THE CHOICE OF FOOD.

BY HENRY SIMPSON, M.D. LOND.

Physician to the Manchester Royal Infirmary, &c.

THE title of the lecture this evening is, "The Choice of Food." It is desirable, however, in the first place, to consider some points which will by-and-by help us in our choice—such as the reasons why we require food, and the purposes which will be served by it.

The whole of nature—by which I mean everything around us—may be divided into things that are living or have been living, and things that never had life. To the former class belong plants, from the giant tree to the living speck so small that a microscope of high power may be needed to show us its existence. In this class, likewise, all animal life is included, from man, who is placed at the head, to the little microscopic point of living jelly, which seems as simple in structure as the lowest form of vegetable life. Indeed, the line which separates animals from plants, though apparent enough a little way above the lowest forms of life, is made out with great difficulty as you descend the scale; and there are living forms which even now cannot be placed with certainty on one side or the other. All living things, and all things that have had life, belong to what is called sometimes the organic kingdom. Contrasted with this there is the great mineral kingdom, the rocks and mountains composing the greatest part of the earth's surface. If you were asked to point out the chief general character which distinguishes the organic from the mineral or inorganic kingdoms, you would, I think, most likely say that *change* is the great feature of the one, while permanence and stability characterise the other. And this answer would be a fairly correct one, because change—incessant change—is characteristic of life, and permanence of inert mineral matter.

If you take a paving-stone, and put it where it is subject to no disturbance, it will remain in the same condition for hundreds or thousands of years. This is shown in those enormous monuments of toil the Egyptian Pyramids: while they stand comparatively untouched by time, the builders of them, with the generations following in the long roll of ages, have lived and died and been forgotten!

Compared with the long duration of some of man's works his life passes away like a shadow; and even while his life lasts his body is in a state of incessant change. The great characteristic, indeed, of life is change. It is shown in the plant, and much more in the animal. Without change no manifestations of life, no vital actions as they are called, can take place. When change is reduced to the lowest point at which life can be sustained, we have a similar lowering of vital action. This is shown in the winter sleep, or *hybernation* of some animals, as the dormouse, and in some creatures lower in the scale, as the *Rotiferæ*, which are so minute that their structure can only be made out with the microscope. All signs of life, all vital activity, may be suspended for a considerable period by the simple process of complete drying. Cold, too, which would kill a man or a child, may be borne by a fish without apparently any injury; for fish have often been frozen with the water in which they lived, until they have formed parts of a solid block of ice, and been in perfect health after a thaw. In these conditions change would be reduced to the lowest ebb, or stopped altogether. On the other hand, all activity of body or mind is accompanied by waste of substance. We cannot move a muscle, we cannot think, without some portion of the muscular tissue, or the brain substance, being so changed that it is useless for any more work. The changed tissue is then only fit to be got rid of. In the wonderful arrangement by which we live and move and have our being it is so contrived that as this waste takes place so does repair make good the damage. Were it otherwise our bodies would soon be enfeebled and our mental power decay.

In the full-grown animal, or in man, waste and repair proceed in such a manner that the bulk and weight remain pretty much the same. In old age they diminish, but in infancy and early life growth has to be provided for as well as mere maintenance. In this case the additions to the system are more than required to make good the waste of tissue, and the surplus is used for building up the growing frame.

Now one great object of food is this repair of the waste constantly going on in the living body; and in the young the building up of the bones, muscles, blood-vessels, nerves, viscera, skin, hair, and nails, which has to be done if the helpless infant is to grow up to adult age. But, beside this, there is another purpose served by food which is also of importance—namely, that of keeping up the warmth of the body. So important is this, that a large portion of our food is employed in this way, and if it were not so we should soon die.

We have, moreover, not only to be kept warm and to increase in growth when young, and be maintained at about the same weight and size in middle life, but we have each of us our work to do. Work is for almost all (perhaps we may say for all) the main business of life. Our work is not all alike. Some have to use their muscles more than others, while these latter may work harder, with eye and brain, than the man who may, in the pride of his strength, despise the feeble frame of a giant in intellect. Not that I would have you think that a great mind is necessarily bound up with a feeble body, for the old Latin grammar example, "a sound mind in a sound body," still holds good, and if you want to find a sound mind I should recommend you to search for it among those who have sound bodies.

In these days it seems as if too high a value were put on work done without much physical effort—desk-work of various kinds—when compared with those occupations in life that require the use of one's muscles. Parents often put their boys to situations in which it is certain that if they succeed they will spend almost the whole of their working life in offices, often close and badly ventilated, without sufficient healthy exercise, and at pay not much, if any, higher than they would obtain at many other healthier employments, under the idea that it is a step upwards. The probability is that they would live longer, and have happier lives, if such parents were less ambitious. Although this is a digression, it seems not unlikely that in the future some kinds of work that cannot be done by machinery may be more highly paid than the lower kinds of head-work. The spread of education must certainly tend to cheapen many employments, as the numbers of those sufficiently educated will make some kinds of brain-work almost a drug in the market. I say this not to disparage education, but rather with the hope that greater value and greater dignity may be attached to some kinds of manual labour.

Returning now to the need for providing force for the performance of muscular work we see that there are three great purposes which food has to serve.

Food has been defined as "a substance which, when introduced into the body, supplies material which renews some structure or maintains some vital process."*

This definition will include some things which none of us ordinarily look upon as food—namely, the water we drink and the air we breathe—but which are of such importance that life without them would be impossible. Besides these there are certain mineral matters which form an essential part of our food. It includes moreover things with which we are familiar, such as meat, fish, butter, milk, bread, oatmeal, rice, potatoes, &c.

Before we can clearly understand how these things can serve the purposes which we have spoken of as served by food, we must shortly tell you the composition of our bodies. Most of you know what is meant by a gas, and are aware that the air we breathe is a mixture of two gases, oxygen and nitrogen. You know, very likely, that charcoal, when it is pure, is called carbon. The purest form of carbon is the diamond; and it is a wonderful thing that a piece of black charcoal and the sparkling diamond can be made up of the same thing. Now carbon, oxygen, and nitrogen are found in our bodies, and hydrogen likewise. Hydrogen is a gas which we do not find existing in a free state like carbon, oxygen, and nitrogen, but in combination with some other substance. That water is such a combination of hydrogen and oxygen is easily shown by a chemical experiment. Certain proportions of these gases are mixed in a jar, and an electric spark passed through, when an explosion takes place, and instead of being merely mixed they have united in what is called chemical combination, and formed a substance (water) quite unlike themselves. You can see the same thing if you hold a plate for a short time over the flame of a spirit lamp. While the plate is cool you have a dew deposited on it, from the union of the hydrogen of the spirit with the oxygen of the air. This, however, has taken place quietly, because it is gradual, not sudden.

These four bodies—carbon, hydrogen, oxygen, and nitrogen—make up the greater portion of the body, and they are called elements, because they have never been divided into bodies simpler than themselves. There are others of the elementary bodies which I may have to mention, some of which are of great importance, but which occur in smaller quantities than those I have named, such as sulphur, phosphorus, chlorine, sodium, potassium, cal-

* Dr. Edward Smith.

cium, magnesium, and iron, the last five being found as salts of soda, potash, lime, and iron; and there are some others I need scarcely mention. These elements, variously combined, form compounds, some of which are inorganic and others organic.

INORGANIC COMPOUNDS.

Of these I will only name a few. First there is water, which exists in so large a quantity in the body as to form two-thirds of its weight, so that if a man weighs 150 pounds you may reckon 100 pounds as water. Then there are a large number of salts. Common salt, which is called chloride of sodium, is the most abundant and most important of these; there are also chlorides of potassium and ammonium; there are phosphates of soda, potash, lime, and magnesia; sulphates of soda and potash, &c.

ORGANIC COMPOUNDS.

These are divided into two great classes, the first of which contains *Nitrogen*. Of these I will mention the albuminous substances, which contain nitrogen, sulphur, and small quantities of phosphorus. The white of an egg is a good example of one variety of *albumen*, and cheese may be taken to represent another nitrogenous body, which is called *caseine*. I may mention a third, *fibrine*, which is obtained in a stringy form when blood is "whipped," as it is termed.

The second great class of organic compounds is called *Non-nitrogenous*. It contains substances composed of carbon, hydrogen, and oxygen, variously arranged. Some of these are called carbo-hydrates, because the hydrogen and oxygen are combined with carbon in the same proportion as they exist in water. Then, too, we have fat existing in and forming an important part of the body. Now muscle—the lean flesh of an animal—contains nitrogen, while the pure fat does not.

As the body consists of mineral constituents, of water and saline matters, and of organic matters, both nitrogenous and non-nitrogenous, it follows that in order to supply the requirements of the body our food must consist of the same ingredients, or of substances which can be easily changed into them when submitted to the process of digestion. It is desirable also that the food should be of such a nature that its digestion can be accomplished without difficulty. You know by experience, most likely, that some things are apt to "disagree," as it is said, while others give rise to no such trouble, but are easily borne by the stomach and readily digested.

If we try to find a perfect food—one on which life can be sustained and growth take place—we must go to those which have been provided by nature. The young of many animals live for a longer or shorter period on the milk of the mother, which not only suffices for the maintenance of life, but also for growth. It must therefore contain all the elements of nutrition within itself, and it may be taken as a sample of a food perfectly adapted to its purpose—namely, the nourishment of the young animal. When examined, it is found to contain nitrogenous matter, chiefly in the form of caseine, fatty matter with which we are familiar as butter, a carbo-hydrate called lactine, or sugar of milk, together with inorganic matter, as water and salines. The young of birds are formed out of the matters contained in the egg, which also represents a food perfectly adapted to its purpose. The egg contains (1) nitrogenous matter, in the shape of albumen, both in the white and yolk; (2) oily matter in the yolk; (3) a trace only of carbohydrate in the form of a sugar, and in this it differs notably from milk; then there are (4) the inorganic matters, water and salts. The latter, however, are taken in part from the shell. This, as the process of hatching goes on, becomes gradually dissolved and absorbed by the growing chick. We may conclude, therefore, from the provision made by nature for the young mammalia—*i.e.*, animals nourished at first on their mothers' milk—and for the young of birds, and also from the universal practice of man, that our food must consist of these four ingredients, nitrogenous principles, non-nitrogenous principles, consisting of fats and carbo-hydrates, and of inorganic principles, namely, water and salines.

NITROGENOUS FOODS.

Although our bodies contain a large amount of nitrogen, it is always combined with other things, and is never free; and it is a curious fact, and one showing a beautiful adaptation to our needs, that though about four-fifths of the air around us consist of free nitrogen, it is not from that source we obtain it. In the atmosphere the nitrogen seems merely to dilute the oxygen, and to be without any marked character of its own. The oxygen would be too active by itself, and without the nitrogen we should burn away too fast. I should have told you earlier that oxygen plays a most important part, in various ways, in our bodies, and is continually being brought into the system through the lungs, being drawn into them with every breath we take. It is taken into the blood, and carried everywhere through the body, combining with matters which have to be got rid of, and, in doing so, producing heat, which is, as you know, necessary to our life. This union of various substances with oxygen is combustion—burning; and though it takes place slowly and gradually, and without light, it produces heat, and is just the same process as that which goes on when coal is burnt in our fire-places—the only difference being that one is much more rapid than the other. Thus our food is burnt, and produces heat, and enables us to use our muscles and exert force; it also goes to form the nerves, muscles, bones, skin, &c., and it replaces the worn-out particles with new ones. Coming back, however, to nitrogenous food, we obtain it both from the animal and vegetable kingdoms, in which there are principles resembling each other very closely. The muscle or flesh of any animal contains one of these nitrogen-holding principles. They are found also in the seeds of plants. All the common kinds of grain we eat are the seeds of various grasses, as wheat, barley, oats, maize, or Indian corn and rice. There are other grains, not used, however, so much by us, but still largely eaten in some parts of the world, obtained from plants not belonging to the grasses, such as buck-wheat. Highly nitrogenous food is also obtained from another tribe of plants, which includes the various kinds of peas and beans, and also lentils, which have been very popular of late. All these seeds contain nitrogenous matter in different proportions, and are therefore classed along with meat, as substances which will, when digested and taken into the blood, nourish the muscles. They sometimes go by the name of flesh formers. I may here say, in passing, that all vegetables contain nitrogenous matter, but in some the quantity is so small that they are not of much value in nourishing the muscles, though they may be useful in some other way. Milk and eggs have already been mentioned as containing nitrogenous matter.

Before going into detail as to these nitrogenous foods I must tell you very briefly what happens to a piece of meat when it is taken into the stomach and digested. It has first of all been divided into very small pieces in the mouth by the action of the teeth. On being swallowed it is exposed to the action of an acid juice, which is poured out of the walls of the stomach, and which gradually dissolves it, and makes it capable of passing through the walls of the digestive canal, and of being taken into the blood. This is rendered all the easier because, instead of lying still in the stomach, the food is rolled round and round by the movements of its muscular walls, and so brought into contact and mixed up the more readily with the gastric juice. Now whether the nitrogenous matter consists of the flesh of an animal, or of boiled peas or beans, or of a glass of milk, it has to undergo the same changes before it can be taken into the blood and be made use of in building up the tissues. In the raw white of egg we have a nitrogenous fluid which we call egg albumen, and you might think it would be fit for the use of the body without this change; but it will not in that state pass through animal membrane, and cannot therefore be taken up by the blood before being changed by digestion. Our food must consist of all the classes we have mentioned before, and we will now say a few words on the uses of *fat*. The quantity present in the human body is estimated at 6lb. It is found in almost all the organs and tissues, but most abundantly in the brain, which contains 8 per cent; in the spinal cord, which contains about 23½ per cent; and in what is called the fatty tissue, which is abundant under the skin, of which it forms more than 82½ per cent; and most abundant of all in the marrow of bones, where 96 per cent consists of fat.

The principal forms in which we take fat as food are, the fat of animals, where it is often intimately mixed with the flesh or lean part, as in bacon, and as butter, lard, suet, or dripping. In many parts of the world vegetable fat is much used, in the form of oil, as olive oil, and as existing in various seeds, containing much fatty matter. Of these seeds I may name a few, as the cotton seed and linseed, which are used largely as food for cattle, and mustard and rape seed. In some parts of Central Africa, where milk and butter are rarely to be obtained, vegetable fats, as palm oil, are among the necessaries of life; and you are aware, no doubt, of the enormous quantity of fat which enters into the food of the Esquimaux and other dwellers in the arctic regions. There, of course, vegetable fats cannot be obtained, and the fat of the seal and of the whale, which they call *blubber*, is eaten to an extent we should scarcely believe if it were not a well-known fact.

"The principal part of the fat stored up in the body is derived from the fatty matters introduced into the food." In the carnivora, or flesh-eating animals, this is easily understood, but in the herbivora, or those animals which live on vegetable food, it is not so easily accounted for. The amount of fat in their food, as in maize or Indian corn (9 per cent), is not sufficient to account for it. For instance, Messrs. Lawes and Gilbert found that in fattening pigs, for every 100 parts of fat in the food, the animals stored up from 400 to 450 parts of fat in their bodies. It is plain therefore that it must in great part be obtained from some of the other ingredients in the food—namely, by the decomposition of the albuminous matters, or of the carbo-hydrates, as starch. To this, however, we shall have to refer again. The consumption of fat in some shape or another is necessary to our existence, and it is therefore found wherever man has his dwelling-place, whether it be in the frozen north or in the tropics; and the purposes it serves are various. You know that our bodies must be maintained at a certain temperature, and this is accomplished in great part by the union of the carbon and hydrogen of the fat with the oxygen that enters the blood with every breath we draw. The body has been compared with a locomotive steam engine. The burning coal turns the water in the boiler into steam, and so works the piston, which by certain contrivances causes the wheels to turn and the engine to move. At the same time the engine is warm. If the coal burns out, the engine stops and becomes cold. So with our bodies. The fat is burnt, and it enables us to move about and keeps us warm; for you must remember that although no light is produced, because the combustion is not sufficiently rapid, yet that the slow union of the carbon and hydrogen with oxygen produces heat. There is this difference, however, between the steam engine and the body, that in the former this union of the carbon and hydrogen of the coal with the oxygen of the air takes place in the fire-box, while in the body it goes on everywhere, and the whole body, we may say, is burning "bit by bit," as Dr. Foster has expressed it; for you must not make the mistake of supposing that your stomach takes the place of the engine furnace. As long as the fat is in the stomach it might as well be out of the body altogether, so far as any production of body heat is concerned. This oxidation of the fat only takes place after it has got into the blood-vessels. But how do you suppose it gets there? It is not digested in the stomach, but while there, waiting to be passed on into the bowels, it is just mixed up with the rest of the food. Fat will not mix properly with water, as you all know, for if you shake them together in a bottle they will soon separate. Now the blood is a watery fluid, and without some preparation the fat would never be absorbed from the bowel and carried into it. But a short distance below the lower end of the stomach there are two large glands, the liver and the pancreas, or sweetbread, which pour out bile and the pancreatic juice, which, mixing with the fat and forming a kind of cream which passes through the walls of the intestine by means of a special contrivance, enter into little vessels called lacteals, because during digestion they contain this milky-looking fluid, and by them is carried into the blood-vessels. From the blood-vessels the fatty matter gets into the parts around, and forms the fatty or adipose tissue, which consists of little bladders or vesicles containing the fat. They are packed close together, and very minute blood-vessels surround them. This fatty tissue serves useful purposes. It fills up the spaces between muscles, bones, and other structures, and, under the skin, forms a thick layer, which is as good as a topcoat. And though stored up in this way, sometimes in too great a quantity, it may be reabsorbed into the blood and burnt off as the system requires. It is well known that a fat animal will live much longer than a lean one if deprived of food. Those that hybernate (coil themselves up and sleep through the winter) become very fat in the autumn, but are comparatively thin when they wake up.

It is agreed among physiologists that the oxidation of fatty matter in the blood acts an important part in maintaining the animal heat. Starch and sugar do the same to some extent, but from their chemical composition it has been calculated that fat is in this respect of two and a half times the value of the others. This has also been proved experimentally by Professor Frankland, who found that 1lb. of beef fat will by oxidation generate heat enough to raise the temperature of 9,069lb. (about 4 tons) of water by 1·8° Fahrenheit; that 1lb. of arrowroot will in the same way raise only 3,912lb. by the same amount; and that sugar stands still lower.

Of late years, also, it has been made out that fat and the other foods not containing nitrogen are used in the production of muscular force and energy. As Dr. Pavy says, "it may be considered that nitrogenous matter, which constitutes the basis of the various organs and tissues, forms the instrument of action, whilst the oxidation of non-nitrogenous matter supplies the motive power." You see, therefore, that fat plays an important part in our lives.

I must now say a few words about the carbo-hydrates, in which group are comprised such foods as starch, the sugar of the sugar-cane, that of grapes, and lactine, which is the name given to the sugar found in milk. All these varieties of sugar differ in some respects from each other. There are also other substances, as gum, and cellulose, or the woody fibre of vegetables. Sugar and starch exist in large quantities in many of our common foods, and I shall have to say something by-and-by about the latter in the feeding of infants. Sugar is readily dissolved, and can be absorbed from the alimentary canal, but in all probability cane sugar is changed into grape sugar before this takes place. This latter and the sugar of milk seem to act in the system in the same manner.

Now before starch can be applied to the uses of the body, it must be converted into sugar, which is effected in great part by the action of the saliva in the mouth. Unless this change takes place it is only so much useless matter, which has to be got rid of. When starch is examined under the microscope, it is found to consist of little bodies of various sizes and shapes, according to the source from which they are obtained, whether from wheat or the potato, or as found in the different kinds of arrowroot, which are starches prepared from various tuberous roots. These little granules are so hard that unless the starch is cooked before being eaten, this change into sugar cannot take place, and it passes away undigested. Boiling or exposure to heat in some other way bursts the granules, and so they can be easily acted on by the saliva. You will see, therefore, how necessary it is first of all to cook all starchy food, and next to chew or masticate it well, so that it may be submitted to the action of the saliva. When starchy food is swallowed, the action of the saliva is put a stop to by the action of the acid gastric juice, and its digestion is suspended. On leaving the stomach, however, the juices of the pancreas and of the glands of the intestinal walls act energetically on starch, and probably the greater part is digested after it leaves the stomach.

Well, now, these carbo-hydrates serve somewhat the same purposes as the fats or hydro-carbons. There is no doubt that they can produce fat in the body, although it is only recently that this has been satisfactorily proved. But for this purpose they must be taken along with nitrogenous food and salines. As force-producing agents they take a lower place than the fats, but are easier of digestion.

Now we must see what part the inorganic matters—water and salines—play in our bodies, and why they are required in food. Life, as we have before said, consists in change, and without the presence of water no change can take place, and all vital action would cease. I mentioned an instance of this in the drying up of the little creatures called Rotifera. The water itself does not undergo any change, but it makes the chemical and molecular changes possible, by supplying a condition necessary for their occurrence.

SALINE MATTERS.

All food contains, besides the organic compounds, saline matters, which play an important part in the economy, though they have not the force-producing powers of the former. The saline matter exists intimately bound up with the organic principles comprising the different parts of the fabric, and forms an essential element of the secretions. The bones are made up of about one-third animal matter and two-thirds mineral or saline matter, consisting principally of phosphate and carbonate of lime. This has all to be obtained from the blood, which, in its turn, gets it from the food. In the teeth, also, the proportion of mineral matter is very great, especially in the hard outer portion, called the enamel, which is composed chiefly of phosphate of lime, the animal matter being only about two per cent of the whole. This mineral matter is required by the plant as well as the animal, and is found more or less abundantly in all our vegetable food. If you burn a piece of wood you find that you cannot get rid of a certain portion, which remains as ash. If you burn a bone, the animal matter may be completely destroyed, and yet the shape of the bone be preserved, owing to the great amount of the mineral matter remaining as ash. It would take too long if this part of the subject were to be considered in detail; but we may safely consider saline matter, as Dr. Pavy says, "as one of the factors of the formative operations carried on, and no food can satisfy the requirements of life that does not contain an appropriate amount of certain saline principles."

Having gone over in a too hasty, and yet, perhaps, you may think a tedious, manner, some of the principles connected with food, and the purposes it has to serve, I must pass on to the more practical part of the subject. Our food, then, must be mixed. It must consist of nitrogenous and non-nitrogenous matters and salines. Meat is characterised by the large amount of nitrogenous matter it contains, and is therefore well adapted for building and maintaining the structure of the body; but food is also needed for the production of heat and force. This is obtained from the fats, which we get chiefly from the animal kingdom, and from the sugars and starches from the vegetable world.

By butchers' meat we generally mean beef and mutton. Of these, the former is considered more nutritious than the latter, which, however, is often digested more readily by delicate people. The lean of both is rich in nitrogen; but as the amount of fat varies, the quantity of the flesh or muscle must do so.

Pork is consumed largely in the fresh state, and also, when salted, as ham and bacon. Pork is, of all meats, the most difficult to digest, and should always be sufficiently cooked, for a very special reason, namely, that it is often infested with parasites, that is, creatures that live in it. Most of you have heard of tape-worm, and you should be aware that it is apt to affect those who have eaten what is called "measly pork." The creatures producing this condition appear in the pork as whitish specks, something like grains of rice, and consist of a head like that of a tape-worm, with a sort of little bladder for a tail. When this pork is eaten raw, or only half cooked, this little creature is carried into the bowels and grows enormously, becoming developed into tape-worm, which is often many feet long. The name given to it when in the flesh of the pig is *Cysticercus cellulosæ*, and in the tape-worm state it is called *Tænia solium*. The best plan of avoiding it is to have the pork thoroughly well cooked, so that the *Cysticercus* may be killed. And, of course, "measly pork" should not be eaten if it is discovered to be measly. A similar parasite sometimes, but not so often, infests beef and veal, and, to avoid the chance of getting them, they ought also to be well cooked. There is another parasite sometimes found in the pig, which is far more serious than the tape-worm larva. This is the *Trichina spiralis*, which has of late years caused much illness and even loss of life, especially in Germany. The first case that attracted much attention to it occurred in Dresden in 1860, when a robust maid-servant was admitted to the hospital with symptoms something like those of fever. Soon, however, she suffered great pain in the whole of the muscles, increased by the least movement. Inflammation of the lungs then set in, and she died. After death, vast numbers of the *Trichina* were found in the muscles.

In 1863 a very remarkable case occurred at Helstädt, in Prussia, where 103 persons, mostly men in the prime of life, sat down to a festive dinner at an hotel. Within a month more than 20 had died, and most of the others were ill. The cause of this was traced to some smoked sausages which had been made from a pig that had been noticed to be out of condition, and had been slaughtered for food by mistake. The *Trichinæ* were discovered in the muscles of those affected; and the sausages that remained, and the meat from which they had been prepared, were found to be swarming with the parasite. (Pavy). It should be noticed that neither salting, smoking, nor moderate heating, affords any security from this pest. It may be killed, however, by exposure to the temperature of boiling water. You see, therefore, how important it is that food should be thoroughly cooked.

As a rule cured meats are less digestible than those uncured; but bacon is an exception, as it is less apt to disagree than the fat of pork. It is often eaten with meats that are too lean, as veal, chicken, or rabbit. And with one kind of vegetable, that is particularly rich in nitrogen, it has long been known as the popular dish "beans and bacon," the latter adding the carbonaceous matter which is wanting in the former.

Poultry, game, and wild-fowl are favourite forms of animal food, but they differ very much in their digestibility. The common fowl in all its varieties, the turkey, and the guinea-fowl, have tender, delicate flesh, easy of digestion. On the other hand, the flesh of ducks and geese is harder and richer, and much more difficult of digestion. Wild-fowl also have close firm flesh, which is not very easy to digest. The flesh of the rabbit is something like that of poultry, and that of the hare like game. That of the rabbit is so close in its texture that it should be well masticated, and even then delicate stomachs sometimes find it indigestible.

Fish is a food of much importance. In some parts of the world it is almost the sole sustenance of the people, as in the most northern parts of Europe, Asia, and America. There are great differences in the varieties of fish, as to their digestibility. As a rule the white fish are more easily digested than those which have red flesh. Those with white flesh, as the sole, whiting, haddock, cod, turbot, brill, plaice, &c., have but very little fat. Salmon, herrings, eels, mackerel, and pilchards contain, however, a good deal of fat, and are considered richer. Of all these the whiting seems to be the lightest and most delicate. Soles, too, have a good reputation. Haddock, cod, and turbot, are not quite so easily digested. For invalids it is best to boil fish. Many fish are dried, salted, smoked, or pickled in enormous quantities, and are very useful as food, though they are rendered less nutritious and less digestible by these processes. Lobsters, crabs, shrimps, and prawns, belong to a family of animals called *Crustaceæ*, and though they are often spoken of as shell-fish they do not belong to the family of shell-fish proper. They are all nutritious, and many look on them as great luxuries, but to most people they are difficult of digestion.

The shell-fish, strictly speaking, comprise oysters, mussels, scallops, cockles, periwinkles, whelks, &c. Of these, oysters have the highest reputation, and, in these days of their scarcity, command a very high price. They are nutritious, and if eaten uncooked many delicate people find them easy of digestion. When cooked, however, they become leathery and indigestible. Mussels are liked by many, and, generally speaking, are wholesome, but cases of poisoning by them, difficult of explanation, have sometimes occurred. The other shell-fish are not so largely eaten, but all have their admirers.

Eggs of birds, generally of the common fowl, are nutritious and agreeable articles of food, and are used in an immense variety of ways. They are rich both in the nitrogenous and carbonaceous elements of food.

I will now say a few words about milk. As mentioned in an earlier part of this lecture, milk possesses all the elements necessary to nutrition. It contains about 14 per cent of solid matter, and a pint will contain nearly 3oz. of solids. It is now much sold in the form of condensed milk, from which a large proportion of the water has been removed by evaporation. Some sugar is added to it. This, though a convenient and useful preparation, appears sometimes to be unsuitable for the food of infants, and should certainly not be used for them if good fresh milk can be obtained. From milk, of course, is obtained that very valuable article of food, cheese. It is highly nitrogenous, and can therefore often take the place of meat; but some of the harder and closer kinds, which are the richest in nitrogenous matter, require strong powers of digestion, and should be well masticated with a fair proportion of bread. There is a curious difference of opinion as to the digestibility of toasted cheese. It is considered by many as one of the most indigestible articles that can be eaten, while others say it always agrees with them. A good deal may depend on the kind of cheese used. Some of the poorer varieties become at once hard and leathery, and must give the gastric juice a difficult task to deal with. Other varieties, richer in fatty matters, do not all at once become tough and hard, and, if eaten speedily while hot, many digest them very well, if taken in moderate quantity.

From milk, too, we obtain the animal fat called butter, the quality of which varies indefinitely. When good it is the form of fatty matter least likely to disagree with the stomach. If rancid or bad it is very apt to disagree. And in these days of—I was going to say clever—roguery it is terribly adulterated. Very often an excessive quantity of salt, as much as 2oz. to the pound, is added, and sometimes a large quantity of water is worked up with it. But besides water and salt, cheap animal fats, as mutton fat and horse grease, are mixed with it. Palm-oil or palm-tree butter, which is used for candle making and for greasing railway carriage wheels, is said to be added to it. It is also said that some of the cheaper kinds of what is sold as butter or butterine are made up altogether from the fat of animals. It is desirable, therefore, to go to an honest butterman. Lard is obtained from the loose fat of the pig, and, when pure, is a very valuable article of food, which admits of a great variety of uses in the preparation of pastry, &c. But in these days lard is often adulterated. Other cheap fats are mixed with it, starch also, and milk of lime to improve the colour, and to enable a large quantity of water, as much even as 25 per cent, to be mixed with it. Lard is also used to adulterate butter.

Having now spoken of a few of the varieties of animal food used by man, I must mention the principal articles we obtain from the vegetable kingdom. First there are the

FARINACEOUS SEEDS.

Of these, *wheat* is the most important to us here, but it is one which, from a succession of bad harvests, has to be brought, in larger quantities than ever, from parts of the world more favoured as to climate than this country. Every one knows what a grain of wheat is like. It has a hard outermost skin, which is indigestible, and which forms the greatest part of the bran separated from it in grinding. The inner coat, however, is softer, and is that part of the grain which is richest in nitrogenous matter, fat, and salts. If we could not get these matters from any other source, it would be a serious loss to have them all removed from the flour. Generally speaking, however, they are obtained from other sources, and so we may eat white bread if we prefer it. What is called "seconds flour" is the best for domestic use. Flour consists of starch (which is one of the carbo-hydrates), of gluten (which is a nitrogenous substance), with small quantities of gum, albumen, and certain salts.

Wheaten flour is used for the preparation of biscuits, of cakes of all kinds, and of macaroni, which is a very valuable variety of food, made chiefly in Italy.

There is another valuable grain, more used in former days than now, namely, the oat. The Scotch and the north-country people of England used to live chiefly on oat-meal and milk, and were the finest and strongest people in the land. It requires proper cooking, and is then far preferable for children, and even grown-up people, if eaten with sugar or treacle and a little milk, to the white bread and weak tea which have replaced it. It does not seem, however, to be grown so extensively as it used to be, and is, in consequence, somewhat high in price. Rye-meal, and barley-meal, though once common, are now very little seen in this country.

Maize, or Indian corn, is remarkable for the large amount of fatty matter it contains. It is a wholesome nutritious food, but cannot by itself be made into bread, from its deficiency in gluten. It may, however, be added to wheat flour. In the United States and Canada it is largely used in a variety of ways, and also in many parts of Europe.

Rice is another of the cereals extensively used for food, especially in India, China, South America, and the southern countries of Europe. It contains only a small amount of nitrogenous matter, and is well fitted to serve as a partial substitute for potatoes.

The next group of seeds is from another tribe of plants, and consists of peas, beans, lentils, &c. They differ a good deal in flavour, but have a very similar composition, peas and beans containing about 23 per cent, and lentils about 25 per cent of nitrogenous matter. They are, however, comparatively poor in carbonaceous matter, and on this account they are always eaten with fat or oil, as in the common dish, beans and bacon.

Lentils have acquired a sudden popularity in this country, from the letters of Mr. Ward, an enthusiastic vegetarian, in the *Times* newspaper. They are nutritious, and make capital soup, which tastes rich and strong, and is really as sustaining as soup made from good meat stock. They may be cooked in various other ways, and, as far as nitrogenous matter is concerned, might in these times of dear meat, often supply its place. Very much the same may be said of peas and beans. Every one knows what pea-soup is like. The white French beans we call haricot beans make a capital dish when eaten with some fat bacon. They should be slowly and thoroughly cooked and eaten with some pepper and salt. Some people, however, find them indigestible, and they should, of course, only be eaten in the quantity that the stomach can bear with comfort and satisfaction.

I must now mention some of the roots and succulent vegetables.

Potatoes are more used than any other vegetable we have. In Ireland they have always been, and still are, a popular food, notwithstanding the terrible sufferings caused by the potato famine in 1847, which should teach us how unwise it is to trust to one crop only for our food supply. It is said by Dr. Edward Smith, who was a great authority on the subject of food, that an Irishman will eat 10½lb. daily, *i.e.*, 3½lb. at a meal, which is an enormous quantity, and is rendered necessary by the small amount—only about 2 per cent—of nitrogenous matter they contain. Starch is present to about 18 or 20 per cent, but a large part of their bulk is made up of water. They are also valuable from the salts they contain. By themselves, potatoes do not form a good diet, but they are agreeable, and to most people wholesome, and with meat, or fish, or with milk, they are useful and economical. In some parts of the country they are eaten with buttermilk and a little salt, and thus a cheap and good diet is produced. I may say here that buttermilk is a cheap and very valuable form of nitrogenous food that is not sought after as much as it should be. It contains the caseine or cheesy matter of the milk, the sugar, the salts, and a little of the fatty mattter, and it is a pity that so often it is only thought fit for the pig.

There are several other roots, such as the Jerusalem artichoke, which contains about 3 per cent of nitrogenous matter and 14 per cent of sugar, but is remarkable as not containing starch. Then there are carrots, parsnips, and turnips. These have not a high nutritive value, but along with other food they are wholesome and useful, and help to give variety. They are less nutritious than the potato, and have less heat-producing power. Thus Dr. Edward Smith says that 10 grains of potato consumed in the body produce heat enough to raise 2·6lb. of water 1° Fahrenheit, or to lift 1,977lb. one foot high; while 10 grains of carrot only produce heat enough to raise 1·36lb. of water 1° Fahrenheit, which is equal to lifting 1,031lb. one foot high. I may mention beetroot, which contains a large quantity of sugar, and from which, indeed, sugar is largely obtained in France, Germany, and Russia. It is a useful and nutritious vegetable, and is much used in salads. Salsafy and scorzomra are vegetables somewhat of the same character, which might be more used here than they are.

We use also in our food many vegetables of the cabbage tribe, as, cabbage itself in several varieties, and red cabbage, chiefly as a pickle, the different kinds of greens and kale, with Brussels sprouts, savoys, cauliflowers, broccoli, &c. They are agreeable and useful additions to other food, but not of sufficient nutritive value to be taken alone.

There are other useful and agreeable vegetables, which must barely be mentioned, as tomatoes, vegetable marrows, cucumbers, spinach, rhubarb, celery, onion, lettuce, endive, &c. They are all wholesome, and give variety and flavour to meals that would perhaps be otherwise insipid.

There is one plant I must name belonging to the fungus family, the mushroom, on account of the large proportion of nitrogenous matter it contains. It is, however, somewhat hazardous to indulge freely in eating mushrooms, owing to the difficulty of distinguishing those that are wholesome from those that are deadly poison.

FRUITS.

These are agreeable and refreshing, but, from the large proportion of water they contain, not of much nutritive value. They are chiefly of service for the vegetable acids and the salines they contain, and are valuable as anti-scorbutics when the health is lowered from living too much on dried and salted provisions. As a general rule we might, with advantage, eat more fresh fruit and vegetables than we now do.

With regard to beverages, we have water, tea, coffee, cocoa, wine, beer, and spirits. As to the first, we may almost say in the words of the "Ancient Mariner," that we have "water, water, everywhere, but not a drop to drink." Our rivers and wells are polluted, and our towns have to go to enormous expense, and to bring it long distances. It is one of the first necessaries of life, and we deal with it as if it were of no value. We have an abundant supply in this district from the clouds, but we do not store it up; we have streams that once were pure, and might be so again, but we make them the receptacles of our filth. Its value as a purifying agent renders it very liable to pollution, and you must always be careful as to the source from which it is obtained. In Manchester the supply is, on the whole, good and wholesome. With regard to tea, coffee, and cocoa, we may say that they are agreeable and refreshing, if taken moderately. If tea is too strong, and taken immoderately, it produces nervous agitation, tremors, palpitation, &c. It often relieves headache.

Coffee refreshes and invigorates without subsequent depression. It is more heating and stimulating than tea, and some people cannot therefore take it. It sustains the body under exertion and fatigue, and enables it to bear exposure to cold better than almost anything else. To the soldier, and the arctic traveller, coffee has been proved to be very valuable. It is far better as a protection from cold than either beer or spirits—the effect of which is to lessen our powers of resistance—just the opposite of what is often supposed. Cocoa has somewhat the same properties in a lesser degree.

The subject of alcoholic drinks is so large, and I have already trespassed so long on your patience, that I must not venture to say more than that extreme temperance in their use is the best, from the physician's point of view. And for many, perhaps the majority, entire abstinence is the safest.

Having now briefly passed in review some of the principles which bear on the question of food, and mentioned some of the commoner articles used as food, I will say a word or two as to the quantity we need, and the best proportions of the different classes.

We want the nitrogenous matters, which have been termed flesh formers, and the carbonaceous matters, or heat and force producing bodies. It is calculated that we ought to have 300 grains of nitrogen and 4,800 of carbon every day. These numbers are as 1 to 16, so that we want 16 times as much carbon as nitrogen. In albumen, the nitrogen stands to the carbon as 1 to 3·5, so that if we had 300 grains of nitrogen in the form of albumen we should only get 1,050 of carbon, which is too little: and if we got 4,800 grains of carbon from albumen we should have 1,371 of nitrogen, which would be rather more than 4½ times as much as we want.

In bread, the nitrogen is to the carbon as 1 to 30, so that if we had 300 grains of the former we should have 9,000 of carbon, nearly double what we want; and if we took the 4,800 grains of carbon we should only have 160 of nitrogen.

Meat contains about 11 per cent of carbon and 3 per cent of nitrogen, and 6lb. would be required to give the 4,800 grains of carbon, while more than 4lb. of bread would have to be eaten to supply the 300 grains of nitrogen. It is clear, therefore, that it would be better to mix them if we had to live on bread and meat, and it is found that 14,000 grains, *i.e.*, 2lb. of bread, give 4,200 grains of carbon and 140 grains of nitrogen, while ¾lb. of meat—5,500 grains—give 605 of carbon and 165 of nitrogen, which, added together, give 4,805 grains of carbon, and 305 of nitrogen.

This shows the principle that should guide us in our choice of food. If we eat meat, or beans, peas, or lentils, which are highly nitrogenous foods, we ought to take a fair quantity of carbonaceous food with them, either as fat, or as starchy food, such as potatoes; and better still, a mixture of the latter. We shall never come to such exactitude as to weigh and measure our food in every-day life; but it is found that about 23 ounces of dry food, properly proportioned, are required daily, and this would amount to 46 ounces of solid food in the ordinary condition as to dryness. Besides this, 50 to 80 ounces of water or other fluid will be taken. The dry solid is divided as follows:—

Alimentary substances, in a dry state, required daily, for the support of an ordinary working man, of average height and weight. (Moleschott).

	In oz.	In grains.
Albuminous matters	4·587	2,006
Fatty "	2·964	1,296
Carbo-hydrates	14·250	6,234
Salts	1·058	462
	22·859	9,998

There is a valuable table by Dr. Frankland, of the proportionate values of food in relation to work, too long to give in detail, but from which I will quote a few curious facts, namely, "that the same amount of work is obtainable from oat-meal costing 3½d., flour, 3¾d., bread, 4¾d., and beef fat, 5¾d., as from beef costing 3s. 6½d., and isinglass, £1 2s. 0½d. This shows that the power for work is not due to the lean meat we eat nearly as much as to the fat and starch and sugar. But a fair proportion of food containing nitrogen is the best, because the muscles and the body generally are better nourished.

It is a remarkable fact that man's instinct or intuition has caused him almost universally to mix his food in tolerably correct proportion. In 100 parts of food we generally have about 9 of fat, 22 of flesh-forming matters, and 69 of starch and sugar.

I have had to pass lightly over many points that should have been dwelt on more at length. Some, as the preparation and cooking of food, have had to be left untouched altogether. Nor has there been time to go into the detail I wished to do with respect to the economical arrangement of our food. If, however, you will bear in mind the principles I have sought to lay before you as to the requirements of the system, and the properties of the various kinds of food, you will not go very far wrong in your dietary.