Digestion and indigestion : proper and improper feeding in health and disease / by A. Lockhart Gillespie.

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No. 6.

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BY

A. LOCKHART GILLESPIE, M.D., F.R.C.P.Ed.

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DIGESTION AND INDIGESTION: PROPER AND IMPROPER FEEDING IN HEALTH AND DISEASE.

By A. LOCKHART GILLESPIE, M.D., F.R.C.P.Ed.

The term Digestion, as it is popularly understood, applies only to the changes brought about in the alimentary tract which enable us to absorb the nutritious parts of our food. The term, however, covers more than this in reality. By Digestion we mean, not only the changes which are caused in the food in the mouth, stomach, and bowel, but the further changes also which occur in the part of the food absorbed, and by which the bodily processes are carried on. It includes all those processes, many of the greatest delicacy and complexity, some comparatively simple, which are required to alter the different ingredients of our food into compounds capable of being built up in the tissues, or of making good the wear and tear inevitable in all living things. These processes are so wonderfully elastic, within certain limits, that the necessary materials are derived, and almost identical individuals are built up, from very different foods. The Irishman, living chiefly on potatoes, obtains from them the same nutritious substances as the Esquimaux, who lives principally on meat and blubber. The vegetarian does not differ very markedly from the meat-eater. But, although these processes are elastic, the results are not absolutely the same, marked differences in diet leading to excess or defect of some of the tissues. The Esquimaux rejoices in an excess of fat; the vegetarian is lean, with flabby muscles in some cases, with small but firm muscles in others.

Diet, then, although it has nothing to do with man as man,

has a great influence on his characteristics. The Esquimaux has learned to eat that which will give him a natural blanket, dwellers in hot countries have found by experience that vegetables and fruits are often their best foods. It is an interesting fact to note that those nations which eat most meat (excluding uncivilised races, as, for instance, the North American Indians), show the greatest energy and brain-power. The inhabitants of Great Britain and America consume per head more meat than any other nations, and they have taken the lead in energy and inventiveness ; the Germans come next, followed by the French, while the nations of Southern Europe eat but little meat, and are being left behind in the race. The Greeks and Romans appear to have consumed more meat than their present day successors, but not so much as the wild tribes of the North, who in time vanquished them. Quite a little history might be written on the effects of digestion and diet on the affairs of the world.

Mankind has been divided into those who eat to live, and those who live to eat. Healthy digestion is only concerned with the first class, but even in this class there are many, unfortunately, who cannot obtain sufficient to live upon, or sufficient, at any rate, of the proper kind. These cannot be considered under the head of healthy digestion.

For all those who eat to live, a certain quantity of food principles is necessary. Everyone must take in his food a certain quantity of albuminous material, such as meat, white of egg, and the albumins in vegetables, so much fat, starchy and sugary stuffs, salts and water. What we mean when we say that a man requires so much of these different bodies in health, is that amount which, when taken into and used up in the body, will suffice to keep his weight the same. That is to say, that what he eats exactly balances what he uses up. This is known as the normal balance, and, in full-grown people, is the proper diet. In growing people, of course, more food is necessary than that which is used up, and the occupation of the individual at the time will alter the quantity required to keep the balance correct.

All diets do not require to be based on exactly the same proportions of the three great divisions of food-stuffs, the albuminous, the starchy and the fatty. The ideal diet contains precisely the amounts of these classes of bodies which can be used up

under the circumstances. Such a diet, however, would be far too monotonous, and the capricious human appetite would soon fail. Nature's laboratory is so fashioned that an excess of one class compensates for a defect in another. One class is built up in the body from the others, another is formed through another's splitting.

FOOD PRINCIPLES.

Let us now look more closely but briefly into the essential principles of food.

(1) *Water.*—Water forms from 60 to 70 per cent. of the body, enters into the composition of every tissue, and plays an important part in all the changes by which life is maintained. The enamel of the teeth contains the smallest quantity of water, only 2 per thousand, the muscles or flesh as much as 757 parts in every thousand, while the sweat and the saliva are composed of 995 parts of water in each thousand. Water acts as a solvent in digestion, and is a constituent of every tissue. An adult takes, as a rule, about four pints of water in and with his food each day, and excretes about four and a half pints during the same length of time, the extra half-pint arising from chemical processes in the body. Water increases tissue changes, facilitates the getting rid of waste products, and thereby increases the appetite. If too little water be taken, as is frequently the case in women who are afraid of becoming stout, the waste products are not removed in sufficient quantity, they accumulate in the system, and gradual loss of appetite and ill-health results.

(2) *Albuminous Foods.*— Albuminous food, such as the white of an egg, which is almost solely made up of pure albumin, or the lean of meat, forms the most important class. The body can be nourished on albuminous food alone if water and some mineral salts be present. It enters into the formation of every cell, can form both fats and sugars in the body, and is one of the sources of energy whereby we move and live. All albuminous bodies contain an element called nitrogen, which is indispensable in the body. Neither fats nor sugars contain this element.

The albumins in the body exist in two forms, that which is fixed in the tissues and that which is contained in the blood and other fluid media. The first form is little affected in the daily

change of products, only to one per cent. or so, the second undergoes more rapid decomposition, to about 70 per cent. in the twenty-four hours.

We may say, then, that food-stuffs containing nitrogen are absolutely essential, that they repair tissue waste and play a large part in the production of bodily activity and energy. They also may act as force-producers when they have split up, as they can do, into fats and sugar.

(3) *Fats.*—Fats are substances which do not contain any nitrogen, and are highly combustible. When coal is burnt in a fire, the presence of oxygen, a gas forming part of the air, is necessary. The more oxygen the fiercer the fire. Fats like coal contain a large quantity of carbon, and this carbon unites readily with oxygen to form carbonic acid gas. The heat of a fire is due to this simple chemical action, and the chief use of fats in the body is of a similar nature. Exactly as the carbon of coal or charcoal combines with oxygen and evolves heat, so the carbon of the fats in the body combines with the oxygen brought to the cells by the blood from the lungs and produces heat. Now, as fats are so readily burnt off in the body, they act as a store of heat, and also as a sparer of albuminous substances which would be called upon for their carbon if the fats were not present. In this way fat is largely burnt off during muscular exercise, thus saving the tissue of the muscles themselves. Fats are therefore force-producers. Stored up in the tissues they act as a reserve on which the body may draw if the supply of food be insufficient at any time.

(4) *Starches and Sugars.*—The members of this class are termed carbo-hydrates, and are simply composed of carbon and the elements of water in varying proportions. In the body they act as power-producers, owing to the ease with which the carbon unites with oxygen, leaving the water behind. There is no doubt, also, that they may be transformed into fats in the body; indeed, fats are made up of the same elements as the starches, though in different proportions,—the carbon being more, the oxygen less.

(5) *Mineral Salts.*—The chief salts requisite for the building-up of the body are the phosphate of lime, the chloride of sodium, or common salt, salts of potash, and of iron. Lime is required

for the bones, phosphorus for the nerves and brain, soda and potash salts for all the tissues of the body, and iron for the colouring matter of the blood.

The salts give rigidity to the bones, afford the source from which the digestive fluids derive their distinctive qualities and powers, permit the interchange of oxygen between the lungs and the tissues, and help to keep the various albuminous substances in solution in the fluids of the body.

Such a list of necessary substances, no doubt, sounds to you very formidable, but there are few articles of diet which do not contain some portion, at least, of all the five classes.

With the exception of water and the salts, none of the principles above mentioned—except grape sugar—can be taken in by the digestive tract as they occur in the food, cooked or raw. The first stage of digestion consists in various processes adapted for altering them, so that they can be absorbed by the lining membrane of the stomach and bowel.

Digestive Apparatus.

Before considering the changes which the food has to undergo, let us briefly look at the apparatus provided for their accomplishment.

The Mouth.—In the mouth the food is chewed and divided into as small pieces as possible. Bad teeth, with consequent inability to chew thoroughly, is a fertile cause of indigestion. Hasty eating is another. In the mouth the food is mixed with the saliva, an alkaline fluid, which serves to facilitate swallowing, and also acts on the starches of the food. The bolus of food is now caught by the muscles at the back of the throat and sent down to the stomach.

The Stomach.—The stomach is a bag with muscular walls lined with a delicate mucous membrane, which is studded with minute glands. Normally, it is capable of holding about two pints at the most, but it is very distensible, fortunately for some people, and on occasion may accommodate as much as three, or even three and a half pints. It is a very common mistake to imagine the stomach, when empty, as a hollow cavity yawning for food. In reality, when empty the walls fall in, one on the other. When the food enters it, the cells at once commence to

secrete an acid fluid, containing a ferment, pepsin, which helps the acid to digest the albuminous foods, and a ferment, rennet, which curdles milk. The food remains for some time in the stomach, the length of stay varying with the kind of food, but after about two hours the opening into the bowel opens, and allows some of the contents to escape. A German observer has observed this process in the living dog. Portions of the chyme, as it is called, escape at short intervals until the stomach is empty. This usually happens from four to five hours after an ordinary meal. If a drink of plain water, or of some non-irritating fluid be taken when the stomach is empty, most of it passes almost directly through it, and reaches the bowel at once. The walls of the stomach, while the food is in it, contract in such a way that the contents are kept continually churned up, so that the gastric juice can act on them more thoroughly. The contents become more and more acid during their stay until the fourth hour, when they may have an acidity of 0·3 per cent.

The Bowel.—The chyme has now reached the bowel, a long, tortuous tube about 25 feet in length,—20 feet belonging to the small intestine, and 5 feet to the large. This tube is also lined with a membrane supplied with glands and surrounded by a muscular wall, the movements of which are worm-like, and serve to pass the contents, now called chyle, downwards. The secretion of the glands is alkaline. Not far from the beginning of the bowel two ducts open, one from the sweetbread or pancreas, the other from the liver. The sweetbread is a gland which secretes an alkaline fluid with a ferment, which acts on albumins, another which can change starches into sugars, and a third which can split up fats. It probably contains a rennet ferment as well, and a ferment which helps to form emulsions of the fat that has not been acted on by the splitting ferment. The duct which comes from the liver carries the bile, a neutral fluid with a strong emulsifying power over fats. Although bile itself has no antiseptic action, it contains two acids, which are set free in the bowel, and which are strongly antiseptic. The bile is really a waste product from the liver. The liver is a large gland, the largest gland in the body, in which many of the building-up processes from the food-principles take place. It may be looked upon as the clearing-house of the alimentary tract. With the

exception of the fats, all the nutritious parts of the food which have been absorbed pass through the liver.

In the small and large bowel the chief actions are the absorption of fluid and of soluble foods, and the changes caused in the chyle by microbes which constantly abound.

To recapitulate ;—The secretion in the mouth is alkaline, and acts upon starch. The food is minutely subdivided.

The secretion in the stomach is acid, and acts on albumins and curdles milk. It is antiseptic. The finer the subdivision of the food the more easily is it acted on by the stomach juice. Food remains in the stomach from two to five hours, as a rule.

The secretion of the sweetbread or pancreas is alkaline, acts upon albumins and starches, splits and emulsifies fats, and curdles milk. The bile is a waste product which helps to emulsify the fats, and produces an antiseptic action in the bowel after the setting free of its acids. The liver acts as a clearing-house and regulator of much of the food-products. The secretion of the bowel is alkaline, and acts on sugars. The bowel invariably contains numbers of microbes.

The ferments present in the saliva and juice of the pancreas act best in neutral or alkaline fluids: pepsin, the stomach ferment, requires the presence of an acid.

All this complicated apparatus is provided solely to enable us to so alter the characters of our food that we may readily absorb it. As we have already seen, the different principles of the food exist in animal and vegetable substances in forms which can not, for the most part, be utilised by us unless their characters have been altered by the processes of digestion. Albuminous bodies, as found in nature, are of no use to us. But when they have been digested by the ferment and acid in the stomach and the ferment and alkali of the pancreas, they are so simplified that absorption is easy, albumins being absorbed largely in the form of peptones, partly as an intermediate product,—albumose. It is a wonderful fact, and one which we have as yet been unable to explain, that the peptones, as they are absorbed by the walls of the stomach and bowel, are almost at once changed back into albumin again, a process which we are unable to imitate out of the body except by the use of considerable heat, and then only with great difficulty and in very minute quantities.

Fats are insoluble in water, but form soluble soaps with alkalies, and then can be absorbed. With the help of the special ferments in the juices poured into the bowel, this change, of fats into soaps, occurs. The bile and the secretion of the pancreas also possess the power of forming an emulsion of the fats in the fluid contents of the bowel. An emulsion is composed of a mixture of liquid fats, or oil, and water, in which the fats are present in very small particles. So small, indeed, are the particles reduced to in the bowel that they can be absorbed through the lining membrane of the bowel without further change.

Carbo-hydrates, the starches and sugars, have also to be changed in chemical composition before they can be made use of. Thus starch is changed into dextrin and maltose in the mouth and the upper part of the small intestine. Dextrin may be made by anyone by heating some dry starch in a pan until it turns yellowish in colour. This is dextrin. It, in turn, becomes a sugar belonging to the class of cane-sugar. Grape-sugar and the sugar of fruits in general (dextrose and laevulose) are absorbed as such, while cane-sugar and the maltose derived from starch, through the action of the saliva and pancreatic juice, are converted into forms identical with grape and fruit sugars, and are then absorbed. The final change of the cane-sugars into grape-sugars is brought about by a ferment secreted by the glands of the intestinal walls. Thus we have seen the albumins broken down, the fats split up or emulsified, and the starches and sugars altered so that all the three chief classes of nourishment may be capable of absorption into our bodies, where they fulfil their functions in the appointed way.

If you will allow me, I will show you, on the screen, some photographs of a small plant which digests albuminous substances in the same way that we do, but with the aid of a different acid,—formic acid in this case. In this plant we can observe directly an almost identical digestive action to that of the stomach juice on albuminous bodies. What appears on the screen is a series of photographs of a leaf of the common sun-dew (*drosera rotundifolia*), the first, before anything had been given to it, the succeeding ones after a small bit of an albuminous body (Proto-albumose) had been placed on its surface. You can see its tentacles gradually folding over the particle, which soon dissolves, and in time is absorbed after a digestive act very similar to that in our

stomachs. In nature this plant catches and devours flies. I may note, *en passant*, that the sun-dew is very easily put out by over-feeding. It suffers from indigestion in the same manner in which we do. A very small excess of food kills the leaf on which it is placed. Such plants as this do not digest fats or starches.

Diet.

The preceding remarks on the necessary food-principles and the manner in which they are prepared for use in the body are so short that I am afraid that they will only convey a very hazy notion of the subject to your minds. Want of time must be my excuse ; twenty lectures would barely suffice to cover the ground satisfactorily. I hope, however, that I have made the facts alluded to clear enough for you to grasp their significance when they come to be applied to the subject of diet.

The form of diet used is, there is no doubt, of immense importance. I am not at all sure if the present day custom of giving drugs for all kinds of disease is not a retrograde step. But patients themselves are not happy unless they get a "bottle." In the oldest writing on medical subjects known to us, the Eber's Papyrus, dating from about 1550 B.C., the directions with regard to the regulation of the diets proper under different circumstances, both as to occupation and health, are noted with much minuteness. The various physicians and philosophers of the Ancients always dealt very fully with the subject.

At present we are overwhelmed with a host of new drugs, in addition to the too large number already known, and there is the danger that we change our treatment too often and too quickly in the hope that one of the latest cure-alls, probably "made in Germany," will do quickly what nature and natural means would accomplish more slowly. "*Bis dat qui cito dat*!" is often responsible for failures in treatment. As that which we eat must influence our bodies nourished by it, no amount of care in regulating the diet both in health and disease can be too much, nor will the most zealous researches into the rules of nutrition be ever misspent or superfluous.

As mentioned before, the quantities of the four food-principles required to keep the body at a constant weight vary with the person, his age, weight, the climate to which he is exposed, and the amount of muscular work which he performs in the day.

Moleschott gives the following as a model of the amounts required in the case of an adult in a temperate climate and doing a moderate amount of work. The figures represent the alimentary substances in a dry state :—

Albuminous matter, .	$4\frac{1}{2}$	Ounces	Avoirdupois.
Fatty matter, . .	3	,,	,,
Carbo-hydrates, . .	$14\frac{1}{4}$	,,	,,
Salts, ...	1	,,	,,
Total Dry Solids, .	$22\frac{3}{4}$	,,	,,

These figures are given in round numbers, small fractions being omitted.

You may observe that one-fifth of the total dry solids should consist of albuminous material, and rather more than half should be in the form of starches and sugars. If we wish to consume $4\frac{1}{2}$ oz. of albuminous matter in the form of lean beef, we must take 23 oz. of it, as lean beef contains 72% of water and 19·3% of albuminous matter (Parkes). In like manner, 30 oz. of fat beef are necessary. Nine eggs weighing 2 oz. each, $6\frac{1}{2}$ pints of milk, or a stone of potatoes correspond to the amount of albuminous matter given above. If the diet be solely composed of milk, or lean beef, or eggs, much more must be taken than the amounts noted as sufficient to supply the nitrogenous matter required. Albumins do not contain enough carbon in proportion to their nitrogen to fulfil all the duties required of them, if taken alone. So that 6 lbs. of lean meat will be necessary if nothing else than water is taken, to supply the carbon for combustion, or about 11 pints of milk.

Of course, if these articles of diet be taken in such quantity, the albuminous matter is in excess, and much of it has to be got rid of. A mixed diet is therefore the most economical, in which foods rich in albumin are mixed with those rich in starches, sugars, or fats, in such proportions that the ratio between the food-principles is kept as close to the normal as possible. Excess of any one principle leads to increased work on the part of the digestive organs, without any compensating advantage. Mankind very early in the history of the world discovered this fact, and the dietary of most races is a mixed one. The smaller

the strain put on the organs of digestion the better they perform their duties, the more able is the individual to play his part physically and mentally, and the races which practise the greatest economy, compatible with the completest nourishment of their bodies, come speedily to the front.

The quantities given above, as those required by an adult doing a moderate day's work, must be modified for other conditions. Thus 17 oz. of dry food is sufficient for an adult doing no muscular work, while hard work calls for an increased amount. The athlete trains best on a diet containing much meat and little starchy matter, and the meat-eater is capable of more continuous exertion than the vegetarian, but, for short spells of heavy work, starch and sugar save the albuminous framework of the body owing to their greater combustibility. The brain-worker should eat sparingly, or rather should not indulge in heavy meals, though he may eat as much during the day by eating more frequently.

Turning now to the food appropriate to the different periods of life and to the errors often made in the diet during each period, we must first consider the diet of infants.

THE DIET OF INFANTS.

The proper and natural food for infants is, of course, mother's milk. It contains all the necessary elements for nutrition—albumin, fat, sugar of milk, salts, and water. The sugar does not ferment like cane or grape-sugar, and is only in small quantity. Milk contains no starch; indeed, infants have little or no power of digesting starch. Nursing mothers should take a full but simple diet, with not too much meat. Soup (not broth), gruel, and chocolate increase the flow of milk. The usual plan of stuffing nurses with meat and beer or porter, and keeping them cooped up in a badly-ventilated room, is almost criminal. Thirteen ounces of beer is quite enough for each day, and open exercise should be taken daily if possible. All highly-spiced foods and irritating drugs must be avoided. Many medicines taken by the mother affect the child through the milk.

If through ill-health, laziness, inability, or "because it is not the fashion," artificial feeding is resorted to, cow's milk is the

best substitute. But, as cow's milk contains more albuminous matter and less sugar than human milk, it has to be diluted with hot water ; for the first month two parts of water to one of milk, and after that half and half, and some sugar added. The sugar should be sugar of milk if possible. The popular idea that the milk from one cow is the best for an infant is based on an error. The milk obtained from a large herd is much more likely to remain uniform in character than that from a single animal. In bringing up a " bottle " baby, it should be remembered that the stomach of a new-born baby can only hold about two ounces of fluid, and that any attempt to make them take more at one time is wrong. Again, the stomach of an infant will tolerate more of its mother's milk without disturbance than it will cow's milk. The curd of the latter is harder and more indigestible. The stomach filled too full of mother's milk gets rid of the surplus with great ease and without irritation, while if equally full of cow's milk some may be got rid of, but a large curd, somewhat difficult to digest, remains, and irritation results. I have no doubt that it is a mistake to allow a baby to take as much of a bottle as it can. Far better to give it small quantities oftener. Frequently a baby is said not to be thriving on the bottle, when the fact is that too much is being given, not too little, leading to irritation, incomplete digestion, and diarrhœa. The quantity of mother's milk required during the first month of life is only 14 to 20 ozs. in the 24 hours, and not more than 40 ozs. up to the end of the first year. To illustrate the absurd lengths to which some mothers will go, I might quote a case mentioned by Dr Burn Murdoch lately, where an infant was getting over 80 ozs. of milk by the bottle each day, and where the mother could not be convinced that the reason of her child's ill-health was due to excessive feeding, until the doctor showed her four quart bottles filled with water as barely representing the amount of fluid passing through her child each day. On the same occasion I ventured to suggest that in every nursery a framed motto should be hung up, consisting of the words, " LITTLE AND OFTEN," in large letters.

Failing cow's milk, which, by-the-by, should always be boiled if there is the slightest suspicion of infection about, condensed milk is often used, but is not to be recommended ; too often it is

made from skim milk, is deficient in fat, and contains a large quantity of added cane-sugar. The use of many of the patent and proprietary foods may be advisable under certain circumstances if only a little is given. The bringing up of a child on them alone generally leads to rickets. As the child gets older and requires something more than milk they may prove of use, but I confess that the production of prize babies, prized only because they are large, though they may be unhealthy and flabby, by stuffing with concentrated foods, reminds me of the process by which the tasty but dangerous *foie gras* is made, or of the manner in which chickens are fattened for the London market. But tastes differ, and nothing pleases a mother more than a wonderful growth in her infant. A moderate growth with firm tissues is better than flabby enormity.

A word may be added with regard to that abominable but common habit of giving infants, however young, a taste of anything that is going. Many a time have I seen a baby brought to me for digestive troubles, who should only have been getting milk, seriously ill because the mother could not resist giving it a taste of herring, of fried liver, or a "drop tea" which had parboiled for hours on the hob.

As the child grows older, some addition to the milk becomes advisable, and nothing is better than gruel made of oatmeal flour. Dr Samuel Johnson, in his famous dictionary, described oats as a grain used in Scotland for human food, in England to feed horses. The sneer loses much of its point if we retort, Where can you find such men or such horses? Oats * contains more fat and ash than other grains, and, along with the milk, forms an ideal diet which possesses the great advantage of not cloying the appetite after long usage. One of the most extraordinary errors possible, that arrowroot is nourishing and easily digested by infants, is responsible for many a weakly child. Arrowroot consists simply of starch and water, generally potato starch; a young child cannot digest starch nor live on water. Many a baby apparently being fed on an abundance of farinaceous food is practically being starved. It is often found to be difficult in weaning a child to get him to take food from a spoon. A very good plan in nursed babies is to give them, even in the third month, some milk drawn off in this manner.

* See Appendix, Table I.

Diet in Youth.

As the period of youth is characterised by rapid growth, and, as a rule, by great bodily activity, while the brain is also exercised, often I am afraid too strongly, in the course of education, at this time the food supply must be large, simple, and easily digested. Over-work, bodily or mental, combined with insufficient nutriment, during the time when the growth of the body in all its parts is so rapid, leads to diminished increase, and to weakened organs, which may not exhibit their weakness until later. Insufficient food, it should be remembered, is often synonymous with too much or too indigestible a diet, or with the time when the meals are taken. No growing boy should be allowed to eat a heavy meal shortly before going to bed, or perhaps, even to have any butcher meat at that time at all. The brain in youth is much more easily excited than in later years. It is in the process of training, and its equilibrium is easily upset. The act of digestion of a heavy meal and the absorption of the products of digestion excite it, and night-frights, bad dreams, or unrefreshing sleep are the result. As the body grows for the most part in the night season, it is health as well as rest for us in youth to sleep well and long. A meat-tea is an abomination, the tea at that time prevents the proper digestion of the meat, although at breakfast this influence is not so apparent, as the digestive organs are rested and more able to cope with it. A good meal in the middle of the day, with plenty of meat and fat, a rest after it, tea, nominally tea, but far better milk and breadstuffs about four, and a light supper of porridge or bread and milk an hour before going to bed are best. Children should be taught to chew and swallow each mouthful of food without the addition of whatever liquid they may be getting at the time. To mix up the food and the drink in the mouth leads to an inefficient action of the saliva on the starches. A heavy meal in adults often induces somnolence, in youth it is more apt to cause cerebral excitement and wakefulness, although a light meal before going to bed may act in the opposite way. This arises from the withdrawal of some of the blood going to the brain to assist in the digestive processes. Sleep occurs when the brain contains less blood than during wakefulness. The relation between the two is obvious.

Children often detest fats, but fats are of use to them for the purpose of sparing the albuminous matter taken into the body. If there are not enough fats or sugars in the food the albumins are made use of in the upkeep of the energy of the body, and are prevented from building up, or are removed from, the tissues. Luckily, although children as a rule dislike fats, they have a very sweet tooth, and the sugar in jams, syrup, and treacle may serve the same purpose in some measure.

The common idea that boys have digestions like ostriches is responsible for much bad after-effects. With lots of fresh air and exercise, they are certainly able to eat a great deal, and if what they get be simple in nature, and given at proper times, no harm accrues. Some boys, apparently, can eat anything and everything, at any time, without harm to their digestion at the time or afterwards, but many, under such a course, although showing little symptom of inconvenience at the time, will live to wish that they had not eaten so much, or so often, or such rich foods, in later years. A doctor, who was also a director of a large boarding-school, once said, when exception was taken to the size of the cod-liver oil bill for the year, that no one should grudge money spent on cod-liver oil for children, because it was really a food, not a medicine. Many children dislike it as much or more than fats, but there is no doubt that if they are given it early in life, before they can grasp the fact that it is regarded as a medicine, and are brought up to look upon it as one of the daily meals, they will grow up more healthy and vigorous, especially if they dwell in towns. But if cod-liver oil cannot be tolerated, cream and butter are just as good. A rather fine lady once called on a London consultant on behalf of her daughter. He recommended a course of cod-liver oil and whisky. The lady objected to giving her daughter either of these, for the one was nasty, and the other vulgar. The consultant agreed with her, and assured her that cream and curaçoa would do just as well. There is no specific virtue in cod-liver oil, it is a bland oil which does not upset the stomach very easily. Other fats, which may cause no gastric discomfort, are equally good. The late Dr Hughes Bennett ascribed the main causes of consumption to the "dearness of butter, and the abundance of pastry-cooks." Those children who will not eat the fat of meat,—and they should not

be forced to do so,—should be given it in another way, as in bacon, or suet-pudding, or mixed up with potatoes. Fats in bulk often cause symptoms of indigestion, but, if finely subdivided, may be easily digested.

Just one word about the diet of girls who are close to, or have shortly passed, the period of puberty. The common affection of bloodlessness is, I believe, caused more by insufficient food, which includes too much useless food, than by the want of fresh air. Girls at this age are terribly afraid of getting too stout, because it is the period at which they naturally begin to fill out. They eat little, drink less, and too many of them tight-lace too much. Too much fluid taken with the food is slightly detrimental ; too little is worse. I am often surprised at the minute quantity of fluid taken by some young ladies in the twenty-four hours. Little fluid soon causes loss of appetite, and brings about a retardation of the repair of the body waste, and an accumulation of waste products in the tissues and blood. I am sure that the sluggish action of the bowels, so common in girls at this age, is largely due to too little fluid, associated with small meals, except, perhaps, at tea time. Think for a moment of the amount of water a boy drinks, as a rule, during the day, and compare it with that a girl, even if taking active exercise, allows herself. Some even indulge in vinegar at most of their meals, destroy their digestion, but are happy because they retain an elegant figure. Again, another thing that has struck me in most women is the exceedingly small quantity of salt they add to their food. Salt, no doubt, is added during the process of cooking, and is contained in certain amounts in most foods, but I am sure that the addition of a good deal of common salt to the food helps digestion in the stomach, and the whole bodily health, more than you would think. In the body it aids in the secretion of the acid of the gastric juice, indeed, if you give an animal a diet containing no trace of common salt, the acidity of the stomach juice soon falls, and it has been even found that if a salt allied to common salt—the bromide of soda—be given in place of it, the corresponding acid, hydrobromic acid, is secreted by the cells of the stomach, which have none of the common salt in the blood to make use of. Common salt in solution has also a great power of facilitating the solution of albumins in the

fluids of the body, rendering them more easily carried from one place to another. To sum up, then, young people should eat simply, have no late meals, have plenty of porridge and fats, should not drink too little fluid, or take too little salt, and should be taught to attend to the functions of nature in a regular manner. For them oatmeal porridge, or fruit, such as dates, prunes, or figs, are better aperients than drugs, and are taken more readily.

In Adult Life.

So many of us can eat this, and can't eat that, "one man's meat is another's poison,"—that nothing like a fixed dietary can be framed to suit everyone, even under the same circumstances.

We may lay down, however, that over-eating is as bad in its ultimate effects on the body as undue indulgence in alcohol. We must understand that over-eating includes eating too much of one of the three classes of food-principles, while too little may be taken of the others, and may occur even when the total weight of food taken does not exceed what represents a normal amount. Thus one leading a sedentary life may eat too much meat in the day, although, if part of the meat be replaced by starchy foods, the diet would not be abnormal.

There is no doubt that those who eat meat and take much exercise are the most energetic, but if they take little exercise and much meat they become phlegmatic and dull,—one writer even says that English ill-temper is one of the consequences of excessive meat-eating.

How little food is required by a man doing manual labour in twenty-four hours to support his body without losing weight? To arrive at the answer to this question, the proportion of the three principles of food to each other, which will allow of no excess of any of them being left unused in the body, must be found out. It has been shown that the proper proportion of meat stuffs to starches and fats is as 1 : 3.5, or 4.5, while the fat should not be more than as 1 : 9 of the starchy food.

This proportion can be obtained and sufficient nutriment afforded from 30 oz. of bread, ½ oz. of butter, and 10 oz. of cheese. Or again, from 19½ oz. of oatmeal, 3½ pints of milk, and 5 oz. of bacon. To these must be added enough water to bring the total fluid taken to about 90 oz., and salt to a total of 1 oz.

How a sufficient diet can be made both cheap and palatable is shown by two daily menus taken from Mrs Hart's book on Diet, adapted for a labourer, his wife, and eight children.

Quantity of Food.	Cost.	Carbonaceous.	Nitrogenous.
BREAKFAST—OATMEAL PORRIDGE :	s. d.	oz.	oz.
1¼ lb. of oatmeal . .	0 2½	14	3
1½ pint tinned milk . .	0 1½	2¼	1
½ lb. treacle . . .	0 1½	7	...
DINNER—IRISH STEW :			
1¼ lb. meat . . .	0 8	3½	3½
4 lb. potatoes . . .	0 2½	14	2
1¼ lb. onions . . .	0 1	5½	1¼
A few carrots . . .	0 1	¼	...
½ lb. rice	0 1	7	½
1½ lb. bread . . .	0 2¼	13½	2¼
TEA—BREAD AND COFFEE :			
2½ lb. bread . . .	0 3¾	22½	3¾
2½ oz. coffee . . .	0 2½	¼	¼
1½ pint tinned milk . .	0 1½	2¼	1
Total . . .	2 5	92	18½

Quantity of Food.	Cost.	Carbonaceous.	Nitrogenous.
BREAKFAST—BREAD AND COCOA :	s. d.	oz.	oz.
2½ lb. of bread . . .	0 3¾	22½	3¾
1½ oz. cocoa . . .	0 1½	¾	¼
1 pint tinned milk . .	0 1	1¼	½
2 oz. sugar . . .	0 0½	1½	...
DINNER—LENTIL SOUP, TOASTED CHEESE :			
1½ lb. lentils . . .	0 3	15	6
1 lb. cheese . . .	0 8	4½	5½
1½ lb. bread . . .	0 2¼	13½	2¼
TEA—RICE PUDDING AND BREAD :			
¾ lb. rice	0 1½	10½	¾
1½ pint tinned milk . .	0 1½	2¼	1
2 oz. sugar . . .	0 0¼	1½	...
1½ lb. bread . . .	0 2¼	13½	2¼
Total . . .	2 1¼	86½	22¼

Excess of food may not be absorbed, and may lead to excessive decomposition in the alimentary canal. If too much meat be taken and too much of it digested and absorbed, symptoms of mild blood-poisoning may be caused. If more fat and sugars are absorbed than can be used up, naturally deposition of fat may take place. On the other hand, if starchy food be withheld, but more fat given, little inconvenience arises. Vegetarianism can be so conducted that the proper proportions of the three chief food elements are preserved, especially as both eggs and milk are allowed. But vegetarians are apt to be flabby, not energetic, while, as they have to eat larger quantities to gain a sufficient supply of albumins, their digestions often suffer in the end. A very common statement by vegetarians, in defence of their diet, is that some vegetables contain more albumins than meat. For instance, one hundred parts of pease-meal contain more albumin than the same weight of beef or mutton, but the albumin does not seem to be so easily digested as that of beef or mutton. With milk, eggs, cheese, and the different cereal and vegetable products, a very good dietary can be made out. Some people are without doubt the better of a vegetarian diet, but its continuance is apt to lead to gastric fermentation, and bodily flabbiness, unless, as happens only rarely in this country, though common in China and elsewhere, great muscular exertion enables the body to use up the excess of starchy material, when such a diet appears to be quite compatible with strength and vigour.

Food Accessories.

Alcohol.—The subject of the use and abuse of alcohol must be approached in a careful manner, and in a strictly unbiassed frame of mind. The abuse of alcohol causes such evident results that the use of it is always in danger of being overlooked. First, let me tell you a scientific fact about it. If you were to take enough food to cause an increase in your weight from day to day, and then added some alcohol to it, you would either gain weight more slowly, or perhaps lose a little. If you took just enough food each day to keep your weight the same, and then added some alcohol, you would probably get lighter, but if your daily food was not sufficient to keep your weight up, and you, in addition, took some alcohol, you would find that you would get

heavier, or, at least, not lose any more weight. Alcohol is, therefore, a food if the ordinary diet is insufficient, and is not required when you are taking enough food to fulfil the wants of the body. In this way it is of the greatest value in fevers and wasting diseases where the food taken is rapidly burnt up, or where sufficient cannot be absorbed for the increased needs of the body. Alcohol is so easily absorbed, and so easily taken, that it is often invaluable in such cases.

Alcohol is taken by people when cold to warm them, when hot to cool them, when tired to invigorate them, and when brain-weary to stimulate them ; again, it is taken when the brain is too active, to cause sleep. Why it acts in all these ways is too complicated a question to enter into here. But one thing we may say, it is a great mistake to take it when cold, unless we are going into a warmer place, or when tired, when we have much exertion before us. This is because it acts as a stimulant at the time, while its action as a stimulant is followed by depression of all the bodily functions. It wards off the cold for a short time, but renders you more susceptible to it afterwards ; it increases your power of exertion for perhaps an hour or so, but after that you are less able to do muscular work than if you had not taken it.

With regard to its action on digestion when taken with the food, alcohol increases the flow of saliva, and, when dilute, stimulates the gastric secretion and the movements of the stomach walls. Spirits, such as brandy and whisky, have been found to act simply by reason of the alcohol they contain on digestion in the stomach ; wines and malt liquors rather because of the other matters in them than of the alcohol, unless, as in port and sherry, the percentage of alcohol is high.

One ounce of whisky, containing half-an-ounce of pure alcohol, poured into fourteen ounces of water in a large tumbler, results in a mixture containing only three per cent. of alcohol, a proportion which has been found to stimulate digestion rather than impair it. A glass or two of port, with about 20 per cent. alcohol, disturbs the process much more. It will surprise you to learn that, if some experiments which have been lately made are correct, bad whisky, properly diluted, seems to be better for digestion than good. The fusel oils, so often condemned as

hurtful, prove to be digestive stimulants in the small quantities in which they are present in poor classes of spirits. As a rule, however, those who drink impure whisky do not trouble to dilute it much, if at all.

Alcohol, if taken too strong, that is, if the contents of the stomach contain more than three per cent. of it, acts injuriously on digestion; if much is taken in the day, especially between meals, it hurts the liver and other organs; it is a food in some circumstances, a transient stimulant in most. Two ounces of alcohol a day is the most—and less is better—that should be taken in the twenty-four hours. Four ounces of whisky contains that amount, and one imperial quart of English beer or porter, or nine ounces of port, and eighteen ounces of champagne, remembering that wines and malt liquors act more deleteriously on digestion than spirits for the same proportion of alcohol.

Tea, Coffee, and Cocoa.—Like alcohol, the use of these accessories is rendered grateful, owing to their stimulant effects, for, with the exception of cocoa, they are not foods. Why all people should delight in the taking of stimulant accessories with their food is a question which has often been discussed. Perhaps Sir William Roberts is right in ascribing it to the result of long experience, whereby the benefit of substances which actually retard digestion, and hinder the too rapid absorption of its products, may be the right one. Excessive tea-drinking often leads to results as injurious as those following too much alcohol, especially when it is taken after long infusion. The worse the tea the shorter should the infusion be. Three minutes for ordinary teas, and from ten to fifteen minutes for the best kinds are ample. If it is desired to keep it warm for some time, pour off the tea from the leaves, when further heating can do no harm.

Coffee is made abominably in this country, because too little is used to begin with; and secondly, because, unlike tea, it should be boiled as well as infused. Pour boiling water over the coffee, boil the grounds in a little more water, pour this over some fresh coffee, and the result wlll contain one-third of the weight of the coffee in solution, not a fifth, as is usually the case. As it is used in stronger solutions than tea it is more stimulating, especially when drunk plain. The difference between tea and coffee and alcohol

in their stimulating effects lies in the absence of collapse or diminution of power after the stimulating effect has passed off.

In addition to these qualities, cocoa possesses a very marked value as a true food, as it contains a large quantity of fat and much starch.

Condiments.—The ordinary pepper and mustard stimulate the appetite, and to some degree the powers of digestion, but, like other stimulants, are liable to be used to excess and to become indispensable at each meal. In moderation, however, they do no harm.

Sweetmeats.—Sweetmeats made of good sugar and flavoured with innocuous substances do little harm, if taken in moderation, on either the teeth or the stomach. They are apt to cause symptoms of fermentation if taken in large quantities, and especially aggravate this condition if taken when it is already present. Children naturally display a partiality for sweets, while at the same time disliking fats, and it is a mistake to prohibit them altogether. A child will often eat a "jam-piece" in which butter has been spread below the jam, when bread and butter alone is refused. Treacle and brown sugar are excellent additions to their bread and butter. A regular use of the tooth brush, with a gritty but not too hard powder, will keep off most of the bad effects on the teeth caused by the fermentation of the sugar.

DIGESTIBILITY OF FOODS.

At the end of this lecture you will find a table of the different grades of digestibility of the ordinary articles of diet.*

This table is founded on the observations on a man, in whom an opening in the stomach resulted from a shot-wound, by a Canadian doctor, and shows the time taken to digest the different foods by the gastric juice. You will see that tripe, pig's feet, and rice come first, that lamb is more digestible than mutton or beef, boiled pork than roast pork, and that salted pork and hard-boiled eggs take longer to digest than any of the others. You will be surprised to find that oysters take as long to digest when raw as stewed mutton. As a rule, boiled meats are sooner

* See Appendix, Table II.

digested than roast, though they are not so nutritious, roast sooner than salted or smoked, and raw quicker than either. A raw egg, if whipped, leaves the stomach in an hour and a half; if not whipped, in two hours; when softly boiled, in three hours; and when hard boiled, not until five hours have elapsed. Although most cooked foods are more indigestible as regards the time taken, yet cooking serves many useful purposes. It changes starches into dextrins, produces odorous substances in meats, which give them a pleasant flavour, and destroys parasites and germs of disease. In roasting or grilling, the chief object should be to cause the formation of a skin of coagulated albumins outside, allowing the meat within to be heated sufficiently without loss of juice. If the heat, after the outer skin has formed, be too great, it cracks, and some of the juice escapes. A strong heat at first, followed by a milder heat, is the proper way to roast. In the same way and for the same reason, in boiling meat the water should be first brought to the boiling point, or even better, above 212° Fahr. if some salt be added to it; the meat placed in it soon shows a coagulated skin, when the temperature of the water should be lowered. The chief result of cooking meat is the coagulation of the albumins, and as they coagulate at a much lower temperature than the boiling point of water, it is a waste of energy and coal to keep the water boiling all the time.

More of the fluids of meat escape during the process of boiling than in roasting, and the meat is therefore less nutritious, but the water it is boiled in may be used in other ways. Vegetables should be cooked by steaming whenever possible, as much of their albumins and salts are lost when boiled in water. Potatoes are best steamed in their "jackets," to save any loss of potash salts which they contain.

In making soups, the temperature of the mixture should never be allowed to go above 164° Fahr. until the very last, as all the albumins of the meat become insoluble and remain in it, and are not contained in the soup. For this reason beef-tea, as often made, contains little or no nourishing material in it; to make it properly, the beef should be cut up into small pieces and soaked in water for some hours, then gently heated, but never boiled. If made with boiling water at first it contains some of the salts and extractive matters of the beef, and acts only as a stimulant

like tea ; though, of course, the stimulant action may be of use now and then. To give you an example—If an egg be broken into water which is boiling, or is brought quickly to the boil, and the coagulated white strained off, the water remaining represents beef-tea made with boiling water, and contains only a very small quantity of salts and organic matter. No one would look upon this as of any use. If the egg be mixed with warm water and strained, most of the albumin remains in the water and forms an easily digested and nourishing drink. The albumin of an egg and of meat act in the same manner.

Many of the meat extracts sold in the market correspond to the water in which an egg has been boiled, while others are really nutritious and contain the meat albumins. It would not be safe for me to mention here those which belong to the first class, but Bovril is a good example of the second.

Indigestion.

Of all diseases or ailments, indigestion, or dyspepsia, is perhaps the most common. Some people may go through life unacquainted with other forms of disease, very few, probably none, ever fail to experience to a greater or less extent, those distressing symptoms termed indigestion. Many, however, complain of symptoms which they do not ascribe to indigestion, but which are really the result of some form of this malady, others again suffer from it alone, while a third class present the signs of indigestion which are really the symptoms of some other disease showing itself in affections of the digestive organs.

You see what a wide field is opened. You all must have heard of a " stomach cough,"—this may be the only warning that your digestion is out of order. Neuralgia is constantly a sign of the same thing, generally indicating that you are not taking sufficient fatty food, or are unable to make use of that which you do take. Many other symptoms which appear not to be related to digestion can often be traced to some fault in it.

One of the commonest complaints is the presence of a load in the stomach after eating, with heaviness, and disinclination to do anything. This at once should suggest that the stomach is unable to digest what has been given it, and that it requires strengthening, and at first less to do. Simpler food, well-cooked, at

regular times and in smaller quantities, no strong tea, and regular exercise is all that is required at the beginning. If the trouble still persists there is nothing better than a purely milk diet. Many people say that they can't digest milk, that it makes them bilious. That is because they take it in tumblerfuls at a time, or on the top of other things. I have found very few who could not take it as it should be taken, for a short time, in indigestion, that is, alone, or with soda-water, and in small quantities every now and then. A wine-glassful is quite enough, taken every quarter of an hour, and it is often wonderful what a good effect is produced in a day or two. After this, other things may be cautiously added, and if they do not disagree, persevered in. Bovril is a very good addition to the milk, and later, liquid custards, or chicken and rice soup. A little self-denial at the beginning is an excellent thing for the patient, and a bad thing for the doctors. If the symptoms complained of are chiefly of the nature of heart-burn and acidity, it is important to notice what kind of food is followed by them. If bread and vegetables disagree, and there is much wind present, a good purge, a meat diet (for the most part), and a good drink of hot water each night, before going to bed, to wash out the stomach, are all things which may safely and with advantage be tried. Acidity without the production of gas, which becomes worse some time after food, is generally an indication of some nervous derangement, and may be assuaged, not cured, by taking alkalies, as soda, or grated meat, but which usually requires a tonic and a rest from work.

The stomach chiefly digests albumins, and it is a very good rule when it appears to be out of order to give it that kind of food which it is adapted to deal with in as simple a form as possible; to eat it slowly, chewing it well; not, perhaps, going so far as the thirty-two bites of the Gladstonian legend; not to eat too much at a time; and to try the effect of more fresh air, and exercise of a pleasant kind. The slightest symptom of indigestion indicates that something is wrong, and a very mild form of experimentation in the food taken, or in the time of the meals, may serve to show what should be avoided.

I mentioned "grated meat" above. The plan I adopt for this is to order cubes of thoroughly cooked roast mutton or beef, when cold, about half-an-inch in size, to be grated through an ordinary

vegetable grater. This finely-divided meat may be taken on toast, with or without butter. The meat used should, of course, be free from fats. In most cases of indigestion, toast or rusks are more easily tolerated than bread, owing to the heat used changing the insoluble starch into soluble dextrins ; but they should never be taken hot, still less as "hot buttered toast."

In most cases, also, fluids should be sparingly drunk during meals, especially when the digestion is weak, as they only serve to dilute the digestive acid still more. But a good drink of water, or soda water, may be taken with advantage an hour or so before the meal. As I explained above, water taken in this way does not remain for any length of time in the stomach, and serves to remove any obnoxious remains of the food. In other cases where the ordinary acid is present in too great a proportion after a meal, fluids taken with it, or shortly after, tend to do away with the pain and inconvenience arising from the excessive acidity, and thus may do good.

In women suffering from bloodlessness, the slightest symptom of indigestion should lead them to seek advice. As a class they are exceedingly liable to that grave form of dyspepsia, gastric ulcer, "an ulster on the stomach," as an old lady once informed me was the matter with her daughter. Early treatment of the bloodlessness soon checks to a large extent the tendency for these ulcers to form. One of the first symptoms of ulcer of the stomach is a sharp pain localised to one spot, which is aggravated at once after food is taken. Another is the vomiting of blood. In the latter case, place the patient in bed, let her have no food, give her a little ice to suck, put a mustard leaf over the stomach, but before doing these send someone for a doctor.

One of the most distressing results of long continued dyspepsia, in addition to the weariness of life and the irritability of temper and cynicism, of which Thomas Carlyle is such a well-known example, is the inability to enjoy those social gastronomic functions—dinners—with safety. In health, an occasional good public or private dinner, with sound wine, appears to do good rather than harm ; at least so great an authority as Dr Lauder Brunton says so. To one inclined to dyspepsia they are better avoided, or, if unavoidable, only those dishes which appear simple, as fish, the roast, or game, if not *passé*, should be taken, with a little cham-

pagne. No mixing of drinks. Champagne by itself, or diluted with soda water, and weak whisky and water after dinner is all that should be allowed. If necessary, all wines may be eschewed, and nothing but spirits and water taken.

Another result, and a serious result, of long continued dyspepsia is the permanent dilatation of the stomach. Its muscular walls are weakened, it is unable to contract sufficiently to expel all the contents into the bowel. These remain and ferment. Cases of this sort have occurred in which currants eaten fourteen days before were found in the contents of the stomach, when withdrawn by the stomach tube. Among the causes which lead to this condition are prolonged weak digestion with great flatulence, and drinking too much fluid at one time. Munich, I believe, possesses a greater proportion of inhabitants suffering from this dilatation of the stomach than any other city, a circumstance which it owes to the excellence of its beer and the quantity of it drunk at one time. Too often the unfortunate possessor of such a dilated organ seeks professional treatment at such a late stage of his malady that little more than palliative measures can be taken.

A very common form of indigestion is often erroneously ascribed to some fault of the stomach, but is really due to abnormal processes in the bowel. But this is more a subject for your medical attendants than for you.

Gout is often the cause of dyspepsia, but in this matter, also, I must refrain from dogmatising, for none of us as yet know exactly what gout is, and although we may be able to cure the symptoms at the time, we are seldom able to drive away the gouty tendency. All those who are gouty should forswear sweets and wines, and should drink considerable quantities of water, or aerated water, between meals and before going to bed.

I trust that I have been able to make plain to you some of the things which lead to faulty digestion, and that my all too scanty statements may bring about a lessening of that common and depressing ailment, dyspepsia. The old saying, *Mens sana in corpore sano*, might with as great a degree of truth be read, *Mens sana cum digestione sana.*

APPENDIX

TABLE I.

THE COMPOSITION OF CEREALS.

Grain.	Proteids.	Fat.	Digestible Carbo-hydrates.	Cellulose.	Ash.	Water.
Wheat	12·42	1·70	67·89	2·66	1·79	13·56
Rye	11·43	1·71	67·83	2·01	1·77	15·26
Barley	11·16	2·12	65·51	4·80	2·63	13·78
Oats	11·73	6·04	55·43	10·83	3·05	12·72
Maize	10·05	4·76	66·78	2·84	1·69	13·88
Rice	7·81	0·69	76·40	0·78	1·09	13·23
Millet	11·3	5·6	67·3		2·3	12·3
Buckwheat	9·28	1·89	70·68		0·86	14·27
Wheat flour	8·91	1·11	74·28	0·33	0·51	14·86
Do., coarse	11·27	1·22	73·65	0·84	0·84	12·18
Rye, fine	10·21	4·64	73·64	0·64	0·98	13·99
Do., coarse	11·06	2·09	67·78	2·61	1·69	14·77
Barley-meal	10·89	1·23	71·85	0·47	0·63	14·83
Pearl-barley	7·25	1·15	76·19	1·36	1·23	12·82
Oatmeal	14·29	5·65	65·73	2·24	2·02	10·07
Maize-meal	14·0	3·80	70·68		0·86	10·60
Ground rice	7·43	0·89	77·62			14·15

TABLE II.—DIGESTIBILITY OF FOODS.

Food arranged according to the time required for digestion in the stomach.	Mode of preparation.	Duration in stomach till solution or disappearance.	
		Beaumont.	Richet.
Schnapps	...	...	30′ to 40′
Milk	...	...	30′, 1 h
Cauliflower	...	...	
Cane sugar	...	...	
Bullocks' tripe	roasted	1 h	
Pigs' feet	boiled	1 h	
Rice	,,	1 h	
Peas with butter	...	...	1—2 h 30′
Baked potatoes	...	...	1 h, 2 h 15′, 2 h 30′, 3 h
Whipped eggs	raw	1 h 30′	
Barley broth	boiled	1 h 30′	
Salmon trout	,,	1 h 30′	
Ripe apple	raw	1 h 30′	
Meat (?)	...	...	1 h 30′, 2 h 30′, 4 h, 5 h 30′
Venison	boiled	1 h 45′	
Calves' brains	,,	1 h 45′	
Sago	,,	1 h 45′	
Spinach	,,	...	1 h 45′, 2 h, 4 h
Maccaroni with fat	,,	...	1 h 45′, 2 h 30′, 3 h 15′
Eggs	raw	2 h	
Milk	,,	2 h	
Bread	baked	2 h	
Salad	raw	2 h	
Soup with fat and bread	boiled	...	2 h
Rice with fat	,,	...	2 h, 2 h 45′, 3 h, 3 h 15′
Lentils with egg	,,	...	2 h, 2 h 45′
Bullocks' liver	raw	2 h 15′	
Turkey	roasted	2 h 25′	
Pork	boiled	2 h 30′	
Lamb	,,	2 h 30′	
Beans	,,	2 h 30′	2 h
Potatoes	,,	2 h 30′	2 h 30′
Cabbage	,,	2 h 30′	
Cauliflower with fat	,,	...	2 h 30′, 2 h 45′
Rice with fat and wine	,,	...	2 h 30′
Maccaroni with fat	,,	...	2 h 30′, 3 h 45′
Oysters	raw	3 h	
Mutton	stewed	3 h	
Soft eggs	boiled	3 h	
Beef-steak	...	3 h	
Ham	boiled	3 h	
Lean bacon	fried	3 h	
White bread	baked	3 h	
Fish	boiled	3 h	
Onion soup	,,	...	3 h
Eggs with sugar	...	...	3 h 30′
Pork	roasted	4 h	
Poultry	,,	4 h	
Veal and bacon	,,	4 h	
Black bread	baked	4 h	
Cartilage	boiled	4 h	
Cabbage	,,	5 h	
Pork	salted	5 h	
Hard eggs	boiled	5 h	

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