition of, 39
Vegetable acids, importance of their salts, 29
—— albumen, 73
—— casein, 74
—— fibrin or gluten, 7, 74
—— foods, 73
—— —— induce obesity, 342
—— —— in gout and uricæmia, 463, 464
—— jelly or pectin, 9, 79, 102
—— marrow, 97
—— soups for febrile patients, 369
Vegetarianism, 341
——, Dr. Raymond on, 346
——, Dr. Treille on, 346
——, Jules Béclard on, 345
——, Professor Gubler on, 346
Venison, Properties and composition of, 40
Vermicelli, 81, 193
Vichy waters in dyspepsia, 407
Vinegar, 144
——, its effects on digestion, 144
—— to be avoided in anæmia, 501
Vineyard snail, 50
Voit's and Pettenkofer's experiments on food requirements, 210
Volnay, 134
Voslauer, 134

Waste of vegetable food in England, 349
Water and mineral substances, Class of, 9
——, Functions of, in body, 30
——, Importance of, to febrile patients, 369—372
——, its properties, 106
Watercress, 97
Weaning, Date of, 289
Weber, Dr. Hermann, on food in phthisis, 512
Weir Mitchell's cure for obesity, 488
—— —— diet in neurasthenia, 501
—— —— on the milk cure, 527
Wet-nurse, Milk of, 57
—— ——, Qualities of, 291
Wheat, Composition and properties of, 77, 78, 85
Whey and "sweet" whey, 61
Whey cure, 531
——, Composition of, 62
——, Preparation of, 304
—— useful in fever, 365
Whisky, 127
White or acid wines, 130, 136, 137
Whole meal, 80
—— —— bread in prisons, Recipe for making, 243
—— wheat-meal, 80, 189
Wines, 129—139
——, Aroma of, 131, 135
——, Classification of, 136
——, Fining of, 132
——, Fortified, 132, 136
——, Hungarian, 137
—— in gout, 469
——, Plastering of, 137
——, Red, 130, 136
——, Sparkling, 133
—— suitable to the gouty constitution, 139
——, Tannin in, 131, 135
——, their retarding effects on digestion, 138
——, White or acid, 130, 136
Woodcock, 43
Wort, 140

Yam (*Dioscorea batatas*), 91
Young children, Dietary of, 313

Zeltinger, 134
Zymine (Fairchild's), 545

Printed by Cassell & Company, Limited, La Belle Sauvage, London, E.C.

Surgical Applied Anatomy. By FREDERICK TREVES, F.R.C.S., Surgeon to, and Lecturer on Anatomy at, the London Hospital. *New and Extended Edition.* **7s. 6d.**

"The author of 'Surgical Applied Anatomy' is an able writer, and is also an authority on purely anatomical questions. There are excellent paragraphs on the anatomy of certain well-known surgical affections, such as hip-joint diseases, constituting a feature quite original in a work of this class, yet in no way beyond its proper scope."—*London Medical Record.*

Clinical Chemistry. By CHARLES H. RALFE, M.D., F.R.C.P., Physician at the London Hospital. **5s.**

"The volume deals with a subject of great and increasing importance, which does not generally receive so much attention from students as it deserves. The text is concise and lucid, the chemical processes are stated in chemical formulæ, and wherever they could aid the reader suitable illustrations have been introduced."—*The Lancet.*

Human Physiology. By HENRY POWER, M.B., F.R.C.S., Examiner in Physiology, Royal College of Surgeons of England. **7s. 6d.**

"The author has brought to the elucidation of his subject the knowledge gained by many years of teaching and examining, and has communicated his thoughts in easy, clear, and forcible language, so that the work is entirely brought within the compass of every student. It supplies a want that has long been felt."—*Th Lancet.*

Materia Medica and Therapeutics. By J. MITCHELL BRUCE, M.D., F.R.C.P., Lecturer on Materia Medica at Charing Cross Medical School, and Physician to the Hospital. Containing an account of the action and uses of all the important new Drugs admitted into the Pharmacopœia. **7s. 6d.**

"We welcome its appearance with much pleasure, and feel sure that it will be received on all sides with that favour which it richly deserves."—*British Medical Journal.*

Physiological Physics. By J. MCGREGOR-ROBERTSON, M.A., M.B., Muirhead Demonstrator of Physiology, University of Glasgow. **7s. 6d.**

"Mr. McGregor-Robertson has done the student the greatest service in collecting together in a handy volume descriptions of the experiments usually performed, and of the apparatus concerned in performing them."—*The Lancet.*

Surgical Diagnosis: A Manual for the Wards. By A. PEARCE GOULD, M.S., M.B., F.R.C.S., Assistant Surgeon to Middlesex Hospital. **7s. 6d.**

"We do not hesitate to say that Mr. Gould's wor is unique in its excellence."—*The Lancet.*

Comparative Anatomy and Physiology. By F. JEFFREY BELL, M.A., Professor of Comparative Anatomy at King's College. **7s. 6d.**

"The book has evidently been prepared with very great care and accuracy, and is well up to date. The woodcuts are abundant and good."—*Athenæum.*

A Manual of Surgery. Edited by FREDERICK TREVES, F.R.C.S. With Contributions by leading Physicians and Surgeons. Complete in Three Volumes, each containing about 600 pages fcap. 8vo, fully Illustrated. **7s. 6d.** each.

"It would be almost impossible to find at present any work in which the subjects treated of are written more clearly or concisely. The editor has had a difficult task to accomplish in the production of this work, and we congratulate him on the successful result."—*Lancet.*

Forensic Medicine. By A. J. PEPPER, M.S., M.B., F.R.C.S., Examiner in Forensic Medicine to the University of London. (*In preparation.*)

Hygiene and Public Health. By SHIRLEY F. MURPHY, M.R.C.S., Lecturer on Hygiene and Public Health, St. Mary's Hospital, and B. A. WHITELEGGE, M.D. **7s. 6d.** (*In preparation.*)

Other Volumes will follow in due course.

CLINICAL MANUALS
FOR
Practitioners and Students of Medicine.
Complete Monographs on Special Subjects.

"A valuable series, which is likely to form, when completed, perhaps the most important Encyclopædia of Medicine and Surgery in the English language."—*British Medical Journal.*

THE object of this Series is to present to the Practitioner and Student of Medicine original, concise, and complete monographs on all the principal subjects of Medicine and Surgery, both general and special.

It is hoped that the Series will enable the Practitioner to keep abreast with the rapid advances at present being made in medical knowledge, and that it will supplement for the Student the comparatively scanty information on special subjects contained in the general text-books.

LIST OF CLINICAL MANUALS.

Food in Health and Disease. By BURNEY YEO, M.D., F.R.C.P., Physician to King's College Hospital, and Professor of Clinical Therapeutics, King's College. **9s.**

The Pulse. By W. H. BROADBENT, M.D., F.R.C.P., Physician to, and Lecturer on Medicine at, St. Mary's Hospital. **9s.**

Ophthalmic Surgery. By R. BRUDENELL CARTER, F.R.C.S., Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, St. George's Hospital; and W. ADAMS FROST, F.R.C.S., Assistant Ophthalmic Surgeon to, and Joint-Lecturer on Ophthalmic Surgery at, St. George's Hospital. With Chromo Frontispiece. **9s.**

"Its clearness and conciseness will cause it to be welcomed by students and young practitioners as an agreeable and useful guide to the modern practice of eye diseases."—*British Medical Journal.*

Diseases of Joints. By HOWARD MARSH, F.R.C.S., Senior Assistant Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital, and Surgeon to the Children's Hospital, Great Ormond Street. With Chromo Frontispiece. **9s.**

"This volume is excellently planned. Mr. Marsh brings to bear upon it keen critical acumen."—*Liverpool Medico-Chirurgical Journal.*

Diseases of the Rectum and Anus. By CHARLES B. BALL, M.Ch. (Dublin), F.R.C.S.I., Surgeon and Clinical Teacher at Sir P. Dun's Hospital. With Chromo Plates. **9s.**

"As a full, clear, and trustworthy description of the diseases which it deals with, it is certainly second to none in the language. The author is evidently well read in the literature of the subject, and has nowhere failed to describe what is best up to date. A model of what such a work should be."—*Bristol Medico-Chirurgical Journal.*

Diseases of the Breast. By THOMAS BRYANT, F.R.C.S., Surgeon to, and Lecturer on Surgery at, Guy's Hospital. With 8 Chromo Plates. **9s.**

"Mr. Bryant is so well known, both as an author and a surgeon, that we are absolved from the necessity of speaking fully or critically of his work."—*The Lancet.*

Syphilis. By JONATHAN HUTCHINSON, F.R.S., F.R.C.S., Consulting Surgeon to the London Hospital and to the Royal London Ophthalmic Hospital. With 8 Chromo Plates. **9s.**

"A valuable addition to the series of Clinical Manuals of its publishers, by an expert and accomplished writer, moderate in tone, judicious in spirit, and yet expressing the decided convictions of one whose experience entitles him to speak with authority. The student, no matter what may be his age, will find in this compact treatise a valuable presentation of a vastly important subject. We know of no better or more comprehensive treatise on syphilis."—*Medical News, Philadelphia.*

Fractures and Dislocations. By T. PICKERING PICK, F.R.C.S., Surgeon to, and Lecturer on Surgery at, St. George's Hospital. **8s. 6d.**

"We must express the pleasure with which we have perused the book, and our especial admiration for the lucidity of the author's style, and the simplicity of his directions for the application of apparatus; in the latter respect it is always difficult to combine clearness with brevity, but herein Mr. Pick has been most successful."—*Glasgow Medical Journal.*

Surgical Diseases of the Kidney. By HENRY MORRIS, M.B., F.R.C.S., Surgeon to, and Lecturer on Surgery at, Middlesex Hospital. With 6 Chromo Plates. **9s.**

"Mr. Morris writes clearly and forcibly, and handles his subject very thoroughly, so that the reader rises from the perusal of the work impressed with its importance. It would be difficult to find these subjects treated more carefully and thoroughly."—*British Medical Journal.*

Insanity and Allied Neuroses. By GEORGE H. SAVAGE, M.D., Medical Superintendent and Resident Physician to Bethlem Royal Hospital, and Lecturer on Mental Diseases at Guy's Hospital. **8s. 6d.**

"Dr. Savage's grouping of insanity is practical and convenient, and the observations on each group are acute, extensive, and well arranged."—*The Lancet.*

Intestinal Obstruction. By FREDERICK TREVES, F.R.C.S., Surgeon to, and Lecturer on Anatomy at, the London Hospital. **8s. 6d.**

"Throughout the work there is abundant evidence of patient labour, acute observation, and sound reasoning, and we believe Mr. Treves's book will do much to advance our knowledge of a very difficult subject."—*The Lancet.*

Diseases of the Tongue. By H. T. BUTLIN, F.R.C.S., Assistant Surgeon to St. Bartholomew's Hospital. With 8 Chromo Plates. **9s.**

"Mr. Butlin may be congratulated upon having written an excellent manual, scientific in tone, practical in aim, and elegant in literary form. The coloured plates rival, if not excel, some of the most careful specimens of art to be found in the pages of European medical publications."—*British Medical Journal.*

Surgical Diseases of Children. By EDMUND OWEN, M.B., F.R.C.S., Surgeon to the Children's Hospital, Great Ormond Street, and Surgeon to, and Lecturer on Anatomy at, St. Mary's Hospital. With 4 Chromo Plates. **9s.**

Mr. Owen's volume will rank as an invaluable *résumé* of the subject on which it treats, and should readily take its place as a reliable and compact guide to the surgery of children."—*Medical Press and Circular.*

Other Volumes will follow in due course.

Cassell & Company, Limited, Ludgate Hill, London.