DIETETICS

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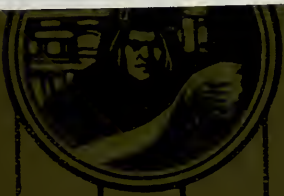

THE PEOPLE'S BOOKS

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PREFACE

It is open to serious doubt whether the progress made in the study of dietetics has been of such a sweeping character as to warrant its inclusion in the category of the sciences. There are, however, many indications that it has advanced beyond the stage of a simple accumulation of facts and experiences, and is preparing to take its place as a subject amenable to law.

This short treatise does not pretend to be more than a fairly careful résumé of the principles underlying the important question of nutrition, although I have endeavoured to impart a personal character to the book by taking every opportunity of expressing my own views on all the important points. I am hopeful that it may serve as a guide of more than ephemeral interest and value, not only to those who desire no further acquaintance with the subject, but to those who wish to pursue the fascinating study among the larger text-books.

ALEXANDER BRYCE.

Birmingham.

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DIETETICS

CHAPTER I

THE NUTRITIOUS PRINCIPLES ILLUSTRATED PRACTICALLY

Dietetics may be defined shortly as the science which treats of foods and feeding. It is to be noted that these words are employed in their most expansive sense to include all alimentary substances which can be or are customarily used by man for nourishing or aiding in the nutrition of his body. As the fundamental object of food is to build up and maintain the body in a condition capable of meeting the demands made upon it by daily life, our first duty will therefore be to obtain an accurate conception of the composition, from a chemical aspect, of the human body, and for the purpose we have in view this need not detain us very long.

This information can, of course, only be derived from analysis of the dead body, and hence we are compelled to surmise that the living material protoplasm of which it is composed is essentially the same substance, dead or alive.

The results of an investigation into the chemical structure of the human body may be stated in two different ways. In the one we may give a detailed account of the various elements of which it is composed, but as few of these exist in the free state this hardly advances our knowledge very materially. It is of some importance to know that the following are always found: carbon, hydrogen, nitrogen, oxygen, sulphur, phosphorus, sodium, potassium, calcium, magnesium, chlorine, iron, iodine, fluorine, silicon, and lithium, the last four being in very small proportions. The other method of stating the composition of the body is of infinitely greater value, because by the grouping of these elements into compounds we actually come face to face with the very substances which require to be built up or renewed by food. Thus we find that at least 70 per cent. of the body weight is composed of *water*, that the bulk of the remainder consists of *proteins* and *fats*, whilst only a very small quantity of *mineral matter* and still less of *carbohydrates* are able to be discovered.

The Alimentary Principles.—It will seem that these five substances are easily divisible into two classes: the *organic*, consisting of proteins, fats, and carbohydrates, and the *inorganic*, including water and mineral salts. The term usually applied to the whole group when referring to their presence in the body is that of the *proximate principles*, but as component parts of the food they are more generally known as the *alimentary principles*.

Before concentrating our attention more definitely on these words or making any attempt to give a definition of food, and in order to infuse a real live interest into what may very well become a somewhat dry subject, I think it will be judicious at this stage to give a short, succinct account of the recent controversy on the respective merits of white and brown bread. By this means we shall at once put ourselves in possession of some of the most prominent factors in the domain of dietetics, and at the same time rescue this little treatise from the accusation of being simply an epitome of a dry-as-dust scientific text-book.

What is Brown Bread?—There is not the slightest doubt that originally this term was used to signify bread which was made from stone-ground flour manufactured from the whole grain of wheat, the colour of which without compromise was distinctly and decidedly brown. It has been stated over and over again that the regular use of this bread would have prevented the decay of the teeth which is such a prominent feature amongst all classes to-day, and I am inclined to support this belief.

But it is also true that the introduction of this bread was responsible in some measure for the very evil which it would have stayed had it been permitted, and this paradox is easily explicable.

It was soon found that wholemeal bread required a considerable amount of mastication—the sole reason for the existence of good teeth, because whenever an organ is well used it becomes healthy, and when it ceases to be used, Nature quickly removes it or causes it to atrophy. It is not, therefore, a question of an extra amount of mineral salts or indeed any other ingredient of the wholemeal which is of such outstanding value to the teeth. It is simply and solely because the introduction of bread made from it compelled a more thorough use of the teeth, and the pace which was set in the last half of the nineteenth century being far too fast to permit of the mastication of wholemeal bread, it was soon discarded as nasty and unfit to eat.

Prodigious efforts were made by bakers to perpetuate its use under the designation of brown bread, and substitutes containing a little malt, or simply white flour with an admixture of bran, obtained a certain vogue, and still persist to-day. These possessed the great advantages, from the public point of view, that they required much less mastication and were not nearly so liable to become dry and hard as wholemeal bread. They therefore rapidly became popular amongst those who considered it judicious to shun the use of white bread, under the mistaken conception that they were of equal dietetic value with bread made from stone-ground flour manufactured from the whole grain of wheat.

Standard Bread.—Thus it came about that bread possessing none of the advantages of wholemeal bread and distinctly inferior to ordinary white bread became substituted for the former in the popular favour, much to the detriment of the nation. Glimmerings of the truth were fitfully published, chiefly due to the efforts of the medical profession, but these were without any appreciable result until a crusade was undertaken by the daily papers, stimulated doubtless by the Bread

Reform League. Under these influences the issue became very much confused, and all sorts of claims were made for a distant relative of wholemeal bread containing 80 per cent. of the whole-wheat berry, designated "Standard" bread. All the physical deterioration which is so rampant to-day was attributed to the use of white bread, which was described as a mere mass of bleached starch, lacking in the essential elements of nutrition and quite unfit for food.

Standard bread, on the contrary, was said to contain four times more mineral salts, which are so valuable in building up the bones and teeth and contributing generally to the strength of the body; a much larger proportion of protein, which is the basis of all life; a certain proportion of fat not to be found in white bread; and a small proportion of bran in a finely powdered condition, which, by acting as a mechanical stimulant to the intestine, regulated the bowels and overcame the tendency to constipation. In addition to this, being distinctly firmer and harder, it compelled more careful mastication, thus cleansing the teeth and leaving them in a more healthy condition, and incidentally improving the digestion by the only effective means at the disposal of the individual.

About the only disadvantage admitted to be found in this standard bread was its unfortunate colour, but this was minimised as much as possible, until its dull, dirty-white shade was merged into an almost golden-yellow. After such a magnificent advertisement one could hardly wonder that standard bread quickly established itself in public favour. What the medical profession could not compass in a glorious half-century of effort, crowded with schemes for the amelioration of the ills of suffering humanity, a halfpenny journal was able to accomplish in a few weeks of daily suggestive therapeutics.

Now whilst I have no desire to disparage the merits of standard bread, I have little hesitation in predicting that after a few months the public will again revert to the use of white bread. I am fortified in my conviction by the history of the past century, and whilst I look upon the present popularity of standard bread as a veritable triumph for the press, all experience goes to show that the working-classes at least pin their faith entirely to the white variety.

The Merits of White Bread.—There must, of course, be a reason for this preference, and it quickly becomes apparent on a little study of the subject. Careful examination of a grain of wheat by cutting it into thin slices will reveal the fact that it consists of the following parts: (1) the germ from which the future plant will grow accounts for 1½ per cent. of the whole grain; (2) the kernel or endosperm intended as food for the germ and consisting of 85 per cent. of the grain; (3) the bran or protective covering composed of hard woody fibre impregnated with mineral salts constitutes the other 13½ per cent. of the grain. Each of these parts contain protein in varying quantities, the greatest amount in proportion to its size being in the germ, and the smallest amount in the innermost layer of the bran. The endosperm contains of course most of all, in the form of gluten—the sticky substance which makes the manufacture of bread possible—the small particles of which lie in a mass of starch grains. The only fat found in wheat resides in the germ, but it is almost negligible in quantity.

Although it is quite possible to utilise wheat in its entire state as a food by soaking it for a long time in water, then boiling it in milk and adding a little sugar, thus making frumenty, it is usual to *grind* or *mill* it into the state of flour. By the stone-grinding process the bran was discarded and the germ and endosperm ground together. The modern roller-mill, however, not only rejects the bran but also the germ, because of the fact that its oil is apt to become rancid, and its proteins slightly digest the starch, converting it into a soluble form called dextrin and also in a lesser degree into maltose or malt sugar. This of course darkens the colour and hence militates against the popularity of the bread made from it. For this reason, only 70 per cent. of the grain is utilised in the production of ordinary flour, and there are many grades of flour on the market, some wheats containing more gluten than others. The composition of flour indeed is a very variable matter, and as a certain proportion of gluten is necessary to make a good loaf, recourse has been had to blending different varieties of flour, and even adopting special processes to ensure a wholesome nutritious bread.

It can easily be seen that in the effort to secure a presentable white bread, much of the valuable part of the wheat must be sacrificed, especially the germ containing much protein and fat, and the bran containing protein and mineral salts, indispensable to the growth and building up of the body. "Hovis" flour is a special preparation designed to save the germ, which, after separation, is first cooked by superheated steam, thus rendering the proteins ineffective as agents for digesting the starch, and sterilising the fat, which does not thereafter tend to become rancid. It is subsequently ground and added to ordinary flour in the proportion of one part to three, thus constituting a most nutritious product.

Other processes endeavour to save the protein and mineral matter of the bran whilst discarding the indigestible cellulose, and others again, whilst using no selective method of preparation, utilise 80 per cent, of the ingredients of the whole-wheat berry. It is this last class from which the article called "Standard" bread is manufactured, the title indicating that it is always of the same composition, and that the best for purposes of repairing the body waste in the adult and building up the growing frame in the young.

Now in estimating the value of this commodity we must not overlook the fact that a "standard" flour is quite an anomaly, because it is not only impossible to lay down a standard composition for wheat, but it is even impossible to be sure that the various classes of flour made from one single sample of wheat contain a uniform quantity of mineral salts. A report issued by the Local Government Board on "The Nutritive Value of Flour and Bread" emphasises this statement, and asserts that there are commonly wider differences in protein content and energy value between the patent flours obtained from different wheats than between the "patent" flours of a given wheat and the corresponding wholemeal, so that a patent flour obtained from one variety of wheat may contain considerably more of protein and furnish more available energy than an entire wheat and wholemeal flour from another kind of wheat.

Standard bread can therefore never be uniform in composition, and may indeed be very inferior to white bread.

The average composition of wholemeal and white bread, according to Hutchison, is as follows:

Composition of Wholemeal and White Bread Compared

	White Bread	Wholemeal Bread.
Water	40·0	45·0
Protein	6·5	6·3
Fat	1·0	1·2
Starch, sugar, and dextrin	51·2	44·8
Cellulose (indigestible)	0·3	1·5
Mineral matter	1·0	1·2

Atwater shows the following analysis:

	White Bread.	Brown Bread.	Graham (Wholemeal Bread).
Water	35·4	40·0	32·3
Protein	9·5	5·0	8·5
Mineral matter	1·1	1·9	1·5

These analyses compare very unfavourably with the composition of flour made from the wholemeal:

Water	12·1
Protein	12·9
Fat	1·9
Starch (carbohydrates)	70·3
Cellulose	1·6
Mineral matter	1·2

But it must be understood that a large proportion of water is added in the formation of bread, and—what is of vital importance—a great deal of the nutritious value is lost in the baking or cooking. Thus nearly all (71·2 per cent.) of the fats, 1·3 per cent. of the proteins, and 3·2 per cent. of the carbohydrates disappear in the process of baking.

It has been said that statistics can be made to prove anything, and it is certain that one must not place too great faith on an array of figures which represent the chemical composition of a dietetic substance. Chemical composition indeed is of very little real guidance in estimating the actual value to the body of any food apart from the vitally important items of digestion and absorbability. Now it would be quite impossible to trace a piece of bread through all its intricate wanderings in the body, including its incorporation into the actual substance of the body cells and its final rejection in simpler products by the skin, lungs, kidneys, and bowels; but it is easy to form a true conception of its value as a nutritious agency.

Digestion of Bread.—In ideal circumstances a fairly large proportion of a given quantity of bread is digested in the mouth. Starch or carbohydrate is quite incapable of absorption until it has been rendered soluble, and this is effected by the action of saliva, which converts it first into dextrin and subsequently into maltose. Pavlov demonstrated that the chewing of fresh moist bread produced no secretion of saliva worth mentioning, but dry bread caused the saliva to flow in large quantities. Stale bread, crust of bread, toast, zwieback (double-toasted bread), and plenty of biscuit compel fairly prolonged mastication with plenty of saliva, while soft bread is usually bolted with no production of digestive juice of any consequence.

On reaching the stomach this digestion of the starch by saliva still goes on until it has been neutralised by the outflow of gastric juice in from half to three-quarters of an hour, and then the protein is attacked by the pepsin and hydrochloric acid. Bread provokes a secretion of five times more pepsin than an equivalent quantity of milk, and four times more than meat, but a much smaller quantity of hydrochloric acid so as to interfere as little as possible with the alkaline saliva. Gastric juice is only able to digest proteins, and in about two hours and a half a slice of bread is ready to leave the stomach.

The various digestive fluids of the intestine soon complete the digestion of the starch and protein and the small quantity of fat contained in bread, and then absorption into the blood takes place. Up to this point there is practically no difference between white and wholemeal bread, but the superiority of the former now becomes apparent. It is easy to understand that no matter how well digested an article of diet may be, it is quite incapable of nourishing the body until it has been absorbed, and in this connection white bread is paramount, for only 3 per cent. of its carbohydrates, 20 per cent. of its proteins, 25 per cent. of its mineral matter, and 4½ per cent. of its total solids escape absorption—even when it is given alone. When mixed with other foods, for example milk, a very much larger proportion is utilised for the nutrition of the body. When we compare these really excellent results with wholemeal, we find that 6 per cent. of its carbohydrates, nearly 30 per cent. of its proteins, over 50 per cent. of its mineral matter, and 14 per cent. all told of its total solids are actually unabsorbed.

To a very large extent these inferior results are due to the presence of so much cellulose or indigestible woody fibre which prevents the digestive fluids from dissolving the nutrients present, but whether this is the sole reason or not, it is quite certain that, weight for weight, white bread is infinitely more nutritious than wholemeal bread or any far-away imitation of it. Standard bread, therefore, while containing a slightly larger proportion of nutritive ingredients, cannot be nearly so well absorbed as white bread, and its available nutritious power is decidedly less than that of the latter.

Not only is this the case, but the really valuable feature possessed by wholemeal bread, viz. its power to counteract the tendency to constipation, is practically absent from the standard bread, which makes a point of excluding most of the bran on the plea that it is innutritious.

In view of these facts, efforts have been made to manufacture bread containing a much larger proportion of digestible material, and the most successful attempt so far as I am aware is Maltweat, made by Winter of Birmingham. Instead of the 47 per cent. of insoluble carbohydrates of white bread, it only contains 10 per cent., while in lieu of 6 per cent. of soluble carbohydrates it possesses no less than 53 per cent. in the form of maltose and dextrin, *i.e.* nearly nine times the quantity contained in white or standard bread. Its value is also enhanced by its small quantity of moisture—quite 10 per cent. less than any other bread on the market. Hardly less important, however, is its content of protein, which is not only at least 10 per cent. higher than in the best quality of white or standard bread, but is practically all capable of immediate absorption, as in large measure it is not surrounded by an insoluble covering of cellulose. It is therefore not only superior in nutritive power to any other bread, but much less energy is dissipated in digesting and absorbing it, so that its value to the human economy is unexcelled.

CHAPTER II

DEFINITION OF FOOD AND ITS FUNDAMENTAL PRINCIPLES

A CAREFUL consideration of the facts contained in the last chapter will quickly reveal in a concrete form many important principles of dietetics which we shall now proceed to elucidate. Needless to say, it will be impossible to treat these principles in the detailed manner of a text-book, but I hope to be able to give a great deal of valuable practical information which will stimulate my readers to pursue the study of the subject further, with the aid of the bibliography at the end of the book.

Definition of Food.—I have no doubt most of my readers want to know first just what constitutes a food and in what manner it is supposed to nourish the body. The most comprehensive description of a food with which I am acquainted is this: Any substance which when introduced into the body is capable of repairing the waste of its tissues and so building it up and furnishing it with heat and energy.

In thinking over the various substances which would fulfil these functions, we naturally recur to those already mentioned as actually entering into the composition of the body, viz. proteins, fats, carbohydrates, mineral matters, and water. A most searching examination into all the varied diets of all the manifold races of mankind reveals the fact that, despite their enormous differences, each one can be resolved into these five substances, which are hence called the alimentary principles.

Irresponsible professors of dietetics amongst the laity do not hesitate to advance preposterous claims for the inclusion of other principles, such, for instance, as the possibility of inspiring nitrogen from the air and so adding it to the resources of the body, but there is not an atom of evidence in support of any theory which suggests any other than the above means of obtaining nourishment for the body. It is not necessary for more than one of these principles to be present to constitute the substance a food, *e.g.* sugar is a pure carbohydrate and butter is almost a pure fat, whilst white of egg is almost a pure protein. Usually, however, there is more than one present, and we have seen that bread contains all the alimentary principles in certain proportions.

Nature, the Great Food Alchemist.—Proteins, fats, and carbohydrates constitute the organic section of the alimentary principles, and are obtained, at least in the first instance, from the vegetable kingdom. Our bodies after death crumble into dust and mingle with the soil, thus supplying it with nitrates. The atmospheric air contains carbonic acid, likewise derived from the activities of living animals. Plants alone are able to utilise carbon and with the aid of water build it up into carbohydrates. These are eaten by animals, and after being used by them are excreted in the form of carbonic acid and water. Animals after their death therefore become the food of plants, and so it is only right and proper that they in their turn should become the food of animals. Plants again can extract nitrogen from the soil and, assisted by the carbon in the air, build up complex vegetable proteins, which being consumed by animals and broken down into simpler products again become the food of animals.

The power possessed by plants of building up complex organic compounds out of simpler chemical elements is the key to the claim made by vegetarians that plant foods alone are endowed with "vitality," whilst flesh foods are simply decaying devitalised tissue utterly useless for body-building purposes. Experience not only teaches that this argument is quite erroneous, but evidence is accumulating in favour of the existence in animals of a similar synthetic power.

The inorganic section consists of water and mineral salts, but practically the only one of the latter consumed as such is common salt (chloride of sodium), all the others being ingested in intimate association with the organic foods.

The organic nutrients are again divided into nitrogenous and non-nitrogenous, the proteins belonging to the former and fats and carbohydrates to the latter section.

Proteins.—(A.) Animal.—The proteins are the best-known representatives of the nitrogenous class, and are composed of carbon, hydrogen, and oxygen, with nitrogen and sulphur. The first three elements are likewise the component parts of the fats and carbohydrates, so that proteins combine in themselves to a certain extent the properties of both classes of nutrients, and can to a certain extent replace them. It is, however, impossible for the fats and carbohydrates to replace or be built up into proteins, of which the protoplasm of both the plant and the animal cell is mainly composed.

There are many varieties of proteins, most of them being insoluble in water, but some, like the albumins of blood serum, egg, and milk, being quite soluble. One part of egg white and two parts water thoroughly shaken together make albumin water, an excellent food to administer to babies and others suffering from diarrhœa. There are other proteins in blood and white of egg called globulins, which are only soluble in water with the aid of a neutral alkaline salt. Egg yolk again contains vitellin, whilst milk contains caseinogen, both of which are phospho-proteins. The flesh of most animals is composed of proteins, chiefly myosin, and these are associated with nucleo-proteins which on decomposition yield the notorious substance known as uric acid—in its way quite a harmless body if it only be expelled rapidly enough from the system. Being however rather insoluble, especially in acid fluids, it has a way of getting into positions where it is not wanted and thus creating trouble.

(B.) Vegetable.—So far I have only mentioned animal proteins, but there is an infinite variety of vegetable proteins—twenty or thirty different kinds at least being known—and these are not quite so acceptable to the human body as animal proteins, because the latter undoubtedly correspond more closely to the proteins of which our own tissues are composed. Not only is this the case, but the vegetable proteins are usually enclosed in an indigestible envelope of cellulose, just as we have seen in the case of the gluten of wheat in the wholemeal bread, and until this has been ruptured they are unable to be digested and absorbed into the blood. They are therefore in large measure expelled in the fæces quite unutilised, and Voit has shown that in this way as much as 42 per cent. of the nitrogen of the vegetarian's food is lost.

Proteins all agree in one particular, and that is, they undergo a curious transformation called coagulation in the presence of agents such as heat, alcohol, and astringents generally, like alum and tannin, and ferments such as rennet. The hardening of eggs, the clotting of blood, and the curdling of milk are familiar examples of this change.

Like all organic matter proteins may be burned, and when this takes place in the air they are decomposed into carbonic-acid gas, water, oxide of sulphur, and pure nitrogen, which passes off unchanged. A precisely similar process of oxidation—as it is called because oxygen is absorbed from the air—takes place in the body, but the various stages of decomposition are by no means so simple, another process termed hydrolysis being invoked to assist matters. Hence the proteins are not so thoroughly burned up as in the air, so that they leave cinders or ash, which is apt to accumulate in the body under certain circumstances. Urea is the best known of these residual products of the disintegration of proteins, and it is excreted in the urine, but there are many other much more complex and usually poisonous compounds which make their appearance in the lower bowel and are apt to be reabsorbed into the body and so set up a form of self-poisoning termed auto-intoxication.

Fats.—In common with the carbohydrates, fats are composed of carbon, hydrogen, and oxygen, but in contradistinction to them contain more carbon and less oxygen, for which reason a given quantity of fat on burning will produce 2¼ times as much heat. In the human body and bodies of animals they are found in large quantities in bone marrow, adipose tissue, and milk, whilst in plants they are most commonly found in seeds, *e.g.* nuts, linseed, &c. Body fat is a mixture of three fats, stearin, palmitin, and olein, and on account of the low temperature at which the last-named becomes solid, viz. 5° C. (41° F.), the contents of the fat cells of the adipose tissue are fluid during life. Fats and oils are identical in composition, only differing in their melting-points. Fats are insoluble in water, although their component parts, viz. fatty acids and glycerine, are soluble. Hence in the body during digestion they are split up into these substances and so absorbed. Milk contains varying proportions of fat—cow's milk 3½ to 4 per cent., while whale's milk contains as much as 43 per cent., and this is an interesting illustration of adaptation when one remembers the heat-producing powers of fat.

Carbohydrates.—These substances are usually defined as compounds of carbon, hydrogen, and oxygen, in which the last two elements are in the same proportion as in water, and in the main this is so. They are essentially vegetable products—starch, cellulose, cane sugar, grape sugar or glucose, fruit sugar (lævulose or fructose) being typical examples. Two are found in the animal body, viz. milk sugar or lactose and glycogen or animal starch, the latter being present in the liver, muscle, white-blood corpuscles and other tissues. The more common forms are divided int othree classes—(1) the monosaccharoses: grape sugar (glucose), fruit sugar (lævulose), and galactose; (2) the disaccharoses: cane sugar (saccharose or sucrose), milk sugar, and malt sugar; (3) the polysaccharoses: starch, dextrin, glycogen, cellulose. It is interesting to note that before they can be utilised in the body as food they must each be converted into grape sugar.

Sugars are all easily soluble in water, and for household purposes are mainly derived from the sugar cane and the sugar beet, in about equal proportions. It is a great mistake to look upon sugar as simply a condiment, as although it is incapable of supporting life on account of its lack of nitrogen, it is a most important nutrient. It produces heat and energy in a much more economical and agreeable form than protein or fat. The food-fruits, apples, pears, grapes, bananas, owe their food value almost entirely to their content of sugar. The great value of sugar as an energy-producing food is now so well known that in the German army whilst on the march a daily ration of four ounces is issued to each man. It is equally useful as a nutrient in the case of children, and in the winter time when given to the limits of a child's digestive capacity its heat-producing power is calculated to save the expense of an extra garment. It is apt, however, to be indulged in to excess, and in this way may injure the child's appetite and digestion. It is stated to have no ill effects on the teeth, but this is rather doubtful, and in any case there is an enormous contrast between the beautiful molars of the sugar-cane-loving negro and the decaying stumps of the sweet-eating Briton.

Sugar can also be obtained from the sap of the maple tree and from corn and other starches. Molasses is a by-product obtained in the refining of sugar, and syrups are obtained from the evaporation of the saccharine juices of plants. Honey is composed of 60–75 per cent. of invert sugar (*i.e.* derived from natural sugars by inversion) and water, and shares with milk the distinction of being the only dietetic agencies originally intended for this purpose and no other. It is much more easily digested than sugar.

When yeast is allowed to grow in a solution of sugar, alcohol and carbonic acid are produced, and this alcoholic fermentation is well illustrated in the manufacture of beer.

Starch is found in practically all plants, and is composed of a number of overlapping layers separated by cellulose. It is specially abundant in potatoes and cereals. It is insoluble in cold water, but when treated with boiling water the little starch grains swell up and rupture the cellulose envelopes. When heated in the dry state it is converted into dextrin (the common gum used for postage stamps) and soluble carbohydrates. Dextrin is formed in this way in the crust of bread and wherever potatoes or other starchy foods are browned.

Cellulose is the groundwork or skeleton of plants within which the cells are enclosed. It has the same chemical composition as starch, but except in young and tender plants it is quite indigestible, and therefore prevents its nutrient contents from becoming available as food, unless by heat or otherwise the cellulose envelope is ruptured. Carbohydrates and fats are consumed by burning in the air or oxidation in the body, their end-products—when combustion is complete, as even in the body it usually is—being carbonic acid and water.

It is convenient to complete our review of the alimentary principles at this point, and for this purpose we make a short reference to the mineral matters and water.

Mineral Matter.—In a properly balanced dietary there is not the slightest necessity for the addition of any mineral salts to our diet, and except for the almost universal presence of the salt-cellar on our tables we might remain in complete ignorance of their existence. Nevertheless, they are quite indispensable to the vital activities of the body, and animals from whose diet they have been purposely excluded quickly succumb. It is even of greater interest to know that the addition of inorganic mineral salts in correct proportions to a diet which has been exhausted of them is not sufficient to enable it to impart nourishing properties to the body. Mineral salts in the food must therefore exist in some organised form or vital association, and their deprivation even in small quantities is frequently followed by disease. It is now known, for example, that the peculiar malady so prevalent in the East and known as beri-beri owes its inception to the use of polished rice as the staple article of diet, and the addition of the external coats which have been "polished" off the rice soon exterminates the disease. The lacking essential ingredient which is responsible for the outbreak of this disease is some organic compound of phosphorus, and it is worthy of being noted that while the addition of inorganic or even organic phosphates cannot stay the malady, substances like peas or beans, yeast, wheat bran, or rice meal, all of which contain this organic phosphorus in large proportions, at once cure the disease when present, or prevent its development.

On a mixed diet containing a fair quantity of animal food there is really no necessity to add any common salt at table, because animal food already contains an abundance of mineral matter. Nevertheless, most people consume more than half an ounce per day, and it is open to question whether in some cases it may not be extremely harmful to do so. In any case, those who are subject to catarrhal ailments of one kind or another, such as frequent colds in the head, would do well to keep their supplies of common salt within the most moderate limits. Despite this statement, there is no reason to believe that in the average case even a fairly large consumption of salt is attended with injurious results, and there is not the slightest evidence to show that it is in any way associated with the production of cancer, as has sometimes been asserted.

As the human body contains altogether about seven pounds of mineral matter, most of which is to be found in the bones, one is rather surprised to find that we only require about two-thirds of an ounce of mineral matter daily, and apart from the addition of salt which is probably superfluous, the ordinary daily mixed diet is capable of supplying more than this quantity. Sodium, potassium, calcium, magnesium, iron, phosphorus, sulphur, chlorine, are the most essential mineral constituents of the food. Sodium is found chiefly in animal foods, potassium chiefly in vegetable foods—potatoes being especially rich in it; calcium (lime) is especially abundant in milk, eggs, rice, asparagus, and magnesium usually goes hand and hand with it; iron exists in fairly large proportions in spinach, yolk of egg, beef, apples; whilst phosphorus and sulphur are common in most protein-containing foods, cheese, haricot beans, and mutton being notable for the quantity they contain.

Water.—The importance of water in the human economy is manifest when we realise that quite 70 per cent. of the weight of the body is made up of water. It is to be met with not only in the actual tissue substance and as the chief ingredient in all the fluids of the body, but also in transit through the external and internal linings of the body. Without such watery transudation not only would the skin be extremely uncomfortable and the mucous and other lining membranes become painfully evident because of increased friction, but the body itself would suffer serious damage, because its temperature is regulated by this means.

Roughly speaking, about 4½ pints of water are excreted from the body daily, and of this quantity about one half escapes by the kidneys, containing in solution urea, uric acid, and other waste matters from the breaking down of proteins; a little more than a quarter is excreted by the skin as sweat and sebaceous matter, containing some of the fats; a little less than a quarter by the lungs in the shape of watery vapour holding in solution waste matters from the breakdown of the carbohydrates and fats; and the residue (about 2 per cent.) escapes by the bowels. In a vegetarian, however, as much as 10 per cent. may be excreted by the bowels, creating a much more abundant and softer stool than in a mixed feeder.

It is important to note that more water is excreted than is ingested, because about 10 or 12 ounces are actually manufactured from the tissue itself during the process of combustion. It is, however, manifest that the balance must be supplied in the food and fluids consumed, and about half of the whole weight of solid food consists of water. This would leave a little more than two pints to be supplied in an actual fluid form, and it is probably judicious to drink the equivalent of six tumblerfuls of fluid each day. A considerable quantity is consumed as tea and coffee or similar beverages, but the more one can take as pure water the better, because one of the chief functions it subserves is to carry off in solution waste products from the body, and pure water is the best solvent known to chemists. Fat people and those who are out of condition are able to accommodate as much as five pounds of useless water in the interstices of their tissues, and one of the objects of training is to rid the body safely of this excess of fluid. Where a large proportion of protein is consumed the tissues are relatively free from water, whereas the body tends to become richer in water when the fats and carbohydrates are in excess in the diet.

Where the digestion is not impaired, it is an advantage to partake of water or other bland fluid at meal-times, as a better distribution of nutrient material is thereby obtained. Many people who live in a city, however, find that they are apt to suffer from indigestion if fluid is abundantly supplied at meal-times, and this is doubtless due to the fact that the stomach has become atonic and cannot effectually expel the fluid. It should be noted that fluids are always expelled from the stomach before solids.

The best time to take fluid is first thing in the morning and last thing at night, and most people find that a tumblerful of cold water in the morning immediately on rising and the same quantity of hot water at night just before retiring are valuable adjuncts to their diet, enabling them to obtain with comparative ease a daily evacuation of the bowels.

CHAPTER III

FOOD AND BODY BUILDING

We must now pass on to consider the method whereby these various alimentary principles are made available for the purposes of the body, and although the subject is one of entrancing interest, we must dismiss it in the briefest fashion compatible with its appropriate comprehension.

With the exception of water, none of the alimentary principles are in a state capable of incorporation with the body cells. Without being dissolved in some form or other they are unable to enter the circulation, and it is quite possible that even water undergoes some change before this occurs. To effect this change some process is therefore essential, and for this purpose the various organs of digestion exist. The shortest and most arresting definition of digestion indeed is *solution*, and in any case this is the keynote of the various changes produced by the digestive fluids.

Digestion of Starch.—Digestion begins in the mouth, where by means of mastication the food is comminuted and mixed with saliva. This fluid contains a ferment which converts the insoluble starch of such foods as bread and puddings into the more soluble form of maltose or malt sugar. This transformation does not take place in one stage, for there are several steps in the process, and unless the food has been carefully cooked hardly any maltose is formed in the mouth at all. Ptyalin, however, which is the name of the ferment, is able to carry on its salutary work of conversion in the stomach for something like half an hour after the food has been swallowed, or at all events until the bland alkaline saliva has been neutralised by the acid gastric juice. The stages in the best circumstances in the mouth are starch, dextrin, maltose, and the process is not advanced much further in the stomach, although any cane sugar present may be decomposed (or inverted as it is called) by the acid of the gastric juice and ferments contained in the swallowed food into grape sugar (dextrose) and fruit sugar (lævulose).

Up to this point none of the uncooked starch has been changed in any way. It is therefore manifest that digestion is hastened and economy effected if all starchy foods are cooked before consumption. This cooking swells up the starch grain, which therefore ruptures its insoluble coating of cellulose and is quickly transformed into dextrin by the heat. For this reason even bread is the better for being subjected to a second baking process in the oven, and what is called zwieback (double-baked) or pulled bread is quite a favourite form in which to eat bread.

After being ejected from the stomach into the intestinal canal all carbohydrate, whether cooked or uncooked, so far as it can be reached through its envelope of cellulose, is attacked by the amylopsin—a ferment in the pancreatic fluid—and converted into one of the sugars, usually maltose. Finally this mixture of sugars, maltose, lactose, cane sugar, and lævulose, is, by means of another ferment called invertase, changed (in large degree at any rate) into glucose (grape sugar), the most convenient form for absorption.

Digestion of Protein.—The proteins, which are practically always eaten cooked, and in contradistinction to the carbohydrates thereby rendered less digestible, because they not only become coagulated but also contracted and more concentrated in the process, undergo no digestive changes in the mouth. In the stomach, however, they are met by the gastric juice, a fluid containing pepsin and hydrochloric acid, and under its influence pass through a series of compounds termed acid-meta-proteins, proteoses, peptones, polypeptides, each one being a protein in a stage more soluble than its predecessor, until after the acidity has reached a certain stage they are propelled into the duodenum or the first part of the alimentary canal.

The mixture of food is at this stage called chyme, and by a complicated and highly interesting process its acid nature stimulates the walls of the duodenum to send an actual chemical messenger or hormone right through the blood into the liver and pancreas, thus intimating that the time has come for them to put forth their digestive efforts. This results in the outflow of bile and pancreatic fluid, the latter containing a ferment called trypsinogen, which is luckily inactive so long as it remains in the pancreas, otherwise it would soon digest it. Shortly after entering the intestinal canal, however, it meets a friend termed entero-kinase, and this converts it into trypsin, a ferment four times more powerful in its effects on protein than the pepsin of the gastric juice. It acts, however, in an alkaline medium, and so alkali-meta-protein, proteoses, peptones, and polypeptides are formed as before, but a final stage is reached termed amino-acids, and this is all-important because it is the form in which, or immediately antecedent to which, proteins are absorbed.

Digestion of Fat.—Fats are practically unaffected in the mouth and the stomach, and are indeed somewhat of an incubus there, because they have a tendency to interfere at least with gastric digestion by diminishing the outflow of gastric juice. When they reach the small intestine, however, they meet their fate in lipase (the fat-splitting ferment of the pancreatic fluid), and become split up into fatty acids and glycerine, constituting a milk-like solution termed an emulsion.

Absorption.—The interior of the small intestine is dotted all over by a huge number of hair-like processes termed villi, each containing a lacteal and a very tortuous capillary blood-vessel. The mixture of soluble carbohydrates, proteins, and fats with the disassociated mineral salts and water, freely bathes these villi and permits of the absorption of the fatty acids, now converted into soaps by union with the alkaline salts of the bile through the lacteals, and the grape sugar, amino-acids, water, &c.

through the capillaries. In this way the food reaches the circulation and is conveyed by the blood to the furthermost recesses of the tissues—each cell of which has immediate access to the nutrient fluid.

Just what takes place in the circulation is not quite clear, although certain facts are well known, *e.g.* that all the carbohydrates pass into the liver, where they are converted into a substance called animal starch or glycogen, constituting a storehouse for the subsequent necessities of the body, chiefly as food for the muscles. Before passing to the muscles it is again transformed into grape sugar where it is utilised, and if for any reason the muscles are unable to make use of it, it is excreted by the kidney and the disease termed diabetes is present.

It is also known that the tissue cells themselves contain ferments analogous to ptyalin, pepsin, lipase, &c., which attack the tissues in appropriate conditions, *e.g.* after death during putrefaction, but are unable to digest living tissues because of the presence of anti-ferments which counteract their effect.

The intricate changes occurring in the tissue cells themselves, however, are quite unknown. All we know is surmised from the nature of the excretions which are eliminated from the body, the fats and carbohydrates being finally resolved into carbonic acid and water and the proteins into the same substances with the addition of urea, uric acid, creatinin, and sulphates. These end-products are compatible with the belief, which now amounts to a certainty, that the tissue cells themselves are constructed from the alimentary principles and that they are constantly being consumed by a process of slow combustion. This is termed oxidation, because in large measure it takes place under the influence of the oxygen which has been extracted from the atmospheric air and carried in the red-blood corpuscles up to the very walls of the cells. The results of this slow fire are the products mentioned above, which are expelled from the cell into the blood and carried outside the body through various portals—the kidneys, the lungs, the skin, and the bowels.

The cells are thus able to repair their waste substance by appropriating the food supplies in the nearest circulating channel and building them up into their own tissue. It was at one time thought that this could only be effected by proteins, which were the essential food of the cells. But this theory was shattered by two eminent German scientists, Fick and Wislicenus, who in 1865 climbed the Faulhorn, using only non-nitrogenous food during the feat, and finding that their excretion of nitrogen, the peculiar possession of the proteins, was quite insufficient to have produced anything like a tithe of the energy represented by the work done. It is still known that it is impossible to manufacture tissue or flesh substance without protein, but this is wasted in much smaller quantities than was at one time believed, and its expenditure can be very much reduced by a proper reliance on fats and carbohydrates.

It is now well known that the nitrogen of the major portion of protein food is expelled unutilised from the body, the protein having been broken up to obtain, for energy-producing purposes, its carbonaceous molecule. It is hardly fair to allege, and indeed there is no proof to support the hypothesis, that this non-nitrogenous portion of the protein is any more valuable than fats and carbohydrates, and if it be not, then there is no rational basis for eating more than a very limited quantity of protein. It is also a remarkable fact that, except during convalescence from serious illness or for a day or two at the beginning of a holiday, it is impossible to store up as a reserve in our tissues any of the excess protein food we consume, whilst fats and carbohydrates are freely stored up, usually in the form of adipose tissue.

I have already mentioned that exercise does not increase the output of nitrogen, showing that neither protein food nor protein tissue is used for the production of energy. Carbonic acid, on the other hand, is excreted in greatly increased quantities during exertion, and this proves that energy is derived from the combustion of fats and carbohydrates.

Functions of the Various Alimentary Principles.—It is clear, therefore, from what we have seen that the tissues proper, *i.e.* flesh and the various organs, can only be built out of proteins, mineral matter, and water, and that these alone have the power to manufacture and repair tissue.

On the other hand, energy or work, and its by-product heat, can be obtained from any of the food principles, and as adipose tissue wherever it may be deposited is simply a reserve store of energy, it may also be built up from any food substance. It is manifest that fat may form fat. We know from feeding pigs on a diet composed solely of potatoes, that carbohydrates can form fat, and we have seen that proteins have a non-nitrogenous molecule which may be used for the same purpose. The big meat-eater is almost always obese, and as he grows older has a tendency to be diabetic, or at any rate to pass sugar in his urine. Fat, of course, is not flesh, *i.e.* tissue, but it is body substance. So it is interesting to note that the body can grow in bulk either by the increase of its fleshy substance or by the deposit of fatty substance. When, however, a human being reaches full growth, which is attained at the latest by the twenty-fifth year of life, there is no further possibility—unless during exceptional circumstances, some of which I have already mentioned—of adding to his flesh.

Hence after this period of life, food is simply required (1) for repairing the daily wastes of the tissue, and this is effected by proteins in conjunction with mineral matter and water; and (2) for supplying energy necessary for the daily work, and this may come from carbohydrates, fats, or nitrogenous substances such as proteins, or relations of theirs called albuminoids, of which gelatine is a typical example. Doubtless also water and mineral matters play an important part in the process.

Any food in excess of this quantity is either rapidly burned up and excreted from the body without being used, and this is what happens to the surplus nitrogenous material in every case and in many thin people to all the surplus food; or else manufactured into fat, which is deposited under the skin in the abdomen, back, and flanks, face and neck, and this is the fate not only of the fats and carbohydrates but even of the non-nitrogenous portion of the proteins.

The Folly of Fasting.—When, on the other hand, food is administered in quantities insufficient to repair the daily waste, then the reserve store of glycogen in the liver is first called upon, thereafter the adipose tissue is laid under contribution, and finally the protein tissues themselves are compelled to sacrifice their substance to the urgent demand for fuel for the production of energy, to keep the internal machinery of the heart, lungs, digestive organs, &c., at work, and heat, to facilitate their functioning. It is painfully pathetic to read of the victims of the fasting craze who, under the misconception that they can burn up all the accumulated waste matter of the body only and therewith rid themselves of all seeds of disease, at the same time leaving their bodily tissues clean, pure, wholesome, and intact, submit to days and even weeks of starvation under the euphemistic title of "fasting for health." I was gravely informed the other day of one who had triumphantly and successfully passed through the ordeal for over thirty days, and was assured that not a vestige of disease existed; but impatient to claim her reward in renewed vigour, broke her fast just one meal too soon, and succumbed to the effects. It is ludicrous were it not a matter of such serious import to listen to the unmitigated nonsense, supposed to be science, which emanates from the votaries of this practice. Elsewhere I have used the following language to describe the effects likely to be produced by fasting: "The simile which best fits the fasting man is not that of a furnace whose bars are choked with ashes and whose flues are clogged up with soot, so that a general conflagration is welcome to clear away the obstruction in order to produce more effective combustion. It is rather that of a furnace which has disposed of its extraneous combustible material and proceeds to attack the furnace bars and flues and even the very boiler plates themselves, so that an explosion is imminent." [1]

[1] See *Modern Theories of Diet* (Arnold), p. 331.

CHAPTER IV

QUANTITY OF FOOD REQUIRED DAILY

We must now pass on to consider the means at our disposal for determining the amount of food necessary to satisfy the nutritive requirements of the body. These may shortly be classified as "scientific" and "experimental," and it may be admitted at once that no method is altogether satisfactory.

Scientific Determination of the Quantity Required.—It is easy to understand that if we could estimate the amount of nitrogen, carbon, and oxygen contained in the excretory waste matters of the body, we could form a very fair estimate of the amount and character of the food required to provide it with pabulum sufficient for repair and the production of energy. For practical purposes the nitrogen and carbon alone are computed, the former in the urine and fæces and the latter in the expired air. When the amount of nitrogen excreted is as nearly as possible balanced by the amount ingested in the food, then the body is said to be in a condition of "nitrogen equilibrium"—a pretty fair index of health. Assuming that an individual were to excrete 300 grains of nitrogen and 4800 grains of carbon, it would be possible to estimate the amount of meat and bread which would supply these quantities. Meat contains about 11 per cent. of carbon and 3 per cent. of nitrogen, hence 6 lbs. of it would give us 4800 grains carbon and 1309 grains of nitrogen, or 1009 grains too much. Bread contains 30 per cent. of carbon and 1 per cent. of nitrogen, hence 4 lbs. would give 9000 grains of carbon and 300 grains of nitrogen, or 4200 grains too much carbon. By eating meat alone we should require to consume

4¾ lbs. too much to get enough carbon. By confining our attention to bread alone we should require to consume 2 lbs. too much to get enough nitrogen. By combining the two substances we could get a reasonable amount of daily nutriment as follows:

	C.	N.
14,000 grains (2½ lbs.) of bread contains	4200	140
5,500 „ (¾ lb.) of meat contains .	605	165
	4805	305

This is, however, a very clumsy method of computation, and is never employed nowadays.

The scientific method in use is founded upon the conception of food as fuel. When fuel is burned, it is consumed, giving up its heat, which may be transformed into energy, and its constituent parts are disassociated from their organic union of carbon, hydrogen, and oxygen, reappearing as carbonic acid and water when the combustion is complete. A precisely similar process takes place in the human body when fats, carbohydrates, and proteins slowly undergo the series of changes which consume them with the production of heat and energy, and the excretion from the first two of carbonic acid and water, and, from the last, of these same products with urea, uric acid, creatinin, and sulphates in addition.

It is quite easy to ascertain the amount of heat emitted by employing a "bomb" calorimeter, an instrument so constructed that a measured quantity of water absorbs the heat, the amount of which is clearly shown by a thermometer. It is found that when a gram of carbohydrate or protein is enclosed in the little central chamber of the calorimeter and ignited by an electric current it can raise the temperature of a kilogram of water to 4·1° C., whilst 1 gram of fat completely consumed imparts a temperature of 9·3° C. to the water. The unit employed is called a (large) calorie, and hence:

1 gram (nearly $\frac{1}{30}$ of an ounce) of dry protein	=4·1 Calories
1 gram (nearly $\frac{1}{30}$ of an ounce) of dry carbohydrate	=4·1 „
1 gram (nearly $\frac{1}{30}$ of an ounce) of dry fat	=9·3 „

With these facts in our possession it is a simple calculation to estimate the number of calories in any food whose percentage composition is known. Medium fat beef, for instance, contains 76·5 per cent. of water, 20 per cent. of protein, 1·5 per cent. of fat, and 1·3 per cent. of ash or mineral matter. Water is a most valuable medium for assisting the oxidation and other processes which are necessary for the production of energy, but does not contribute in any direct fashion to its amount; the rôle played by mineral matter we can only surmise, but in all probability it is likewise only adjuvant. Hence we have only to take into account the protein and fat.

One ounce of dry protein or dry carbohydrate produces 116 calories of heat on combustion so far as it is complete in the body, and 1 ounce of pure fat yields 263 calories; 1 ounce of fat being therefore equal in energy value to $2\frac{1}{4}$ ounces of protein or carbohydrate. Therefore, 1 ounce of beef with the above composition will contain $20 \times 1{\cdot}16$ calories of protein $= 23{\cdot}2$ calories, and $1{\cdot}5 \times 2{\cdot}63$ calories of fat $= 3{\cdot}8$ calories.

In a similar manner 1 ounce of Cheddar cheese, which like most cheeses contains about one-third water, one-third protein, and the other third fat, will contain $33{\cdot}3 \times 1{\cdot}16 = 38{\cdot}6$ calories of protein, and $33{\cdot}3 \times 2{\cdot}63 = 87{\cdot}5$ calories of fat, more than twenty times as much as medium fat beef. Of course all cheeses are not so rich in fat, and most good beef contains a little more than 1·5 per cent. of fat, but the calculation is not far from the truth. It has indeed been asserted that a cheese of 20 lbs. weight contains more nutriment than a sheep's carcase of 60 lbs., and at about one-sixth of the cost, proving that cheese is a substitute for meat of quite transcendent importance in a poor household.

Given a knowledge of the percentage composition of any food it is not difficult in this way to estimate its caloric value, and I append the following short table complete from the Battle Creek Sanitarium diet-list, which may prove useful for reference. (See pp. 40 and 41.)

The Work of the Body.—It must not, however, be supposed that the energy in an ounce of these foods is as available in the human body as it is when completely burned up in a calorimeter. Losses are sustained during digestion, for, as we have already seen, few if any foods are digested absolutely and fewer still are completely absorbed. In addition to this, proteins are never totally consumed in the body, quite one-fifth of their value escaping in the urine unoxidised. It is also important to remember that a great deal of energy is utilised in the processes of mastication and digestion, and Zuntz has calculated that as much as 48 per cent. of the digested material from hay used in feeding a horse is dissipated in this fashion. It is estimated that in a human being no less than 2800 foot-tons of energy are expended each day in keeping the circulation, respiration, and digestion in working order and maintaining, by evaporation and radiation from the skin, the temperature at the normal amount of 98·4° F. In other words, if employed to work an elevator this amount of energy would raise a weight of 2800 tons one foot high.

It is incredible to think that this amount of energy must be expended before one stroke of external work is done, and even more amazing to know that to produce 300 foot-tons of labour each day the body must actually provide another 1500 foot-tons which is thrown off in heat. This is, however, a better result than that shown by the best steam-engine in existence, in addition to which the body utilises the heat for improving the value of its functions.

It has been found possible, by using a much larger instrument called a respiration calorimeter in which a human being may be enclosed for as long as two weeks, to estimate not only the output of work but also the total heat, carbonic acid, and water output of an individual, as well as to measure the oxygen which he inhales. The amount of course varies with the size, age, sex, and degree of bodily activity; but a man of average size, weighing 66 kilograms and at rest within the calorimeter, has been ascertained to have an energy requirement for 24 hours of close upon 2300 calories. This might be looked upon, therefore, as the minimum energy value of the food necessary to keep such an individual

CALORIC VALUE OF COMMON FOODS

Ounces in an Ordinary Helping.	Food Stuff.	Calories per Ounce.				Total Calories in an Ordinary Helping.		
		Proteins.	Fats.	Carbo-hydrates.	Total.	Proteins.	Fats.	Carbo-hydrates.
¼	Almonds	24·5	146·4	20·2	191·1	7	38	5
⅞	Almond Butter	26	152·8	21·4	200·2	23	133	19
5½	Apples	2·75	7·15	91·3	101·1	2	7	91
3¼	Apple Tart	4·76	11·19	41·7	57·6	14	33	128
3½	Bananas	1·5	1·6	25·7	28·8	5	6	89
3½	Barley (Pearl)	2·97	·87	27·24	31·08	9	3	88
3¼	Beans (Kidney)	8·2	·5	21·6	30·3	27	1	72
¾	Biscuit (Granose)	14·1	1·9	83·6	99·6	10	1	64
3	Blackberries	1·5	2·6	12·7	16·8	4	8	38
3	Blanc Mange	38	36·4	17·3	57·5	11	111	53
½	Brazil Nuts	19·8	178·1	8·2	206·1	9	87	4
2	Bread (Maltweat)	15	3·4	90	108·4	30	7	180
2	,, (Wholemeal)	11·3	2·4	58	71·7	24	5	121
4	Cabbage (Boiled)	·8	6·1	1·9	8·8	3	19	
1½	Cake (Sponge)	12·4	14·2	94·2	120·8	20	23	1
2	Cheese (Cottage), *i.e.* Home-made from Milk	19·9	12·4	5·1	37·3	40	25	1
¾	Corn Flakes (Toasted)	10·8	1·4	91·3	103·5	7	1	6
3	Custard Bread-pudding	8·75	46·08	67·24	122·07	23	133	1
2½	Cutlets (Nut)	22·95	23·3	15·26	61·5	56	57	37
1¼	Eggs (Poached)	16·3	32	...	48·3	26	42	...
2½	,, ,, (on Toast)	14·1	18·28	25·36	57·76	36	47	67
½	Filberts	18·2	174·1	15·2	207·5	9	84	7
2¾	Macaroni au Gratin	10·8	15·88	17·85	44·5	30	45	50
6	Milk	3·8	11	5·8	20·6	22·8	66	34·8
⅞	Nut Butter	34·2	124	20	178·2	28	105	17
½	Nuts (English Walnut)	19·4	169·2	18·2	206·8	9	82	9
2	Nutton	20·8	11	12·2	43	42	22	25

4¼	Oatmeal (Cooked)	3·3	1·3	13·4	18	14	5	56
⅓	Olive Oil	...	264·1	...	264·1	...	100	...
2½	Onions (Boiled)	1·13	4·29	5·1	10·52	3	10	12
5	Oranges	·9	·5	13·5	14·9	4	2	69
3	Parsnips	2	11·85	11·31	25·2	6	36	33
¾	Peanuts	30·1	102·9	8·5	161·5	22·5	77·1	6·3
4	Pears	·7	1·3	16·5	18·5	3	5	67
½	Pecans	11·2	188	17·8	217·8	5	87	8
½	Pine Kernels	39·5	131·7	8	179·2	23	72	5
3	Potatoes (Baked)	3·4	·4	28·9	32·7	11	1	88
...	Prunus Perfect Food	23·0	50	20	93	46	100	40
3¼	Pudding (Cream Rice)	4·25	22·1	19·63	45·98	14	72	64
1	Raisins	3	8·8	88·8	100·6	3	9	88
4	Rice (Boiled)	3·3	·3	28·5	32·1	13	1	111
4¾	Soup (Clear Tomato)	3·1	7	8·9	19	17	36	47
⅙	Sugar	...	...	116·6	116·6	...	...	25
1	Zwieback	11·4	26·4	85·8	123·6	11·4	26·4	89·8
3½	Beef Juice	5·42	1·71	...	7·13	19	6	...
2½	Beef (Roasted Fat)	18·14	136·85	...	155·26	48	352	...
3¼	Chicken (Boiled)	24·6	6·56	...	31·16	79	21	...
5	Cod Fish	19·3	1·02	...	20·32	95	5	...
2¾	Goose	18·1	95·14	...	113·5	48	252	...
3½	Lamb (Roast)	22·2	33·3	...	55·5	80	120	...
2	Lobsters	19	4·8	...	23·82	39	10	1
2½	Mutton (Boiled Leg)	29·1	54·1	...	83·2	70	30	...
3½	Oysters	7·2	3·23	...	10·43	24	12	14
1	Pork (Bacon)	11·3	177·3	...	188·6	12	188	...
2¼	,, (Ham, Boiled)	25·4	68·4	...	90·3	56	144	...
3	,, (Loin Chops)	18·5	84·5	...	103	54	246	...
2¼	Salmon	20·4	46·6	...	66·6	45	105	...
1¾	Trout	22·2	55·5	...	77·7	40	10	...
1¼	Turkey	24·1	59·1	...	83·2	29	71	...
2½	Veal	30·4	11·2	...	41·6	73	27	...

from losing body substance and either eating in upon his reserves or living upon his own flesh. Expenditure of energy in any form, whether muscular, mental, or otherwise, would of course require a corresponding allowance of food, and it is calculated that an average man in the ordinary pursuit of his daily vocation requires something between 2600 and 3200 calories of food value.

Experimental Determination of the Quantity of Food.—Needless to say, it is seldom that such methods of research are invoked to determine the amount of food required, but their description gives an opportunity for explaining many invaluable points connected with diet. It is much more usual to adopt the experimental or empirical method, where the actual food supply of healthy individuals is noted and the excretions from kidney, bowel, &c. fully analysed to discover whether the expenditure is properly balanced. An extension of this system in the form of deliberate feeding experiments upon selected individuals has now been much in vogue in various countries, and the observations in large measure corroborate the results obtained by calorimetry and other scientific methods. The fuel value of the food required varied from as little as 2000 calories for sedentary individuals to as much as 6000 calories for those engaged in laborious occupations.

This is, of course, much too wide a latitude to be of any real practical value to the individual who wants something more precise. The following figures have been supplied by Von Noorden of Vienna. He suggests that the maintenance diet for a man weighing 70 kilograms (*i.e.* 168 lbs.) should be

about 30 calories per kilogram when resting in bed = 2100 calories;
„ 32–35 calories per kilogram when confined to the house = 2240–2450 calories;
„ 35–40 calories per kilogram when taking light exercise = 2450–2800 calories;
„ 40–45 calories per kilogram when taking moderate physical exercise = 2800–3150 calories;
„ 45–60 calories per kilogram when engaged in severe labour = 3150–4200 calories.

After long consideration I am satisfied that the average business man is amply provided for by 2700 calories of food per day.

How much Protein is Required ?—This is one of the most difficult and contentious problems in the whole range of dietetics. One school maintains that you require at least 125 grams, *i.e.* about 4 ounces, whilst another insists that not more than one half of this, or about 60 grams, is ever required by anyone. The explanation of this serious difference is simple enough, for it is found that nitrogen equilibrium may be maintained on very variable quantities of protein. From the remarks we have already made it will be apparent that the problem is complicated by the fact that proteins can be utilised in the body both as building material and fuel substance. We must therefore decide whether it is feasible, and if so healthy and legitimate, to reduce the supply of protein to the exact amount required for repair purposes, relying entirely on the carbohydrates and fats for providing heat and work, or use the protein for the double purpose. Upon our answer to this question will depend our position as supporters of those who like Chittenden advocate the minimum supply of protein, or those who like Voit adhere to the regulation standard. There is much to be said on both sides of the question.

Voit insists that a full supply of protein is essential to a full measure of health and strength, to maintain a powerful opposition to the incidence of disease, a vigorous digestion, and to impart such stimulation to the system as betokens the possession of vital energy.

Chittenden, on the other hand, argues that no protein can be stored in the tissues, that excess of protein propagates toxins which gain access to the circulation and poison the body, that energy is lost in excreting the surplus protein, that disease is eradicated and the body rendered much healthier on a low supply of protein.

The truth apparently lies midway between the views of the two protagonists, as a careful analysis of the average diet-list will determine, but I am personally convinced that the amount of protein necessary is certainly an individual question which is settled for each by a little experience and reflection. Any person who never takes less than 1 gram of protein per kilogram of his body weight, *i.e.* for a man weighing 10 stones about 2 ounces of protein, is not likely to go far wrong so long as he eats a sufficiency of carbohydrates and fat to supplement it. This is, however, a most important point, as within limits the greater the quantity of fat and carbohydrate supplied along with the protein the less is the latter used for supplying heat and work, and the more therefore is available for tissue-building purposes. This is what is meant when it is stated that fats and carbohydrates are "protein sparers," and the ideal condition would be to find the exact quantity which would allow the body to use all the nitrogen in protein for purposes of tissue repair.

On the above basis the full amount of protein requisite for a day's allowance would be equal to $60 \times 4{\cdot}1 = 246$ calories, and would be found in 12 ounces of beef, 10 ounces of lamb, 8 ounces of mutton, 35 oysters, 12 ounces of salmon—none of which contain much in the way of fat and no carbohydrate at all; 10 ounces of almonds, 3½ pints of milk, 6 ounces of pine kernels, 10 eggs, 8 ounces of cheese—all of which contain either carbohydrates or fats and some of them both.

On the other hand, those who accept the higher standard of 125 grams, over 4 ounces of protein, would require to eat 20 eggs, or about 5 platefuls of cooked meat (20 ounces), in order to assure their day's allowance of protein. Doubtless the man who takes from 80–90 grams, about 3 ounces of protein daily, will not sustain any damage thereby and is certain to be amply catered for.

The Requisite Quantity of Fat and Carbohydrate.—It may be inferred from what has been said that this will depend on the amount of protein consumed. If we allow 80 grams, or 328 calories, of protein and agree that 2700 calories are required daily, that would leave roughly 2370 calories to be supplied by non-nitrogenous food.

So far as the tissues are concerned it would not matter whether we decided to select these either from fat or carbohydrate, but there is a limit to the digestive capacity for the former and indeed for the latter. It is largely, however, a matter of temperament and nationality, the Esquimaux depending largely upon fat and the Hindoos on carbohydrate. There should be little difficulty in the digestion of 100 grams of fat per day, and that would be contained in 5 ounces of butter, and represent 930 calories, leaving 1470 to be provided by carbohydrate. About 14 ounces of sugar, or 370 calories, would fulfil the daily demands of the system for carbohydrate.

Needless to say, these proportions are not accepted by all. Dr. Kellogg of Battle Creek Sanitarium firmly believes in a low-protein fleshless diet constructed as nearly as possible of 10 per cent. protein, 30 per cent. fat, and 60 per cent. carbohydrate, whereas the diet we have been considering has close upon 14 per cent. of protein, more than 30 per cent. fat, and less than 60 per cent. carbohydrate.

CHAPTER V

THE NECESSITY FOR A MIXED AND VARIED DIET

It is almost unnecessary to state that it would hardly be possible to live for any length of time on a combination of pure protein, pure fat, and pure carbohydrate. It would not only be inconvenient but ultimately become decidedly nauseous. The nearest approach to such a combination with which I am acquainted was consummated by a patient of my own who had been living on a pure fruit and nut diet and suffered severely from indigestion and malnutrition. He was unable to take milk, but each day made the following concoction: 4 raw eggs, 1 ounce of olive oil, and 1 lb. of steamed rice. These were carefully mixed up and divided into three meals, and despite the Spartan severity of the diet, proved such satisfactory nutrients that the patient gained weight rapidly.

For natural foods, it would hardly be possible to conceive of a simpler and more effective combination—olive oil being the simplest and purest fat; rice being practically the purest carbohydrate—it only contains 5 per cent. of protein, and no fat; and eggs containing the purest of protein along with a little fat, no carbohydrate, and a large number of protein-like substances containing phosphorus, iron, and a most important body called lecithin, all of the greatest value in administering to the demands of a healthy nervous system.

In time, however, even such a diet came to pall upon the appetite, probably because the patient became too fat upon it, and malnutrition again asserted itself. This is the reason which makes a varied diet an absolute necessity even although one were to supply a full measure of calories per day. Monotony in diet is detrimental to the best interests of the body.

Attempts have been made to live on single-article diets, but these have always been attended with disastrous consequences. I have elsewhere recorded the case of the medical man who partook of two meals each day, each containing only one, although usually a different, article of diet. Beef for lunch, milk for dinner, potatoes for lunch another day, or any other single item with a glass of water appeared on his own testimony to satisfy his requirements both physically and æsthetically. His early demise from a mental ailment was doubtless hastened by his ill-timed experimentation.

Folin has lived for a few days on arrowroot starch and water, and in a similar experiment on the tenth day Hammond was obliged to desist owing to debility and fever. Porridge, baked beans, and wholemeal bread have all been tried as exclusive diets, but as a rule had to be abandoned because of diarrhœa or some digestive disturbance. I knew an athlete who lived for a whole month on bananas and water, and said he was perfectly fit at the end of the time although he had lost weight.

Anyone who has followed with intelligence the statements I have made will see that experimenters along this line are guilty of the crassest folly, and perseverance in such a course demands punishment as certainly as an attempt at suicide. In this country there are few people so ignorant as not to know the dangers attendant upon such dieting, and further still, who are not guided by instinct or reason to a more substantial menu. Hence the futility of the argument that it is essential to eat standard bread to prevent being defrauded of valuable ingredients, all of which can be obtained in a much more satisfactory fashion from other foods. For example, fat can be obtained from butter or delightful margarine and mineral salts from milk, even skim milk, and it is hardly possible to conceive of even the very poorest child being deprived of these humble accompaniments to the much-preferred white bread.

Milk: a Complete Food.—Appropriate food combinations have been attained by experience, and each nation and even district has its own list which fulfils all the nutritive requirements of the body. It will always be found that articles rich in carbohydrate or fat are combined with those containing large quantities of protein—bread and cheese, bread and omelette, bacon and beans, potatoes and beef, or cheese or even milk, being all well-known examples. Few people, however, will stop to think that none of these substances except milk was ever actually intended by Nature as a food and for no other object, and hence it comes that milk is practically the only food which contains all the alimentary principles in anything like the normal proportions. It is indeed the only substance which has any pretensions to be called a complete food, serving as the sole natural nutrient for many months in early life, and many adults have been known to subsist on it alone for years at a time and remain in abounding health and vigour.

Cow's milk is most frequently used, and contains in round figures 87 per cent. of water, 4 per cent. of protein, 4 per cent. of fats, 4·5 per cent. of sugar, and ·5 per cent. of mineral matter. This last ingredient is of great importance, containing as it does a large proportion of phosphates and lime and a small proportion of iron.

Its chief defects are its liability to be contaminated with disease germs and its rather serious constipating qualities. Boiling the milk, which kills the disease germs, only seems to increase the constipating effect, but this can be counteracted to a certain extent by eating wholemeal bread with it. A lunch of 10 ounces of such bread with a pint of skim milk will easily supply, at a cost of twopence, one-third of the nutriment required for the whole day, and this compares favourably with a restaurant lunch costing a shilling or more.

If mixed with equal quantities of cream it is an excellent natural cure for "acid" stomach, or heartburn, which is such a troublesome ailment for those who work in city offices.

For those who are "run down" or suffering from nervous exhaustion nothing can equal the restorative qualities of one tumblerful of hot milk three times a day in addition to the ordinary meals.

Whey is prepared by adding two teaspoonfuls of rennet to one pint and a half of milk heated to 104° F., carefully but thoroughly breaking up the clot which forms, and straining through muslin. It possesses few nutritive properties, and is chiefly used as an agreeable drink, although a whey cure consisting of nothing but whey, fruit, and vegetables is much in vogue for those who have lived too freely.

Cream, butter, butter-milk, "soured" or curdled milk, koumiss (fermented mare's milk), kephyr (fermented cow's milk), and many proprietary foods such as casumen, plasmon, protene, are all derived from milk.

Cheese perhaps is its most important product, however, and those who find it difficult to digest, may either eat it with zwieback after being carefully grated, or try the following excellent preparation. Chop or grate a quarter of a pound of cheese, dissolve a saltspoonful of bicarbonate of potash in a little water, place in a stewpan and gently heat. The cheese will soon dissolve, and may be eaten in this form, or half a pint of milk and a couple of eggs added, carefully stirring all the time. Eaten with zwieback, oatmeal cake, or wholemeal bread, the body will easily be supplied with all the alimentary principles in ample proportions.

Another favourite way of preparing cheese is with macaroni as in the well-known *macaroni au gratin.* Soak 1 ounce of macaroni overnight in cold water until required, then pour off the water. Grate 4 ounces of cheese. Place a layer of grated cheese in the bottom of a well-buttered pie-dish, a little pepper, then a layer of macaroni, and so on alternately, having a layer of cheese on the top. Place in the oven for a few minutes to brown. This, eaten with toast, constitutes a complete food.

Eggs.—Eggs are amongst the most important articles of a mixed diet. An egg is an undeveloped chick, and therefore its constituents are practically those which will build up the living body. The shell consists chiefly of carbonate of lime, the white is almost a pure solution of protein, the yolk, besides protein, contains a large proportion of fat and several highly important substances for building up the nervous system. Amongst them are two very important minerals—phosphorus and iron—both in organic combination. Seven and a half eggs will supply for one day all the iron which the human body requires. Yolk of egg, therefore, is an extremely useful food for anæmic persons.

An egg contains a good deal more nutriment than the same weight of meat, but in different proportions. Despite this, however, an egg is not a complete food, because it contains no carbohydrate material. For this reason eggs ought to be added to rice or other cereals, and in this way a pudding becomes a complete food; in the same way bread and butter eaten with eggs constitutes a complete food. When kept, eggs gradually lose a certain amount of their water, and become lighter. A fresh egg should sink at once in a solution of 2 ounces of salt to a pint of water, but the longer it has been kept, the nearer the surface it will be found. Eggs are easily digested, but it is a mistake to imagine that raw eggs are more easily digested than lightly boiled eggs. Two of the latter should leave the stomach in less than two hours. Fifteen to twenty eggs are equal in value to 2 lbs. of medium fat meat. A few methods of preparing eggs for dietetic purposes may be of some interest.

First: Cream Eggs.—Two eggs should be poached and placed on buttered toast. One ounce of butter melted in the stew-pan, a tablespoonful of cream, and a little pepper and salt. Make this mixture hot and pour it over the poached eggs.

Second: Egg and Spinach Toast.—One pound of well-washed spinach should be cooked in 2 ounces of butter in a double-pan cooker, passed through a fine sieve into a stew-pan, and four well-beaten eggs, with an ounce of grated cheese, added. The mixture should be stirred until it is thick, and then served on toast. Many other dishes of a similar character could be easily prepared, and for one who has to cater for himself they are extremely valuable. This is a favourite dish, highly nourishing and most valuable in anæmia, if the spinach does not disagree, but it is apt to be very irritating to the lower bowel.

Fleshless feeders will find a large selection of similar recipes in *The Food Reformer's Companion* (Miles).

Cereal Preparations.—We have already entered very fully into the characteristics of wheat, the best-known member of the class.

Oats are unquestionably the most nutritious of all the cereals, and contain a fair proportion of all the alimentary principles. It is impossible, however, to use it as the sole article of diet for any length of time, or even with the addition of milk, on account of its tendency to produce skin eruptions due to the irritating qualities of one of its ingredients termed "avenin."

Maize is hardly known in this country except for its preparations of hominy and corn-flour, although toasted corn-flakes bid fair to become as popular as they richly deserve.

Barley is rarely used except as barley water, which, contrary to accepted opinion, contains only a little over a half per cent. of nutriment, the rest being water.

Rice is rich in starch, poor in protein, fat, and mineral matter, but is particularly easy of absorption.

The Pulses.—Beans, peas, lentils and their congeners are in a class by themselves. They are well supplied with protein in the shape of legumin—sometimes called vegetable casein—and contain much mineral matter, especially potash and lime. They have little fat, and hence go well with bacon or pork. They are by no means well digested, as they not only contain a large quantity of cellulose, but their protein is very rich in sulphur, which forms fœtid gases in the lower bowel. In addition, like many nuts they contain an irritant principle which is quite incapable of being tolerated by many people.

Pea-flour is a delicious preparation, rarely seen in the South though frequently used in the North, where it is called pease-meal. It is easily prepared by stirring it up with hot water or hot milk, adding a little sugar or preferably salt, and supping it with alternate mouthfuls either of fresh or butter-milk. Half a pound of pea-flour with a pint and a half of milk would supply all the essential ingredients of a day's food.

The pulses are freely used by fleshless feeders, even although they contain the equivalent of uric acid in goodly quantities. Much of this may, however, be removed by soaking them for from eight to twenty-four hours in water. Miles gives the following recipe for "Kedgeree":

Two ounces of rice, 4 ounces of butter-beans, 1 onion, 1 banana, 1 ounce of butter, a little lemon juice, pepper and salt if required, 1 teaspoonful of curry powder, 2 eggs.

Soak the beans overnight, and cook them in a little water so that they absorb nearly all the water. Cook the rice in the same way. Chop the onion and banana fine, and fry them together in the butter, adding the curry powder and any liquor that may have been strained from the rice and beans. Cook the eggs hard, mince them and add them. Mix all together, make the mixture very hot and serve with toast.

CHAPTER VI

VEGETABLES—FRUITS—NUTS—AND FLESH FOODS

Vegetables.—Vegetables of all kinds are very much more used in France as dietetic agencies than they are in this country. The average British cook appears to have absolutely no conception of the method of cooking vegetables ; the ordinary method of soaking them in water and boiling them for a longer or shorter period, then discarding the water and serving up the mass of fibrous tissue which is left, is simply a means of wasting the only valuable part of the vegetable.

Most people have a very fair idea that the valuable ingredient of all vegetable matter is the mineral salts which it contains. Up till quite recently the rôle played by these mineral salts was by no means well understood. It is now known, however, that a deficiency of mineral matter may produce the most serious disease. A century ago, when England was dependent upon sailing vessels for a means of communication with other countries, scurvy was a very well-known disease. It was known to be produced by eating salt meat, and it could be easily prevented by a daily supply of fresh vegetables. As these, however, were not forthcoming on a long voyage, lemon juice containing valuable salts of potash in a very active form was substituted, and even to-day no British ship is permitted by the Board of Trade to travel without a large supply of this substance. Another disease which is not familiar in this country, but is very common amongst sailors in the East, who subsist largely upon rice, is called beri-beri. We have already referred to the fact that it is due entirely to eating rice from which the husk has been removed, and this extra coating of the rice

TABLE SHOWING THE COMPOSITION OF VEGETABLES

	Water.	Dry Matter.	Crude Protein.	Starch.	Cellulose.	
Potatoes	75	25	2·2 80 per cent. lost when soaked in water	19·1	·6	Ash, $\frac{3}{4}$ Potash ,, $\frac{1}{6}$ Phosphoric Acid
Carrots	86·7	14	·5	10·1 chiefly Sugar	1·5	...
Parsnips	80·1	19	1·4	3 per cent. of Sugar	1·3	Ash, $\frac{1}{3}$ Potash ,, $\frac{1}{4}$ Phosphoric Acid
Cabbage	90	10	2	5·8	1·1	Easily digested raw
Cauliflower	About	the same as	Cabbage	...	...	...
Beets	Like	Carrots	...	...	...	...
Cucumber	96	4	A flavour	agent chiefly	·5	...
Lettuce	93	7	1·5	2·5 Starch and Sugar	·5	Contains good deal of Iron. A sedative
Onions	89·1	10	1·5	10·1 and essential oils	2·0	A stimulant to the bowel
Spinach	90	10	2·1	·3	1·1	...
Melons	92	8	·7	7·6 chiefly Sugars	...	...
Tomatoes	91·9	7	1·3	4 per cent. Sugars	...	...
Celery	93·4	6	1·4	3·3	·9	Said to cure Rheumatism
Rhubarb	94·6	5	·7	2·3	1·1	Said to cause Rheumatism

grain contains a kind of phosphorus which is of immense value in the human economy. It has been established by experimental feeding of fowls with the same dry polished rice that a similar disease can be originated in them, and this can be quite easily cured by the addition of yeast, or indeed by adding the husks which have been discarded in the polishing of the rice.

These and many other facts well known to scientific men are evidence that the mineral salts contained in organic form in living vital association with vegetable material are of infinitely more value than those to be found on the druggists' shelves. Now boiling these vegetables dissolves out all those mineral salts, and the mess which is left is simply an inducement to indigestion. Hence to conserve those valuable mineral salts, vegetables should always be steamed, and as this is by no means an easy process for the ordinary cook, a special vessel consisting of one pan within another is utilised for preparing vegetables for the table. In lieu of these processes, ordinary vegetable soup is of immense value, containing as it does all the vital mineral salts so essential for the growth and repair of the body. Probably few people know that spinach is a much more valuable source of iron even than Blaud's pills, and it is a great pity that an agreeable method of preparation of this substance for the table should not be in vogue. Next to spinach the yolk of egg contains more iron than other food known.

Fruits.—These consist chiefly of water agreeably flavoured. They may be divided into the food fruits and the flavour fruits, the former consisting of figs, dates, prunes, raisins. Dried figs are more nourishing than an equal weight of bread, and six ounces with a pint of milk make a satisfying meal. Milk and dates, half a pint of the one and half a pound of the other, constitute another alternative meal.

Nuts.—Nuts can hardly be overrated as articles of diet, though doubtless this statement will appear strange to the individual who eats a few after his dinner and supper and in all probability suffers from severe indigestion therefrom. Nevertheless, it is true that bulk for

TABLE SHOWING THE COMPOSITION OF FRUIT

	Water.	Protein.	Sugar.	Acid.	Kind, Chiefly.	
Apples	85	·5	10·75	·92	Malic	... ...
,, Sweet	86	·5	11·75	·20	,,	... ...
Blackberries	88·9	·9	11·5	·75	,,	... ...
Strawberries	90·8	·95	5·36	1·4	,,	Antiseptic
Lemons	84	·95	2	7·2	Citric	... ...
Oranges	85	1·10	10	1·3	,,	... ...
Grapes	83	1	10–16	1·2–5	Tartaric	... ...
Currants	86	...	1·96	5·8	,,	... ...
Grape Fruit	86	...	10	2·5	Citric	... ...
Peaches	88	...	10	·5	...	A little Prussic Acid
Plums	78	·5	22	1	...	Prunes (Dried Plums), laxative
Figs (dried)	20	5·5	62·8	...	...	Mildly laxative
Dates (dried)	20·8	4·4	65·7	...	...	... ...
Prunes (dried)	26·4	2·4	66·2	...	...	... ...
Raisins	14	2·5	74·7	...	...	... ...

bulk they contain a greater amount of nutriment than any other food substance we know.

Almonds are among the most acceptable members of the class, and contain a highly digestible fat which constitutes 53 per cent. of the total weight of the nut; 21 per cent. of a protein much more soluble in the digestive fluids than the gluten of wheat, and which is also capable of dissolving or helping in the solution of the fat; and in addition about 10 per cent. of carbohydrate with mineral matter. From them can be prepared the most delicious butter of a highly nourishing character, and which by the addition of a little water can be made into a very efficient substitute for milk. Their great objection—and this they share with most nuts—is their large content of cellulose, which is of a particularly dense and unyielding character. For this reason, when using them as a food, either the most careful mastication must be practised—and this is not always possible for adults—or else the nut must be passed through a nut mill and so prepared for consumption. This need not be done every day. Once or twice a week at most a quantity can be got ready and stored in a glass vessel, which is brought to table like a butter-dish or the sugar-bowl. Hovis, wholemeal, or Maltweat bread spread with butter, with a thin layer of honey and a powdering of ground nuts, constitutes a pleasant mouthful of more than tasty character, because of its intensely nourishing and even digestible quality.

Walnuts may be used in this fashion, but it should be known that they possess an acrid property which is liable to disagree, setting up colic in some people. I have discovered that this is in the husk outside the kernel, and when it is peeled off the bad effects disappear. Nuts should never be eaten between meals, and it is most unwise to partake of them at the end of an otherwise sufficient meal. When used by vegetarians they are eaten in quantities amounting to about four or five ounces a day, and this is sufficient to provide them with most of the protein which they require. Chestnuts may be used alone, as they contain a fairly large proportion of

Table showing the Composition of Nuts

(From Hutchison)

	Water.	Protein.	Fat.	Carbohydrates.	Cellulose.	Mineral Matter.
Chestnuts (fresh)	38·5	6·6	8	45·2		1·7
,, (dried)	5·8	10·1	10	71·4		2·7
Walnuts (fresh)	44·5	12	31·6	9·4	·8	1·7
,, (dried)	4·6	15·6	62·6	7·4	7·8	2
Filberts and Hazels (fresh)	48	8	28·5	11·5	2·5	1·5
,, ,, (dried)	3·7	14·9	66·4	9·7	3·2	1·8
Sweet Almonds	6	24	54	10	3	3
Pine Kernels	7·4	21·7	51·1	14	2·5	3·3
Cocoa Nut (fleshy part)	46·6	5·2	35·9	8·4	2·9	1
,, (dried)	3·5	6	57·4	31·8		1·3
,, (milk)	90·3	·5	...	9		...

carbohydrate. The peasantry of France use them freely in the following fashion. After the outside shell is removed they are blanched and steamed, and eaten with a little salt and milk. They are also sometimes ground into meal and made into flat cakes.

Flesh Foods.—It is convenient to apply this description to all those substances usually included under the definition animal food, although strictly speaking the latter term likewise embraces eggs, milk, and its products gelatine, beef-teas, beef-juices, and beef extracts. Flesh foods are still the most favoured articles of diet for supplying the body with building material or protein, and herein lies a great danger, because on account of their attractive character there is a tendency to consume considerably more than is required for the purpose of nutrition. Numbers of the middle classes eat 3½ lbs. of meat or its allies per head per week, while those of the upper classes eat close upon 6 lbs.

Even this does not constitute us the greatest meat-eating nation of the world, this distinction belonging to Australia, and it is probably more than a mere coincidence that this country has also the reputation of consuming per head of the population more pills and potions for the relief of constipation than any other country in the world. The reason is not far to seek, for flesh, which is really muscular tissue and consists almost entirely of protein and water, is almost entirely absorbed, and thus leaves no residue for the bowel to act upon.

As most people know, meat should not be consumed for a day or two after the animal has been killed, unless it can be procured immediately after the animal has been slaughtered, and before what is called *rigor-mortis* sets in. During this time, which commences at a variable period after death, the flesh is decidedly tough, but when it passes away certain acids develop—chiefly sarcolactic acid—which render the flesh substance much more soft and easily digested. Various methods for imitating this process are in vogue; *e.g.* soaking beef in vinegar and water, rubbing lemon juice over veal before frying or stewing, and eating lamb with mint sauce. No doubt for a similar reason the use of vinegar favours the digestibility of the hard muscles of the crab and lobster.

Contrary to popular opinion, cooking reduces the digestibility of meat, raw meat being digested in about two hours, whilst roasted meat takes quite four hours for full digestion. For a weak stomach no more digestible substance could be found than the juice of a tender steak, and this is easily obtained by scraping with a blunt instrument such as the edge of a table-knife in the direction parallel to the course of the muscular fibre. This spreads the fibres and ensures the collection of the nutrient myosin or pulpy substance of the muscle, which can be seasoned with a little pepper, celery, or salt, and served either as a sandwich or stirred into broth.

Just as the feeding of an animal influences the flavour of its flesh, so the kind of meat we eat is not without its influence on the character of the individual. Compare the stolid, tolerant, beef-fed Englishman with the argumentative and opinionated porridge-loving Scot and the restless vivacity of the potato-fed Hibernian. Kean, the famous actor, carried the matter too far when he varied the food for the part he had to play, choosing pork for tyrants, beef for murderers, and mutton for lovers.

The most easily digested animal foods are soft-cooked eggs, sweetbreads, and boiled white fish, a liberal helping of either of these being disposed of by the stomach in something like two hours, whilst roast goose, pork, salmon, herring, and mackerel and other fat-containing substances may linger therein for more than double that time.

On the whole, however, fish is more easily digested than meat, and in any case is an agreeable change, providing a little more gelatine, a little less protein, and distinctly fewer stimulating extractives than meat. The fallacy that because fish contains phosphorus it is an excellent brain food has been exploded long ago. There are few foods which do not contain some proportion of phosphorus, and fish are by no means more noteworthy in this respect than others. But in any case the nutrition or functioning of the brain is not specially influenced by the administration of phosphorus in any form. Hence fish is no more likely to encourage thought than any easily digested or assimilated food may do by contributing to the growth and nourishment of the body.

Meat-Juice.—It is not at all a simple matter to obtain muscle protein or myosin apart from its fibres of connective tissues, &c., and the most popular of beef-juices are by no means so nourishing as they pretend to be, not comparing for a single moment with the nutriment contained in white of egg. The simplest homely method of preparing meat-juice is to cut up the meat into very small sections, soak these for a few hours in water with a little salt, and then squeeze the squares through a piece of muslin. The more elaborate process of first grinding the meat with a heavy pestle and then rubbing it through a fine wire sieve before soaking and straining through muslin is rewarded by a slightly higher proportion of protein.

Many meat-juices on the market are prepared by extraction under strong pressure and subsequent evaporation *in vacuo*, and contain from 15 to 30 or 40 per cent. of protein. These must not be confused with meat extracts, which in common with beef-tea contain very little protein or any other nutrient, and are mostly of value because of their stimulating extractives. They are, however, decidedly cheaper than home-made beef-tea as usually made, and distinctly more valuable. A special claim has been advanced by the proprietors of Bovril that its stimulating properties not only conduce to the better digestion of all protein foods, but also ensures that they are actually built up into the tissues themselves in a proportion from ten to thirty times greater than the weight of the dry Bovril administered. Whatever truth there may be in this statement is obviously of limited application, because we have seen that the power of the body for storing up nitrogen is very slight. In any case, no meat extract can contain anything which is not to be found in meat itself, so that its beneficial properties are not peculiar and may be found quite as well in the ordinary flesh foods of popular acceptation.

CHAPTER VII

THE SELECTION OF A SUITABLE DIET

No good purpose would be served by entering into more detail on the question of nutrients, and doubtless the average man will be better satisfied to know how to apply in a practical manner the information he has already acquired. Fortunately perhaps for himself, Nature has already taken this matter out of his hands by decreeing that experience guided by a healthy appetite is the most convenient method for selecting the most appropriate articles of diet. Each nation has solved this problem for itself in very much the same way, and the results are of the most interesting character.

Volumes have been written upon this subject, and its study is most entrancing, as it is only natural to associate the success or failure of a nation with the food which supplies or fails to supply its energy and vitality. It is difficult, however, to draw any practical conclusions in connection with this question without special reference to climate and occupation, and it is found that a low temperature and hard physical labour necessitate a greatly increased quantity of food. With an indoors occupation where the temperature is hardly less than the average out-of-doors summer temperature, the requirement of food will not vary much. Where, however, the indoor worker perspires very freely, then more food will be necessary to compensate for the large amount of heat carried off by evaporation of the perspiration.

Size and weight are of course important in determining the quantity of food, and for this reason the average woman eats about 20 per cent. less than the average man, whilst a child from five to ten years eats about half the quantity of the average man.

From the theoretical point of view, excessive labour should create a greater demand for the so-called energy-producing foods, fats, and carbohydrates, but experience teaches that proteins are called for in proportionate quantities. During the first week of a holiday and after a protracted illness there is a greater demand for proteins in the form of animal food, but this is soon gratified as indicated by the appetite returning to the normal. The greater indeed the amount of muscular exertion, the greater is the quantity of food required.

Mental work, on the other hand, does not seriously encroach upon the reserves, as is evidenced by the fact that it appears to have very little effect in increasing the excretion of waste matters. Although it is well to recognise that there is no special brain food *per se*, nevertheless brain workers require an easily digested ration with a slightly augmented proportion of protein.

The scientific method of measuring the amount of food required is not of much value to the man at the dining-table. It is sufficient to state that the average business man pursuing a more or less sedentary occupation requires daily about 3 ounces of protein, 2 ounces of fat, and 12 ounces of carbohydrates. These quantities are of course water-free, and do not take into account the fluid originally contained in the food stuff or added during the process of cooking. Roughly speaking, this is about 75 per cent. more, so that such an individual would eat in the course of a day a little over 4 lbs. of food in the condition in which it is served at the dining-table. Doubtless this is an eye-opener for many people, especially those who are in the habit of thinking and saying that they hardly eat anything at all, but it is quite a usual matter for a lusty young fellow to eat daily from 7 to 8 lbs. of food as served in the ordinary course at meal-times.

Specimen Menu for a Day.—The following is a specimen of the food actually consumed in a day by a fairly active professional man, weighing 10 stone 7 lbs., and no doubt will be more acceptable than many pages of instructions :

Breakfast, 8.15 a.m.

	Ounces.
Banana (one good-sized)	3½
Cooked cereal (3 tablespoonfuls)	¾
Milk (a good-sized teacupful)	6
Bacon (one rasher)	2
Egg (one good-sized)	1¼
Sugar (two lumps)	¼
Marmalade (large dessert-spoonful)	¼
Butter (four little balls)	½
Bread (two moderate slices)	4
Cream (two teaspoonfuls)	¼
Weak China tea (one small cup)	...
Total	18¾

Dinner, 1.15 p.m.

	Ounces.
Soup, tomato (one teacupful)	4¾
Bread (half a slice)	1
Meat (beef, a small helping)	4
Potato (one good-sized)	3
Cauliflower (two large tablespoonfuls)	3
Pudding (sago, a good helping)	3½
Prunes, stewed (seven or eight)	3¾
Cheese (piece 2 × 1 × 1 inches)	¼
Biscuit (one)	¼
Total	23¼

Tea, 5 p.m.

	Ounces.
China tea, weak (two small cups)	...
Sugar (four lumps)	½
Cream (two teaspoonfuls)	¼
Total	¾

Supper, 7 p.m.

	Ounces.
Bread (two moderate slices)	4
Butter (four little balls)	½
Fish (small helping)	5
Apples (stewed, two)	6
Total	15½

This makes a total of 58½ ounces, or nearly 4 lbs. of food. Probably most business men consume a great deal more than this without obtaining much additional energy for their daily work, and a careful scrutiny of the amounts will reveal items which look ridiculously attenuated.

But although the body is able to accommodate itself to one or more occasional heavy meals, it is never wise regularly to eat even a little more than is essential to supply its requirements. The secret of successful nutrition is to vary the quantity and character of the food according to the amount of work. After hard muscular exertion a proportionately greater quantity of cereal such as rice, sago, or tapioca pudding, or even beans, peas, and lentils, may be consumed, whereas during a long series of sedentary working days, sweets, pastries, and most starchy foods must be reduced to a minimum, and easily digested protein foods such as chicken and white fish be selected.

During cold weather, pork, duck, eel, salmon, mullet, and other fatty fish, with an extra supply of bacon and butter, will best provide the caloric necessities, whilst during the heat of summer fatty foods of all kinds should be reduced to a minimum, and fruits and vegetables substituted.

Some kind of raw food should be eaten every day, if not at every meal, and for this purpose fruits in the ordinary form, or with vegetables in salads, will be found most convenient. To encourage mastication, some dry food such as Force, Triscuit, Grape Nuts, biscuit, or zwieback should be eaten at each meal. Not more than half a pint of fluid should be drunk, preferably in sips at the close of each meal, with two cups of weak China tea unaccompanied by food in the afternoon, and half a pint of hot water first thing in the morning and last thing at night.

Where it is necessary to economise time in the middle of the day, lunch may be made to consist of a milk pudding with some stewed fruit, and then a typical English dinner of soup, fish, joint, sweets, bread, cheese, and dessert may be indulged in not later than 7 P.M. It will be noted that the detailed menu provides for mid-day dinner with one item of animal food, whilst supper contains the other. This is intended for those who have leisure to spare for the digestion of such a meal, but those who are not compelled to use their muscles much would be well advised to exclude the animal food in the evening, or at least substitute an egg.

Many persons over middle age will find that they are incapable of eating even as much as is mentioned in the specimen dietary, whereas younger men, especially those who indulge freely in exercise, may be able safely to eat quite twice as much. If consistent over-eating be eschewed at all times, and all sources of toxæmia be eliminated, then such misadventures as a gouty old age, rheumatism, and so-called "chill" on the liver need never be experienced.

CHAPTER VIII

FOOD FADS OF VARIOUS KINDS

It will be observed that in my endeavour to reply to the simple question of "What must I eat?" I have adhered closely to the conventional system of mixed feeding practised in this and most civilised countries. This must not be taken as an indication that I have no sympathy with those who for one reason or another consider it advisable to restrict themselves to some other system. On the contrary, I am satisfied that it is not only perfectly possible to live on a system which includes no flesh food whatsoever, but that many people will find it advantageous so to do.

But a simple question demands a simple answer, although the resources of our language are so infinite that simplicity in rejoinder is the exception and not the rule. Nor could it be very well otherwise unless the conditions were specifically defined, for there are at present more than a dozen systems of diet before the public, each one claiming to be the only infallible way to perfect health. Yet no two are in perfect agreement, and most of them are hopelessly at variance with one another.

The vegetarian demands that nothing be eaten but products of the vegetable kingdom, although he recognises with some degree of reluctance that the ovo-lacto-vegetarians must be admitted into the fold, while the latter sect is broad-minded enough to view with favour the man who adds the flesh of fish—a cold-blooded animal—to his menu.

The low-protein advocate has no special predilections on the question of quality, but rigidly restricts the quantity of his proteins, whether animal or vegetable, *i.e.* fish, flesh, fowl, milk, eggs, cheese, peas, beans, or lentils, and does not despise a good cigar or even a glass of wine.

The uric-acid-free dietist, on the other hand, views with horror fish, flesh, fowl, peas, beans, and lentils, tea, coffee, cocoa, meat-soups, beef-teas, and gravies, and regards with grave suspicion sundry other foods supposed to contain uric acid, *e.g.* oatmeal and wholemeal bread, asparagus, and mushrooms, on the plea that all those substances because of their content of uric acid are rank poisons to the body. Yet he eats very considerable quantities of starchy and fatty foods, which are largely proscribed by the individual who favours the doctrine of hyper-pyræmia which suggests that most diseases are the outcome of even a very small modicum of these energy-producing foods.

Milk might easily be held to be above suspicion as the primary and elemental food of all mankind and many of the lower animals, but the amount of lime it contains is considered dangerous by a small sect which, for somewhat similar reasons, is closely allied to the salt-free cranks. This last sect not only never adds salt to its food, but even places its ban upon perfectly wholesome foods containing a little common salt, and thus places itself in opposition to those who use sea water as a cure for most of the ills that flesh is heir to. The mention of water directs our attention to those who never drink a drop of fluid at any of their meals, and little, if any, at other times.

Yeast is looked upon with abhorrence by many who do not otherwise object to cooked food, whilst the "raw-fooders" profess to eat food in an unfired condition, although they do not despise the thermal rays emanating from electricity as a means of making this food more attractive. The curdled-milk cult has all but died a natural death, although "chewers" are still to the fore, but the no-breakfast plan has recently retired in favour of the fasting fad, which only requires steady perseverance to exterminate all who disagree with any of the methods already mentioned.

Is it any wonder that the plain man, the man who asks a straight question and expects a straight answer, should be left stranded on the verge of despair ? He is hardly in better case than the would-be religious devotee in search of the correct sect amongst the more than two hundred religious bodies in this country. And yet he does not cease to eat any more than the wise man ceases to worship, although he, at any rate, has solved his problem by recognising the common ground which is sacred to all the religious sects, that " actions speak louder than words."

Is it possible to find an underlying principle of action which might be applied in the case of diet of such universal application that no simple member of any of the sects can with any degree of assurance find it in his heart to object to it ? The reply to this question is of course conditional on the querist being a fairly healthy individual, and not suffering from any gross form of disease, as, for instance, diabetes, which requires a special form of dieting. The answer to the question, therefore, is that the healthy man can live on any system of diet by attention to moderation and regularity, but the unhealthy man must look to the dietetic expert—not the dietetic faddist—to guide him in the selection of the best system or kind of foods to suit his individual case. All old men attribute their longevity to great moderation in diet, and especially to a minimum allowance of flesh food, the great stimulating properties of which are not sufficiently recognised.

The one thing upon which all these sects agree is the diminished amount of food, and so the only conception which appears to unite them is the fundamental doctrine of moderation, which has not only been taught from time immemorial, but is actually practised by all sensible men at the present time. In this connection Abernethy's famous prescription to " live on sixpence a day and earn it "—by muscular exercise, I presume—may be recalled. His original advice to a wealthy patient suffering from indigestion was to steal a horse, so that the incarceration which would be the outcome of this exploit would compel a parsimonious regimen and diet. Cyrus, the creator of the Persian Empire, subsisted from early childhood on the simplest and plainest diet of vegetable food and water, whilst his soldiers adhered to the same rigorous fare. Edison tells us that for two months he lived on 12 ounces of food per day, taking absolutely no exercise and retaining his weight of 185 lbs. Sidney Smith, who in the evening of his days confessed to suffering from "seven distinct diseases," was a victim of overeating, and declared that he "never saw any gentleman who ate and drank as little as was reasonable."

One must therefore select the system which pleases and suits him best, practise it with the greatest moderation, and he need have no qualms of conscience that the nutrition of his body will suffer in any serious degree.

Idiosyncrasy in Diet.—It would hardly be fair to devote much more time or space to this object, especially as I have dealt with it most exhaustively[1] elsewhere, but, from their popularity and importance, one or two of the systems demand a little more consideration. I am specially thinking of vegetarianism, and the "uric-acid-free" diet so-called, but before referring to them more particularly it will be profitable to direct our attention to a question which may very well in some measure be the explanation of their existence, viz. idiosyncrasy in diet.

Doubtless this is also the origin of the expression that one man's food is another man's poison. We are all acquainted with people who dare not eat oysters, crabs, shell-fish, strawberries, raspberries, or other fruits, without producing nettlerash. It is less usual, however, to find that honey is provocative of vomiting and diarrhœa, but I number among my patients one case of the kind, and many such are on record. Some people indeed are so susceptible to its action, that even a small poultice of honey on the skin will produce these untoward effects.

There is a well-known case of a Spaniard who could not eat meat without vomiting, a woman in whom nutmeg always produced the same effect, and there are many

[1] See *Modern Theories of Diet*, by Alexander Bryce.

people who cannot taste the least scrap of sugar on account of the violent sickness following its use. Haen always had convulsions after eating half a dozen strawberries, and Gould mentions a family in whom the male members exhibit symptoms of poisoning after eating the same fruit, while, strange to say, the female members are exempt. A little boy of this family was killed by eating a single strawberry.

A case is recorded of a woman in whom vinegar—a gentle styptic—always produced hæmorrhage, of a man who always vomited after drinking coffee, and another in whom the slightest dose of manna had a similar effect.

Julia, the wife of Frederick, King of Naples, had such an aversion to meat that she could not carry it to her mouth without fainting, and the anatomist Gavard was unable to eat apples without convulsions and vomiting. Almonds often produce a scarlet rash on the face.

Of all foods, perhaps the one which most frequently gives rise to trouble is the egg. Swelling of the lips, purple spots on the face, vomiting, syncope, and many other alarming symptoms are described by medical writers as following the ingestion of an egg. Sir Morell Mackenzie gave a striking example of idiosyncrasy to eggs transmitted through four generations. The case is far too long to quote in all its details, but was remarkable in that even although the egg was put into coffee, quite unknown to the partaker thereof, it was followed by the most remarkable symptoms. The eye was swollen and wild, the face crimson, the throat contracted and painful—the whole appearance approximating closely to that observed in apoplexy.

Hutchinson speaks of an M.P. who dared not take parsley because sickness and pain in the abdomen, swelling of the tongue and lips, and blueness of the face always supervened quickly thereafter.

Another man could not eat rice in any shape or form without extreme distress, spasmodic asthma being the most violent symptom. On one occasion he took lunch with a friend in chambers, only partaking of bread, cheese, and a little beer. Shortly thereafter he was seized with the usual symptoms of rice poisoning, and it was then discovered that a few grains of rice had been put into each bottle of beer for the purpose of exciting a secondary fermentation.

Figs sometimes cause the most unpleasant itching of the mouth and throat, and split peas have been known to cause the same phenomena in addition to exciting a running of the nose and eyes. Nettlerash has often been excited by eating veal, whilst chocolate in any form always produced sneezing in another case. "Raw-fooders" will doubtless stand aghast at the suggestion of uncooked fruit producing asthma in the case of a lady, cooked fruit inciting no deleterious effects whatever.

The most remarkable case of food idiosyncrasy known to science, however, is that of David Waller, who lived about the year 1780. To him wheaten flour in any form proved to be a noxious poison. He was accustomed to say that of two equal quantities of tartar emetic and flour, although the dose of the former did not exceed that usually prescribed by a medical man, he would much prefer to swallow the tartar emetic than the flour. In two minutes or thereby after partaking of the flour in any form he would have been attacked by a painful itching all over the body, accompanied by violent colic and sickness and continuous vomiting ten times as distressing as that occasioned by tartar emetic. In about ten minutes the itching would be greatly intensified, spreading over the whole surface of his body, continuing for two days with intolerable violence, and lasting for ten days in all. During the last seven days of this period his lungs were seriously affected, he coughed and expectorated vast quantities of phlegm, and really resembled a patient in the last stage of consumption. The odour of wheat sufficed to produce the same distressing symptoms, though in a lesser degree, and for this reason he was in the habit of carrying camphor in his pocket, and as an additional safeguard he practised snuffing. It was only in this manner that life was at all tolerable and he was able to escape from the disastrous effects of the practically ubiquitous wheat.

CHAPTER IX

SUSPICIOUS FOODS AND POPULAR BEVERAGES

Suspicious or Deleterious Foods.—It would be quite easy to supplement our list of cases exhibiting marked idiosyncrasy to one or other kind of food, but enough has been said to serve our purpose. It is judicious, however, to look with some degree of suspicion on certain foods and food substances and to make diligent inquiries as to their source.

For some reason, not altogether explained by Metchnikoff's theory of microbes on their exterior or poisonous fertilisers in their interior, fruits of various classes head the list. Bananas, cherries, melons, prunes, raspberries, oranges, grape-fruit, peaches, plums, apricots, and apples may all in their turn give rise to poisonous symptoms.

Amongst vegetables, in addition to those already mentioned, potatoes, turnips, radishes, onions, cabbage, sage, spinach, and asparagus have been known to excite gastro-intestinal irritation; and onions and spinach, on account of their irritant properties, are frequently used as laxatives by certain individuals.

Oysters, even when not contaminated with typhoid germs, lobsters, crabs, salmon, cockles, and mussels are deservedly classed amongst the indigestibles by large numbers of people, and all excepting salmon are negligible sources of food supply. Like mushrooms they should only be looked upon in the light of flavouring agents.

Cheese may contain tyrotoxicon, a poisonous product with effects like cholera, and beans always contain an irritant principle which can only be extracted from them by most careful soaking.

In countries where rye is a staple article of diet, epidemics of a deadly nervous disorder called ergotism, due to the growth of the fungus ergot on the rye plant, are not unknown. Lathyrism is another disease, usually however confined to animals, caused by the consumption of a plant allied to the bean and containing a bitter toxic principle. We have already mentioned the incidence of beri-beri in rice-feeders; and pellagra, which is now endemic in the United States, is attributed to the consumption of maize.

Nuts of all kinds, but especially peanuts and walnuts, possess, in their kernels or the thin skin covering the kernel, an irritating substance which gives rise to severe colic in many people, and is quite unable to be tolerated by others.

The eating of flesh is regarded with extreme horror by vegetarians chiefly because of its tendency to originate disease in the body of the consumer, but in this country at any rate there is less evidence of its capacity to communicate disease directly, than there is amongst fleshless food substances. It is true that epidemics of trichinosis were until recently fairly common in Germany, due to eating "measley" pork, but the few cases recorded in this country in the last half-century have all been imported from abroad. The allegation that cancer, rheumatism, and other diseases are attributable to flesh consumption is disproved by careful investigation.

Popular Beverages.—Well may the wise man pray, "Feed me with food convenient for me," for it is fairly safe to say that no single article of diet has emerged scathless from the critical survey of the dietetic reformer or his antagonist. We may even extend this indictment to the various fluids which the ingenuity of mankind has devised for quenching its thirst. However vigorously the scientist may promulgate the view that alcohol is strictly speaking a food, there can no longer be any doubt that it is in reality a tissue poison of the first order, which manifests its narcotising and finally degenerative action chiefly on the nervous system. It has indeed no claim to be termed a stimulant, being in plain terms only a drug with a temporary exhilarating effect followed thereafter by a long period of depression. The conclusion of practically all thoughtful medical men is that it is quite unnecessary in health, and if not of doubtful value in the treatment of disease, is at least capable of being replaced in most instances by less dangerous substances.

The virulent antipathy displayed by fanatical temperance reformers by reason of its use as a beverage or even as a medicine is quite misplaced, if they are themselves devotees of the "cup that cheers yet not inebriates." For tea, coffee, and cocoa all owe their undoubtedly stimulating and refreshing effects to their contained active principle, viz. caffeine, or one of its allies, a drug which can be procured from any chemist's shop and is to be found on the shelves of every dispensing physician. When used in moderation the valuable stimulating effects of each of these beverages is unquestionable, although it is undoubted that just as a certain percentage of the population is poisoned by the smallest quantity of alcohol, many people display a decided idiosyncrasy for tea, coffee, or cocoa. Some indeed exhibit a condition of chronic intoxication manifested by palpitation, breathlessness, nervousness, headache, indigestion, and in particular neuralgia and mental and physical depression.

It is sheer nonsense to state that a stimulating effect can be produced without a corresponding period of after depression, for action in this respect is always equal to the reaction produced, and it is certain that the injudicious use of any of these beverages is liable to be followed by the development of a craving no whit less tolerable than that for alcohol. This can be quite easily demonstrated, in an ordinary tea or coffee drinker at any rate, by ceasing to partake for a day or two, when the genesis of an unbearable headache will not fail to convince him that he has been under the influence of a drug. At least if it should do so, he need only resume his accustomed potations, when his headache will vanish like magic, and proclaim aloud that he has been cured by "a hair of the dog which bit him."

It is quite certain, however, that in the average person the use of tea, coffee, or cocoa may be continued in moderation for a lifetime without inducing any degenerative effect on the nervous system, at any rate of a character analogous or comparable with that so well known to follow even the moderate use of alcohol.

CHAPTER X

VEGETARIANISM

We can now apply ourselves with some degree of confidence to a brief consideration of some of the problems associated with vegetarianism. It may be said at once that it has now been established beyond the possibility of doubt that many people in this and every country of the world can safely and with advantage abstain from flesh foods in every form. This is, however, a very different thing from saying that the ordinary mixed diet of this and every civilised country in the world is disease-producing and dangerous to a degree, and that the only rational, and indeed the natural, diet of man is that which can be obtained without circumventing the death of any animal.

This is unquestionably the proposition which was enunciated when first the propagandism was mooted. There have probably indeed existed in all ages of the world's history, as there exist to-day, whole communities and nations which have contrived to live without animal food of any kind, but in the main these people solved their dietetic problem very much as civilised people have done, viz. by evolution and experience. This is essentially different to the attitude of the classical vegetarian who, not content with having discovered the diet which has peculiar virtues in his own case, stoutly asseverates that because it suits him, it must therefore, and for a similar reason, suit every other person. Unquestionably his position would be incontestable were he able to demonstrate that in any particular respect his diet was superior to the mixed one. If, for instance, he could prove that it produced less disease, was more conducive to longevity, more agreeable, or more economical, built up more powerful bodies or contained less poison-producing substances than a diet containing flesh food, then he would have powerful reasons for his contention that a fleshless regimen is the only suitable and correct one.

It has been my privilege to be closely associated with vegetarians for many years, and I have hence been able to make a most careful investigation into their claims, but I am bound to admit I have not yet been satisfied that in any of the points above-mentioned they have been able to establish their position on a firm basis. On those points which are merely matters of opinion they have a perfect right to their own views, but where they appeal to science or experience they must not be offended if one is able to bring forward evidence which clearly refutes their arguments.

So far as I have been able to judge, there is no irrefutable argument in favour of adopting a fleshless diet excepting that of its suitability for the individual, and with this I have no quarrel. I have the highest respect for the man who having adopted a vegetarian diet is able to build up a strong and powerful body therefrom, and he himself is in possession of an absolutely infallible argument in favour of vegetarianism in his own body. I am perfectly satisfied that many such individuals exist in this and other countries, because we have indisputable evidence of their prowess in the athletic world, in the business world, and in the domain of literature. I am equally satisfied that many who now adhere to the mixed diet would be infinitely improved in health and vigour were they to adopt a reasonable fleshless regimen. But I cannot agree with the statement of those who assert that it would be advantageous for all to adopt a fleshless diet, because my experience of vegetarians of all classes has not convinced me that they are stronger, healthier, longer lived, better tempered, or in any degree better than the average mixed feeder, who makes moderation and regularity the watchwords of his whole life.

I would earnestly counsel any who may be desirous of experimenting with a fleshless regimen to reject without hesitation the suggestion that they should restrict themselves to a pure vegetarian system. In India it has been abundantly proved that "pure vegetarianism as practised by the Bengalis and Beharis was totally unsuited to their nutritive requirements, detrimental to their health, annihilated every spark of ambitious desire, and degraded huge masses of the people almost to the level of the brutes."[1] This is the observation of one whose investigations were made with a view to discovering the most suitable diet for the prisoners confined in Bengal gaols.

I am quite prepared to admit that given a careful and proper selection of food, with careful and appropriate preparation thereof, it is possible to attain a degree of health and vigour quite up to the average. But amongst the pure vegetarians, or fruitarians as they are called in this country, such a result is exceptional, and in too many instances disastrous consequences ensue upon an attempt to live on such a regimen.

It is quite otherwise, however, with those who are not averse to the admission of animal protein in the shape of eggs and milk and its products into their diet. I am personally acquainted with many who have adopted such a regimen, and I frankly confess that in the main their health and vigour is quite up to that of the average mixed feeder, although, except in a few isolated cases, they are not conspicuous for vitality, "energy" in the fullest sense of the word, initiative, or outstanding merit in the ordinary affairs of life. I hope I may not be misunderstood in this connection, for I have every reason to be grateful to many amongst the ranks of the vegetarians. I confess also that I admire and rather envy them for their ability to live on a fleshless diet, and I suspect this is the outcome of my sympathy with one strong argument in favour of vegetarianism, viz. the "humanitarian" plea.

I deplore the necessity for the killing of animals to obtain their flesh as food, although I am convinced that

[1] See *Modern Theories of Diet.*

I am somewhat guilty of sentimentalism in thus proclaiming my sympathy. I feel, however, that I am no whit worse than the lacto-vegetarian, because by including eggs and milk in his diet he has deprived himself of what in my estimation is the most powerful reason for advocating the fleshless regimen. I have no wish to emphasise this anomaly too strongly, for doubtless he consoles himself with the view that in any case his senses are not shocked with painful evidences of the death of the animals which must be sacrificed to gratify his nutritive requirements.

The Uric-Acid-Free Diet.—In his efforts to support his practice by scientific evidence the vegetarian has taken advantage of two theories, neither of which is very suitable for his purpose. Both have originated in quite recent years, and in the first instance, at any rate, had nothing whatever to do with a fleshless diet.

The better known, which is technically called the purin-free diet, owes its inception to a medical man who suffered from violent headaches which could not be prevented by any amount of medication. Determined to uproot them, he began to exclude one article of diet after another from his daily menu, obtaining thereby increasing relief, until he ultimately evolved a highly ingenious and scientific system of dieting which has proved of immense value in the treatment of many disorders. The first offenders deleted from his list were fish, flesh, fowl, tea, coffee, and cocoa, all of which he demonstrated contained a large percentage of uric acid or substances which formed uric acid in their passage through his body. For this reason he was hailed as a deliverer by the vegetarians, and they immediately announced that flesh foods were disease-producing solely on account of their content of uric acid.

Most unfortunately for them, however, further investigations proved that not only peas, beans, lentils, but peanuts, oatmeal, wholemeal bread, asparagus, mushrooms, and other substances likewise contained uric acid or material which in the body is capable of producing uric acid. Despite these further discoveries, however, to this day their chiefest objection to flesh foods is their content of uric acid, conveniently forgetting or else explaining away the fact that their most trusted fleshless foods are equally worthy of indictment. In condonation of this anomalous attitude they advance the statement that careful preparation enables them to deprive vegetable foods of their contained uric acid, whereas by no amount of forethought can the uric acid be expelled from flesh foods.

It is interesting, however, to note that meat-juices, beef-teas, and gravies contain the major proportion of the purins or uric-acid-forming substances in flesh foods, and every cook knows how easy it is to separate them from the solid substance. This is, however, a work of supererogation, because Pavlow the eminent scientist has proved that these very meat-juices are the most digestion-compelling substances in existence. Hence the value of a few mouthfuls of good soup at the beginning of a meal.

From the uric-acid point of view, therefore, the average vegetarian is precisely in the same position as the average mixed feeder. I believe it is quite impossible to discover a perfectly purin-free diet, although it is doubtless easy to construct a daily menu comparatively free from substances likely to manufacture uric acid in the body. I am quite convinced that the uric-acid craze has been overdone. One can hardly open a daily newspaper without finding in its advertisement sheets reference to one or more medicaments calculated to expel all the uric acid from the body. Now apart from the fact that there is only one disease, viz. gout, the origin of which is known to be associated with uric acid, and in which it is judicious to use with extreme caution such substances as sweetbreads, kidneys, and liver, which contain an excess of that substance, uric acid to the extent of twelve or more grains is daily manufactured by the living tissues of every human being. It is conceivable that if this quantity is all that any individual can excrete in one day, the addition of any in the food would be dangerous, and in all probability there may be some susceptible individuals for whom this proposition is true.

But it has been proved that the average man is abundantly capable of clearing out of his body not only all the uric acid he manufactures himself, but all he introduces in his food, and there is not a single iota of evidence to inculpate uric acid as the originator of all diseases. At the same time, I must frankly admit that the origin of disease is in some way associated with toxins or poisons which we have been unable to excrete and which we are unable to isolate. I am quite sure, however, that any individual who can excrete all the poisons elaborated by the daily work of his tissues can with impunity swallow any average quantity of uric acid or food containing it.

Auto-intoxication as a Cause of Disease.—This theory is probably older than the one we have just mentioned, but as a causation of chronic disease intestinal auto-intoxication has only come to the front in recent years. To my mind it is certainly a much more feasible explanation of the origin of disease than any other yet advanced, because we are yet so slightly acquainted with the intimate processes at work in the living tissues, that we are unable to appreciate it at its full significance.

Briefly the proposition consists in the statement that the undigested portions of our food become a prey to microbes in the intestinal canal, and that highly toxic or poisonous substances are thus formed which are absorbed into the blood, and so act deleteriously on the body. The alimentary canal, we know, is haunted by countless numbers of germs, and it has been computed that at least 128,000,000,000,000 are discharged each day in the fæces. Fortunately for us they are divided into two classes: (1) Those which live on the remnants of protein food, the toxins of which are most deadly in character; (2) Those which prefer fats and starches, the by-products of which are much less irritating to the body. These rival sets of microbes are continually at war with each other, and the harmless set have no compunction in annihilating their more lethal opponents.

If therefore one provides a sufficient amount of pabulum in the shape of starchy or sugary food, we may expect an excess of these harmless inhabitants of our intestine and a corresponding diminution of those liable to occasion trouble. This is the conception underlying the "curdled" milk treatment, because not only is a large quantity of sugary matter provided in the milk, but the germs themselves are supplied in abundance in the hope that they may establish themselves in the colon and so overcome its dangerous denizens.

On the plea that flesh foods always provide a large surplus of indigestible material from which the microbes of putrefaction may produce toxic substances, one section of the vegetarians not only eschews fish, flesh, and fowl, but also limits the quantity of vegetable protein to very small proportions. It is also claimed that vegetable protein is much less putrefiable than the animal variety, but this is more or less conjectural, and in any case, largely because of its surrounding envelope of cellulose, a greater proportion of it is undigested and unabsorbed than of animal protein.

It may be laid down as a general principle that wherever you provide a supply of food for them, colonies of microbes will establish themselves and flourish in accordance with the quantity and nature of their nutriment. Now there is always a residue of proteins, fats, and carbohydrates in the colon, and we must therefore expect to find different varieties of micro-organisms in the lower bowel, but it is by no means a foregone conclusion that their by-products will produce a malign influence on the body. In any case it is unfair to lay the blame of any such deleterious effect on the by-products of the proteins alone without reference to those of the fats and carbohydrates, for the latter produce many irritating acids which are capable of absorption, and so of becoming problematical factors in the causation of disease in the body.

Doubtless ere this many of my readers are inquiring why, if the facts be as I have stated, every individual is not suffering from disease in some form, and his query is perfectly apt and pertinent. It is to be hoped that the reply will be satisfactory and illuminating. The truth is that Dame Nature recognised this very difficulty from the beginning and laid her plans to obviate it. In the first place, the various digestive fluids, and in particular the hydrochloric acid of the gastric juice, are decidedly antisceptic, and consequently antimicrobic, while the lining membrane of the whole alimentary canal not only excretes a healthy mucus which acts as an antidote to the toxins of the micro-organisms, but the living wall itself, so long as it is intact, is an effectual barrier to their access into the blood. Finally, in normal circumstances, and certainly in the healthy individual living and working in the open air, the bowels empty themselves of their poisonous contents frequently and at regular intervals. Where this does not take place there is more chance of absorption, although, strange to say, in fairly severe constipation, probably because of the lack of moisture in the colon, the effects are often apparently less serious than where there is simply an insufficient daily evacuation.

Even when the toxins have been freely absorbed, Nature is not forgetful of her protective functions, for she has in the first place planted the liver with its internal purifying arrangements as a huge destructor to nullify the poisonous emanations of the colon, and the most feasible explanation of "biliousness" is that the liver resents an overplus of work in this direction and violently proclaims her objection. But the upheaval is more than a protest, for it is likewise an effective means of ridding the system of superfluous and probably dangerous material. When for any reason the liver becomes complacent enough to cease its rejection of such material, almost invariably other and more serious conditions arise. For the poison now obtains access to the blood and sets up headache, skin diseases, rheumatism, asthma, or some such malady, although there are special means provided for metabolising the toxins in the thyroid and other ductless glands.

When they are unable to be metabolised then, an effort is made to excrete them by the skin, the kidneys, and the lungs, and no doubt many diseases of those organs arise in this manner. The doctrine of intestinal auto-intoxication is thus a fascinating one, and provides an explanation of the onset of disease which is at once simple and satisfying. Needless to say it is not the whole explanation, but it is full of promise of good health for the man who acts upon it by keeping his bowels open, his skin active, and his lungs free and easy by exercise in the open air.

CHAPTER XI

MASTICATION AND MODERATION

I HAVE entered somewhat fully into one or two of the theories associated with the dietetic problem, so as to enable each individual reader to realise for himself the difficulties surrounding the subject, and if possible to aid him in selecting the best diet for himself. I am particularly anxious to emphasise the fact that my references have been entirely connected with the healthy person. In this liberty-loving country there is too frequently manifested a disposition to decide questions which are entirely outside of the individual realm and for which expert knowledge is really essential. I have no quarrel with the healthy man who strikes out a particular dietetic line for himself, and maintains the highest possible vigour of mind and body thereupon. He has solved a most important problem for himself. But where in such manner one succeeds in effecting a satisfactory solution, many drive sheer on to the rocks of disaster.

I would therefore advise everyone who contemplates making any serious change in his diet, a change for example out of harmony with the established diet of the country or district in which he lives, to submit the proposed alterations to his medical attendant, and in the event of his approval to present himself for medical examination at more or less frequent intervals. This warning has no special reference to any one system, for I am acquainted with individuals living on the most diverse systems who are yet able to maintain themselves in perfect health, but because I am convinced that the malign influence of some dietetic systems is so seductive that it would be well to check it before it has attained serious proportions.

It is imperative, however, for the unhealthy individual to make no experiments on his body, but to place himself under the guidance of a medical expert who will enable him to select the best foods or system to suit his diseased condition.

A reference to the day's menu which I have already detailed will prove that I adhere to the orthodox arrangement of the meals usually observed in this country. The stomach requires something over four hours after breakfast and something over five hours after a substantial midday meal to empty itself, and to load it with food at any shorter interval or to do violence to the body by fixing any much longer interval is likely to lead to trouble. Still it is a very complacent organ, in witness whereof one has only to reflect upon the five or six daily opportunities for the more or less serious ingestion of food in a hydropathic, and the six or seven similar opportunities on a transatlantic liner. I confess I have been filled with amazement at the impunity with which people can, on occasion if not regularly, abrogate all the dietetic laws of health, at least as far as the occurrence of serious indigestion is concerned, though doubtless the demon of obesity or excessive thinness, of gout, rheumatism, or constipation, patiently awaits at their elbow to take possession when opportunity serves.

For such individuals the problem of careful mastication does not exist, and if they have ever heard of the famous Horace Fletcher, they have quietly ignored his teaching and consigned his practice to oblivion. Their mission on earth may not be precisely that of living to eat, but on the other hand they are entirely ignorant of, or prepared to despise, those who only eat to live. Eating is a pleasure, and in this pleasure loving and seeking age the pleasures of the table are not forgotten. Happy the man who can afford to swallow his food after a few perfunctory movements of his jaws, the best evidence of his eupeptic condition. Still happier the man, however, who having recognised his tendency to dyspepsia faithfully chews every bite until at least all the solid elements it contains are reduced to such a state that they can be swallowed with every certainty of digestion. Even if the number of chews should approach the three or four hundred for each bite, I am not inclined to hold him up to public derision, for I can promise him relief for his indigestion and ultimately permanent cure, if he will only persevere.

I must not trespass on my space in connection with this great subject, often called "Fletcherism," further than to indicate that there is every reason to believe, from scientific evidence of the highest character, that the nutritive requirements of the body are distinctly diminished by the practice of careful mastication. From every point of view, therefore, it is true economy to encourage it, for apart from the financial reason involved, it is judicious to prevent the expenditure of needless energy in the body. Every particle of food beyond what is actually required for the repair of the tissues and the supply of requisite energy is not only superfluous, but involves a loss of energy in digesting and excreting it. Huge eaters are not therefore necessarily nor usually the best workers, for experience proves that the man who settles down to his regular daily occupation soon recognises that to be efficient he must limit his consumption of food. Only during a well-earned holiday can he afford to indulge his appetite, and that for a very restricted period. On all hands it is admitted that longevity is rarely attained by the excessive feeder, whereas good health and great age are perfectly consistent with the consumption of a very moderate amount of food.

It is quite in the nature of things for my readers to desire some information on what precisely constitutes moderation, and I must confess that this is a question not easily answered. A rough-and-ready guide is found in the suggestion that one should never rise from the table with the appetite completely satisfied, but this of course presupposes a hearty appetite and a healthy condition of mind and body. At the same time it must be admitted that there is much truth in the statement, for the appetite, properly interpreted, is Nature's method of estimating the nutritive requirements of the body, and never fails the man who has honestly earned it.

It is difficult to say just how far it is legitimate to institute measures for tempting the appetite, as it is called. Everything which would contribute to rendering plain food plainly cooked more attractive, such as scrupulous cleanliness, table decorations, beautiful flowers and congenial company, should be welcomed, but the addition of complicated dishes and sauces, entrées, condiments, alcoholic liquor and liqueurs, is sure to lead to a violation of the law of moderation.

The secret of good health and long life is to be found in eating a sufficiency of food at regular intervals, in engaging in a regular but not too laborious daily occupation, in keeping the body clean and the mind cheerful, in having sufficient rest and recreation, and in making moderation in all things the watchword of the whole life.

COURSE OF READING SUGGESTED

I. "Food and Dietetics." By Robert Hutchison, M.D. Edward Arnold.

This is by far and away the best book on diet published in this or, at any rate, any English-speaking country. It is full without being encyclopædic, and scientific without being so technical that the lay reader cannot understand it. There is hardly any aspect of the subject which does not receive attention, and in addition the book is eminently practical.

Other books of a similar character and about the same size dealing with the whole subject, but placing more emphasis on different aspects, are :

Diet and Dietetics. Translated from the French of A. Gautier. Constable.
Dietotherapy and Food in Health. Davies. Rebman.
Practical Dietetics. W. Gilman Thompson.

II. "Modern Theories of Diet." By Alexander Bryce, M.D. Edward Arnold.

It is difficult to estimate the value of one's own production, but in this book I deal with practically all the important systems of diet which are entitled to serious consideration, and some which my readers may think might safely be ignored. It is the only book of moderate compass in which both facts and theories are placed in array so that they may be contrasted for practical purposes. The first two chapters should be passed over on the first reading by all but advanced students.

For special treatment of the theories, see :

(1) *A Fleshless Diet.* Buttner. F. A. Stokes & Co.
(2) *The Nutrition of Man.* Russell H. Chittenden. Heinemann.
(3) *Uric Acid in the Causation of Disease.* Alexander Haig, M.D. Churchill.
(4) *The Food Factor in Disease.* Francis Hare, M.D. Longmans, Green & Co.

(5) *Le Rôl du Sel en Pathologie et en Therapie.* Achard.
(6) *Natural Hygiene.* Lahmann. Sonnenschein.
(7) *The A.B.—Z of our own Nutrition.* Horace Fletcher. B. F. Stevens & Brown.
(8) *Intestinal Auto-intoxication.* A. Combe. Rebman.
(9) *The Prolongation of Life.* E. Metchnikoff.
(10) *No-Breakfast Plan and the Fasting Cure.* Dr. E. H. Dewey. Fowler.
(11) *Sun-cooked Foods.* Eugene Christian.
(12) *The Penny Guide to Fruitarian Diet and Cookery.* J. Oldfield, M.D.
(13) *The Herald of Health.* C. L. A. Wallace. June 1903.
(14) *Inanition and Fattening Cures.* C. von Noorden. Rebman.
(15) *Fasting, Vitality, and Nutrition.* H Carrington. Rebman.
(16) *Anomalies and Curiosities of Medicine.* Gould and Pyle. W. B. Saunders & Co.

III. "The Laws of Life and Health." Alexander Bryce, M.D. Melrose. (Popular edition.)

As eating and drinking are amongst the fundamental laws of health, and as it is of vital importance to know the relative value of each law of health, a careful study of this book is strongly recommended.

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